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TIKUR ANBESSA

SCHOOL OF MEDICINE

DEPARTMENT OF MEDICAL BIOCHEMISTRY

ASSESSMENT OF M ETABOLIC SY NDROME AMONG GOVERNMENT OFFICE WORKERS OF SOME RANDOMLY SELECTED OFFICES IN AKSUM TOWN, CENTERAL ZONE, TIGRAY REGION, ETHIOPIA.

BY

EPHREM MAMO (BSc.)

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATED STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR DEGREE OF MASTER MEDICAL BIOCHEMISTRY IN SCHOOL OF MEDICINE, COLLEGE OF HEALTH SCIENCE, DEPARTMENT OF MEDICAL BIOCHEMISTRY

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"Assessment of Metabolic Syndrome Among Government Offices Workers of Some Randomly Selected Offices in Aksum Town, Central Zone, Tigray Region, Ethiopia."

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A thesis submitted to the school of Graduated Studies of Addis Ababa University in partial fulfilment of the requirement for the degree of Master of Science in Medical Biochemistry.

ADDIS ABABA UNIVERSITY
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Declaration Sheet

This is to certify that the thesis work prepared by Ephrem Mamo, entitled "Assessment of Metabolic Syndrome among Government Workers of Some Randomly Selected Offices in Aksum Town, Central Zone, Tigray Region, Ethiopia". Submitted in partial fulfillment of the requirements for the degree "Master of Science in Medical Biochemistry in the department of Biochemistry complies with regulations of the university and meets the accepted standards with respect to originality and quality. Signed by the examining committee.

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Abstract

Background: *Metabolic syndrome is a serious public health concern that describes a cluster of disorders and is associated with several health problems. The global prevalence of metabolic syndrome has increased dramatically in the past decade, workplace which directly influence the physical, mental and social well-being of employees are considered important environmental and social determinants for risk of metabolic syndrome. Therefore, biochemical profiling of these population is required.*

Objectives: *This study aimed to assess the association between working environment and metabolic syndrome among workers in Aksum town, central zone, Tigray Region, Ethiopia.*

Methods: *A cross sectional study was conducted from September, 2020 to August, 2021 in Aksum town. A standard questionnaire was used to collect data on socio-demographic variables. Biochemical analysis was done using COBAS C 311 analyzer for the determination of lipid profile, fasting blood glucose and anthropometric measurements. The data were interred into SPSS version 25 and binary logistic regression and linear regression were analyzed to evaluate the association between variables. If P. value ≤ 0.05, it is considered as statistical significance.*

Result: *The findings of this study showed that the magnitude of metabolic syndrome was 16.0% (13% government office workers & 3% Daily laborers). The most common metabolic syndrome components among government office workers reduced high-density lipoprotein-cholesterol were 19%, hypertriglyceridemia was 22% & hypertension was 24%, had significant positively associated with a higher risk of metabolic syndrome (P< 0.05). Hyperglycemia were 18% and abnormality of body mass index was 30% frequently found in government office workers (P >0.05). Government office workers 35% had less vigorous physical activity level, 38% had less type of olive oil used for cooking & 27% had less than 3 serving of fruits and vegetables per week as compared to daily laborers (P< 0.05).*

Conclusion: *In this study, the prevalence of metabolic syndrome was (16%), 13% of government office workers had a higher comparable to 3% of daily laborers. Metabolic syndrome was more common in government office workers, urban population and with advancing age, by hypertension, dyslipidemia and central obesity were the most frequent components of metabolic syndrome.*

Keywords: *Metabolic Syndrome, Lipid Profile, Government Office workers, Metabolic risk factors & Daily laborers.*

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Abbreviation and Acronyms

ATP III	Adult Treatment Panel III
AKU	Aksum University
ATHO	Annual Report of Aksum Town Health Office
Apo B	Apolipoprotein B
BMI	Body Mass Index
CVD	Cardiovascular disease
CHSRH	College of Health Science and Referral Hospital
CHD	Coronary heart disease
DAG	Diacylglycerol
DBP	Diastolic Blood Pressure
EDTA	Ethylene diamine tetra acetic acid
FBG	Fasting blood glucose
HDL-c	High density lipoprotein Cholesterol
LDL-c	Low density lipoprotein Cholesterol
Met S	Metabolic syndrome
NCEP	National Cholesterol Education Program
NCDs	Non communicable diseases
NEFA	Non esterified fatty acids
SBP	Systolic Blood Pressure
TC	Total cholesterol
TG	Triglycerides
T2DM	Type 2 diabetes mellitus
VLDL	Very low-density lipoprotein
WC	Waist circumference
WHR	Waist-to-hip ratio

1. INTRODUCTION

1.1. Background

The economic growth and associated shifts in the socio-demographic features of people globally have led to changes in the lifestyle and diet with increased risk of non-communicable diseases. Non-communicable diseases are the leading causes of death globally, killing more people each year than all other causes combined (Solomon & Mulugeta, 2019). Nearly 85% of the global premature deaths associated with NCDs occur in low- and middle-income countries (Solomon & Mulugeta, 2019). If the current growing burden of NCDs continues, the cumulative loss to the global economy has been estimated to reach $47 trillion by 2030 (Bloom *et al*., 2017).

A number of definitions have been published by organizations including the National Cholesterol Education Program (Expert Panel on Detection, 2001), the International Diabetes Federation, and the World Health Organization (Gregg *et al*., 2003), among others. Although there is no consensus on definition of metabolic syndrome, several variables including large waist circumference, high fasting blood sugar (FBS), abdominal obesity, low HDL-cholesterol level, hypertriglyceridemia, and hypertension are major risk factors for metabolic syndrome (Reaven, 2005). Of these, the 2001 Third Report of the NCEP's Adult Treatment Panel has emerged as the most widely used definition, primarily because it provides a relatively simple approach for diagnosing the metabolic syndrome by employing easily measurable risk factors (Grundy *et al.*, 2004).

Specifically, the NCEP ATP III defines, metabolic syndrome as having three risk factors: The Adult Treatment Panel III criteria were used for the diagnosis of metabolic syndrome. The diagnosis was made if at least three of the following five criteria existed. 1) Waist circumference ≥102 cm for men and ≥88 cm for women. 2) Serum triglycerides level ≥150 mg/dL. 3) Serum HDL-cholesterol level ≥40 mg/dL in men and ≥50 mg/dL in women. 4) systolic blood pressure (SBP) ≥130 mm Hg or diastolic blood pressure (DBP) ≥85 mm Hg. 5) FBS ≥100 mg/dL (Alavi *et al*., 2015).

Previous research suggested, the cause of the metabolic syndrome has yet to be the same reason some of them says strong genetic influence (Mozumdar & Liguori, 2011), Many epidemiological

studies show that regular physical activity reduces the risk of metabolic syndrome factors, while lack of physical activity increases risk metabolic syndrome (Churilla & Fitzhugh, 2009; Edwardson *et al*., 2012; Gebreegziabiher *et al.*, 2021). Earlier studies have demonstrated an association of the metabolic syndrome with sedentary behaviors (Ford *et al*., 2005; Rennie *et al.*, 2003). including television or video viewing, and computer use outside of work or during leisure time. Given the importance of physical activity for reducing metabolic risk factors, various public, private, and governmental organizations have recommended minimum physical activities levels for achieving minimal health benefits (Haskell *et al*., 2007).

Obesity and physical inactivity are the driving force behind the metabolic syndrome; but a second set of factors, metabolic susceptibility, usually is required for the metabolic syndrome to become evident (Grundy, 2008). These NCDs shared common and key modifiable behavioral risk factors like unhealthy diet, lack of physical activity, use of alcohol, tobacco which in turn lead to clinical disorders like overweight, raised blood pressure, raised cholesterol, and finally chronic disease (WHO, 2017).

These risk factors have shown clustering, and synergizing effect through time and are associated with higher prevalence of NCDs including cardiovascular diseases and related mortality (Kaukua *et al*., 2001). According to the 2017 report of WHO, NCDs such as CVDs, cancer, diabetes and chronic respiratory diseases are the global leading causes of deaths and are responsible for about 70% of all deaths worldwide (WHO, 2017). Metabolic syndrome is a combination of metabolic dysfunctions including: hypertension, insulin resistance, dyslipidemia, and central obesity which are associated with an increased risk of cardiovascular diseases and type 2 diabetes (Sowers, 2008). With the rise of cardio metabolic risks such as obesity, hyperglycemia, hypertension and dyslipidemia cardiovascular diseases become the leading causes of premature mortality (Carney *et al*., 2016). In addition high rates of smoking, alcohol consumption, poor diet and limited physical activities are risk factors for cardiovascular disease (Vancampfort *et al.*, 2011).

These metabolic syndromes were characterized by different criteria according to different guidelines. However, these criteria do not fully predict and are difficult to recognize in a single clinical setting. Therefore, structured lifestyle interventions are required to adequately treat Met S disease and reduce residual CVDs caused mortality. Metabolic syndrome is a constellation of

interrelated abnormalities (namely obesity, dyslipidemia, hyperglycemia, and hypertension) that increase the risk for metabolic syndrome disease (Kaur, 2014). This is a common metabolic disorder which increases in prevalence as the population becomes more obese (Tran *et al.*, 2011). Excess weight and lack of physical activity are two important determinants of the metabolic syndrome (Ryu *et al*., 2016). Measuring a person's level of physical activity and measuring sedentary behaviors provides a more complete picture of that person's overall activity pattern.

Therefore, an understanding of how sedentary behavior relates to health status may provide new avenues for clinical and public health approaches in disease prevention and control. Common sedentary behaviors include watching television or videos, playing video games, and using the computer (Wijndaele *et al.*, 2009). There for, metabolic syndrome progresses slowly in a person in a relatively long period of time (Gautam, 2018).

Several African studies have reported the prevalence of metabolic syndrome in urban populations. However, very few studies have quantified the prevalence of metabolic syndrome among working adults, community and population including government office workers and daily laborers in Ethiopia.

There is limited data on the prevalence of metabolic syndrome and associated factors in Tigray region, in general, and in Aksum town, in particular. Therefore, this research aimed to fill the gap and be part of the research community and insight future research and recommendations for potential interventions.

Literature Review

1.2.1. Metabolic Syndrome

Metabolic syndrome is not an illness without anyone else's input, but instead an arrangement of undesirable conditions, established in one's poor way of life; it is additionally connected with the expanded predominance of weight (Yeh *et al.*, 2011).

The main components of metabolic syndrome include obesity, high blood pressure, high blood triglycerides, low levels of HDL cholesterol and low-thickness lipoprotein-cholesterol, which can build the danger of CVDs and diabetes mellitus (Trepanowski *et al.*, 2011).

American Heart Affiliation and the National Heart, Lung, and Blood Organization have characterized metabolic disorder as comprising no less than three of the previously mentioned conditions (Nencioni *et al.*, 2018). Metabolic syndrome is among the main sources of bleakness and mortality around the world (WHO, 2008).

Metabolic syndrome has become one of the major public-health challenges worldwide. There has been growing interest in this constellation of closely related cardiovascular risk factors the metabolic syndrome is a clustering of metabolic abnormalities that has been found to be associated with a risk of coronary heart disease, stroke, and cardiovascular mortality greater than that of its individual components (Cipullo *et al.,* 2014). Metabolic syndrome is defined by combinations of interconnected physiological, biochemical, clinical and metabolic factors that directly increase the risk of atherosclerosis, cardiovascular disease, type 2diabetes mellitus and all are the related causes of mortality (Yeh *et al*., 2011).

Central obesity is the second of insulin resistance to be the key component of metabolic syndrome lead to hyperglycemia, hyperinsulinemia result activation sympathetic nervous system, increase arterial tone sodium(Na) reabsorption, reduction of insulin secretion, overstimulation of pancreatic B-cell function the most dangerous risk factors for development of cardiovascular diseases (CVDs) and type 2diabetes mellitus (Kaur, 2014).

The syndrome itself has had a variety of names, such as the insulin resistance syndrome, deadly quartet, syndrome X, syndrome X plus, among others (Ogbera, 2010).

1.2.2. The Etiology of Metabolic Syndrome:

Metabolic syndrome is defined by several phenotypic abnormalities, including central (intra-abdominal) obesity, dyslipidemia (elevated triglyceride, and reduced high-density lipoprotein cholesterol), impaired glucose tolerance, and hypertension (Cavallo-Perin *et al.,* 2002).

Elevated circulating inflammatory and/or thrombotic markers (tumor necrosis factor-, interleukin-6, and plasminogen activator inhibitortype1) or reduced levels of anti-inflammatory molecules such as adiponectin have also been associated with metabolic syndrome (Kaptoge *et al.*, 2012). This syndrome has become a public health challenge worldwide, estimated at 25% to 40% of individuals between the ages of 21 and 64 years of age (Lorenzo *et al.*, 2007).

1.2.3. Definition of Metabolic Syndrome

I. NCEP ATP III Definition

The National Cholesterol Education Program-Third Adult Treatment Panel guidelines suggest that a person is diagnosed with metabolic syndrome when she/he has three or more of the five risk factors: (a) hypertension, (b) hyperglycemia, (c) abdominal obesity, (d) dyslipidemia (raised total cholesterol, elevated triglycerides and decreased high-density lipoprotein cholesterol) and (e) insulin resistance syndrome (National Institute of Health, 2001). The above definition was extended from a simpler definition released by the National Cholesterol Education Program Adult Treatment Panel III (Lackner & Peetz, 2019).

When a subject has metabolic syndrome if he or she has three or more of the following abnormalities criteria: The abnormalities are like abdominal obesity (with a waist circumference ≥102 cm in men and ≥88 cm in women)**;** Hypertriglyceridemia (≥150 mg/dL); Low HDL-c (<40 mg/dL in men and <50 mg/dL in women; High BP >130/85 mmHg; High fasting glucose: >110 mg/dL (Thaman & Arora, 2013).

Among the different definitions of metabolic syndrome, **Table 1** the National Cholesterol Education Program Adult treatment panel three (NCEP ATP III) was chosen because: The definition is recent and very easy to adjust the shortcoming compared to other definitions. For example, (a) This definition different from the WHO definition on several fronts. The NCEPATP

III did not believe that insulin resistance is mandatory for the development of metabolic syndrome and hence suggested the term metabolic syndrome instead of the previous used term insulin resistance syndrome. This definition recognized central obesity as the culprit and hence body mass index, which is the parameter for generalized obesity, has not include in this definition. Abdominal obesity is estimated by waist circumference instead of BMI, cut-point for waistline is high and no consideration of ethnic differences. (b) The cut of point used for BP and HDL-c are stringent as compared to those suggested in the WHO definition, but by avoiding the need for clamp techniques and measurement of micro-albuminuria, The National Cholesterol Education Program Adult treatment panel three (NCEP ATP III) definition is much more practically applicable and this definition has many literature references related to my topic.

Table 1 The Metabolic Syndrome Definition of an Involving (timeline) Concept August, 2021.

Metabolic Syndrome	**Clinical Measurement or Criteria**					
	IR (Insulin Resistance)	**BMI or WC**	**TG**	**HDL-c**	**BP**	**FBS**
NCEP, ATP III (2001)	None, but any three of the following five features	M ≥ 102 cm, W≥88 cm	TG ≥ 150 mg/dL	M< 40, W< 50 mg/dL	≥130/85 mmHg	> 110 mg/dL

Note: Waist Circumference and HDL-c are Only Observable Parameters for Male and Female.

1.2.4. Epidemiology of Metabolic Syndrome

Metabolic syndrome is a collection of associated conditions such as dyslipidemia, high blood pressure, impaired glucose tolerance, and abdominal fat. It has first been described in 1988, and it is now widely adopted that it is a health situation that promotes atherosclerosis (Panagiotakos & Polychronopoulos, 2005). Each of the associated conditions has an independent effect, but clustering together they become synergistic, making the risk of developing atherosclerosis greater (Federspil *et al*., 2006).

Moreover, many investigators have shown a direct association between the prevalence of the syndrome with increased risk of cardiovascular disease and diabetes. Because each independent factor of the metabolic syndrome can increase the patient's cardiovascular risk, an integrated,

comprehensive approach is indicated for patients with the syndrome. Treatment of metabolic syndrome is primarily based on Therapeutic Lifestyle Change, implementing weight-loss diets and exercise programmers to increase physical activity (Workalemahu *et al*., 2013).

Substantial proportion of individuals living in Western nations is afflicted with multiple metabolic abnormalities. A recent report estimated that 115 million people in US, Japan, France, Germany, Italy, Spain and United Kingdom suffer from the metabolic syndrome (Ford *et al*., 2004). Moreover, it is estimated that at least 47 million Americans have this condition, while by the year 2010 the number of US citizens that have this condition it is estimated to be between 50 to 75 million (Panagiotakos & Polychronopoulos, 2005). Reported that more than 70% of adults have at least one of the major characteristics of the metabolic syndrome (Ferrannini & Natali, 1991). The Study investigators (Panagiotakos *et al.*, 2004) recently reported that the prevalence of the metabolic syndrome was 25% in men and 15% in women from Greece (Anagnostis, 2012).

The prevalence of the metabolic syndrome in a South Mediterranean population was similar with the prevalence of the syndrome in a sample of 8814 American men and women from the 3rd National Health and Nutrition Examination Survey (1988–1994). The prevalence of metabolic syndrome in a Portuguese sample was 27.0% in women and 19.1% in men (Santos *et al.*, 2008). Moreover, almost all these studies observed that the prevalence of the syndrome increases with age. Differences in genetic background, dietary habits, levels of physical activity, population age and sex structure, levels of over- and under-nutrition, may influence the prevalence of both the metabolic syndrome and its components worldwide. Nevertheless, all these data suggest that the prevalence of the syndrome is high due to increasing obesity and sedentary lifestyles; and reflect the growing necessity for therapeutic intervention (Panagiotakos & Polychronopoulos, 2005).

The worldwide prevalence of metabolic syndrome in adult population is also increasing with an estimated prevalence of 20%-25%which increases lifelong burden of cardiovascular diseases (Nolan *et al.*, 2017). A recent study in Ethiopia among public employees in Mekelle town showed a prevalence of 40% metabolic syndrome (Lemlem *et al.,*2018).

Physical inactivity, smoking family history of diabetes, obesity and sedentary lifestyle all influence the prevalence of metabolic syndrome (Herath *et al.*, 2018). In order to reduce the

prevalence of the metabolic syndrome, life style changes included the consumption of low-saturated diet (<7% of total fat) and the adoption of a physically active lifestyle. In this review we focus our interest of the effect of diet and exercise on the prevalence of the metabolic syndrome (Phing *et al.*, 2017).

The prevalence of metabolic syndrome in Ethiopia was reported to be 4.8% based on a national survey (Gebreyes *et al*., 2018). The pooled prevalence of metabolic syndrome in Ethiopia was found to be 34.89% (95% CI: 26.77, 43.01) and 27.92% (95% CI: 21.32, 34.51) by using NCEP/ATP III and IDF criteria, respectively (Ambachew *et al*., 2020). The latest report on the prevalence of Met S in urban dwellers in Tigray is 21.8% (Gebreegziabiher *et al*., 2021).

1.2.5. Pathogenesis of Metabolic Syndrome

Metabolic syndrome is a cluster of physiological risk factors (Alberti *et al*., 2009) and has been associated with an increased risk of death (Dalusung-Angosta & Gutierrez, 2013) and of numerous diseases, including cardiovascular disease (Mottillo *et al.,* 2010), cancer (Esposito *et al.,* 2012), kidney disease (Thomas *et al.*, 2011), and diabetes (Ford *et al.*, 2008).

Metabolic syndrome is a multi-factorial process induced by a combination of genetic and environmental factors and recent evidence has highlighted that circadian disruption and sleep loss contribute to disease pathogenesis (Maury *et al*., 2014).

The pathogenesis of the metabolic syndrome is multiple and still poorly understood. No single factor has yet been identified as an underlying causal factor. There is a growing belief, however, that obesity, especially visceral obesity, may play an important role in the development of the syndrome (Ren *et al.*, 2018).

Visceral adiposity seems to be an independent predictor of insulin sensitivity, impaired glucose tolerance, dyslipidemia and elevated blood pressure. An increasing number of studies **Figure 1** confirm that oxidative stress, chronic inflammation and angiogenesis all play important roles in the pathogenesis of metabolic syndrome (Saklayen, 2018).

Chronic hyperglycemia causes oxidative stress in tissues prone to complications in patients with diabetes. Oxidative stress occurs in a cellular system when the production of free radical moieties

exceeds the antioxidant capacity of that system. A puzzle of many pieces of evidence suggests that free radical over generation may be considered the key in the generation of insulin resistance, diabetes, and cardiovascular disease (Maury *et al*., 2014).

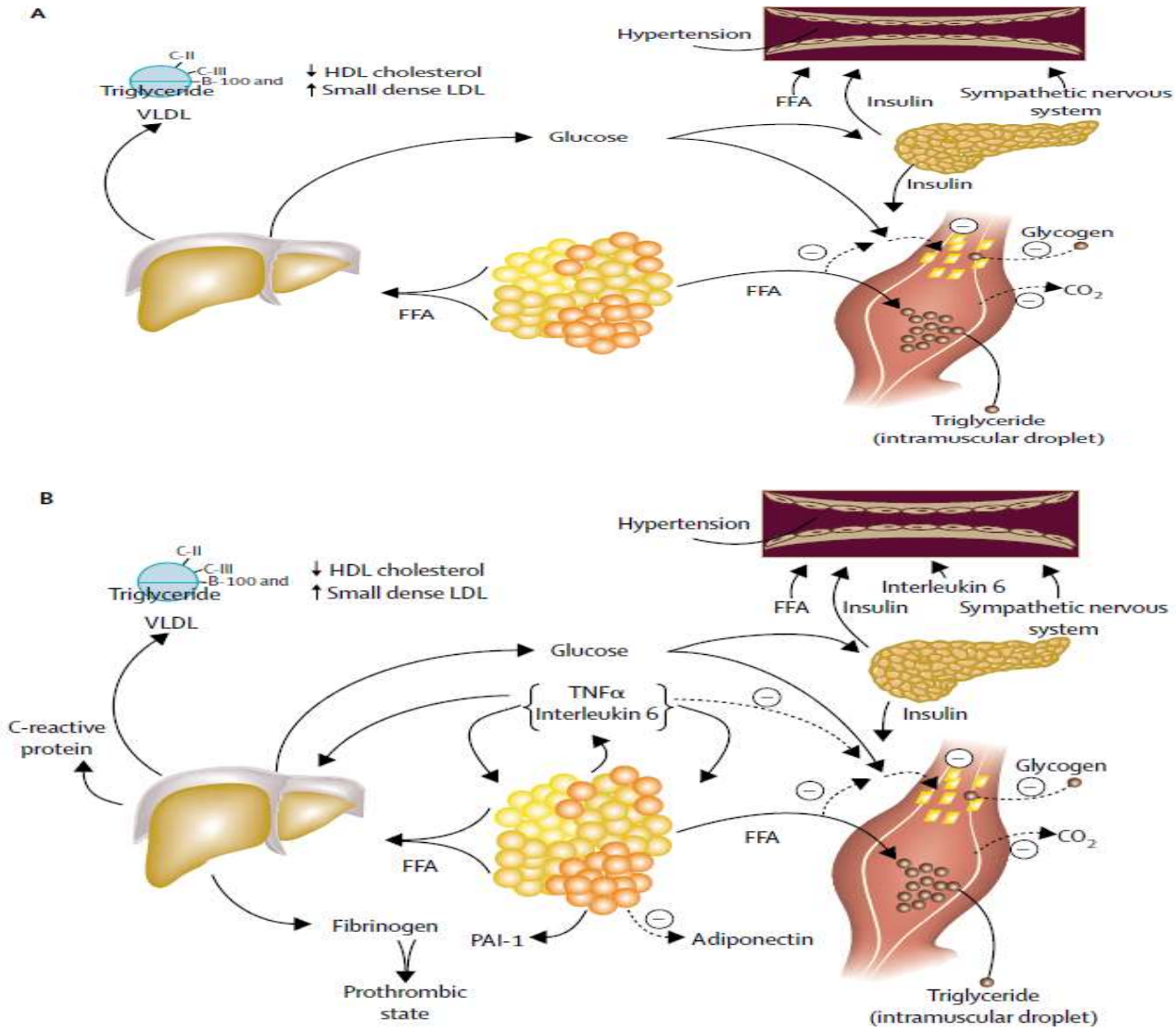

Figure 1: Pathophysiology of Metabolic Syndrome (Neuhauser, 2005).

A: Free fatty acids (FFA) are released in abundance from an expanded adipose tissue mass. In the liver, FFA produce an increased production of glucose, triglycerides and secretion of very low-density lipoproteins (VLDL). Associated lipid/lipoprotein abnormalities include reductions in high

density lipoprotein (HDL) cholesterol and an increased density of low-density lipoproteins (LDL). FFA also reduces insulin sensitivity in muscle by inhibiting insulin mediated glucose uptake. Associated defects include a reduction in glucose partitioning to glycogen and increased lipid accumulation in triglyceride (TG). Increases in circulating glucose and to some extent FFA increase pancreatic insulin secretion resulting in hyperinsulinemia. Hyperinsulinemia may result in enhanced sodium reabsorption and increased sympathetic nervous system (SNS) activity and contribute to the hypertension as might increase levels of circulating FFA.

B: Superimposed and contributory to the insulin resistance produced by excessive FFA is the paracrine and endocrine effect of the proinflammatory state. Produced by a variety of cells in adipose tissue including adipocytes and monocyte-derived macrophages, the enhanced secretion of interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF-α) among others results in more insulin resistance and lipolysis of adipose tissue triglyceride stores to circulating FFA. IL-6 and other cytokines also are increased in the circulation and may enhance hepatic glucose production, the production of VLDL by the liver and insulin resistance in muscle. Cytokines and FFA also increase the production of fibrinogen and plasminogen activator inhibitor-1 (PAI-1) by the liver that complements the overproduction of PAI-1 by adipose tissue. This results in a pro-thrombotic state. Reductions in the production of the anti-inflammatory and insulin sensitizing cytokine adiponectin are also associated with the metabolic syndrome and may contribute to the pathophysiology of the syndrome. IL-6= interleukin-6, FFA=free fatty acids, PAI1=plasminogen activator inhibitor 1, TNF-α=tumor necrosis factor alpha, VLDL= very low-density lipoproteins

Obesity

The epidemic of obesity and overweight poses a major challenge to the prevention of chronic non-communicable diseases throughout the world (Swinburn *et al.,* 2011). In some developing countries it presents a double burden alongside the enduring problems of under nutrition, recognized in the World Health Organization report, Obesity – preventing and managing the global epidemic (Nishida *et al.,*2017).

Obesity is a major public health problem that has reached epidemic proportions worldwide (Finucane *et al*., 2011). It is associated with numerous metabolic and cardiovascular disturbances such as insulin resistance, type 2 diabetes, hypertension, and dyslipidemia (Hedley *et al*., 2004).

However, these cardio metabolic abnormalities are not found in all obese people (Ferrannini *et al.,* 1997), as evidenced by the occurrence of a subset of apparently healthy obese subjects referred to as metabolically healthy obese (Sims, 2001). Obesity is a principal causative factor in the development of metabolic syndrome. **Figure 2,** It was reported that increased oxidative stress in accumulated fat is an important pathogenic mechanism of obesity-associated metabolic syndrome (Vancampfort *et al*., 2011).

Fat accumulation correlated with systemic oxidative stress in humans and mice. Production of ROS increased selectively in adipose tissue of obese mice, accompanied by augmented expression of NADPH oxidase and decreased expression of ant oxidative enzymes (Feig *et al.*, 2006). Research aimed at deciphering etiology of obesity and the metabolic syndrome remains focused on two behavioral factors; namely, diet and physical activity, even though epidemiologic research suggests that these two cornerstones of treatment and prevention account for only a small-to-moderate portion of the variance in these phenotypes (Hinnouho *et al*., 2013).

Accordingly, low physical activity (sedentary life style) and over consumption of high energy yielding foods above the needs of an individual results in fat depositions leading to obesity (Sellayah *et al.*, 2014). As the prevalence of obesity and the metabolic syndrome continue to rise (Holmes *et al.*, 2010).

Research increasingly speculated that genetic, epigenetic and environmental factors may augment the traditional concept of energy imbalance in the etiology and pathophysiology of obesity and the metabolic syndrome (Eisenmann, 2006).

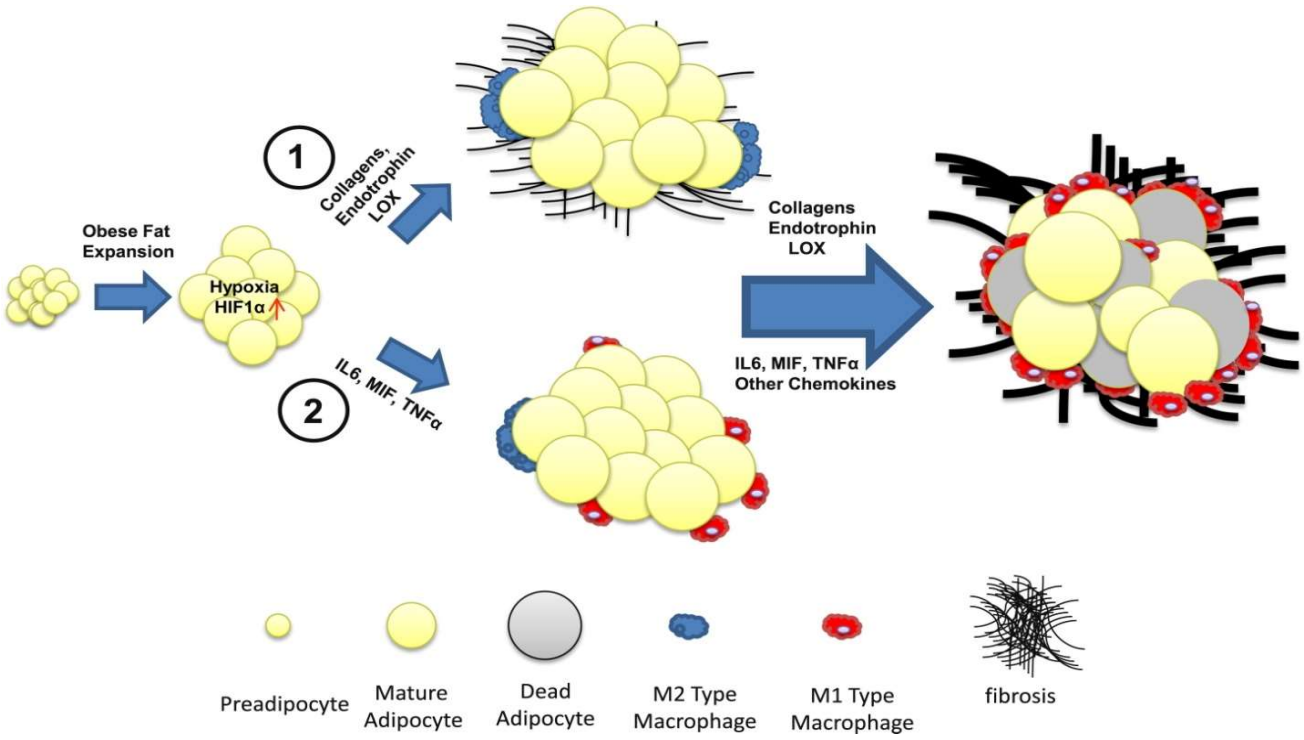

Figure 2: Proposed Models for the Sequential Steps Leading to Adipose Tissue Fibrosis and Metabolic Dysfunction (Sun et al., 2013).

Obese fat pad expansion quickly leads to a hypoxic state. As a result, HIF1α is induced.

(1) A whole set of "fibrotic response" genes, including collagens and their biosynthetic enzymes, such as LOX, are dramatically up regulated under these conditions. This regulation results in the abnormal development of ECM, leading to local fibrosis, which triggers necrosis of adipocytes. The dead adipocytes then attract classically activated proinflammatory M1 macrophages, which ultimately lead to inflammation and metabolic dysfunction.

(2) Other models suggest that HIF1α may also directly induce proinflammatory factors, such as IL6 and MIF, which in turn causes M1 macrophage infiltration. The preadipocytes, macrophages, and interactions between these cell types ultimately produce fibrotic components, which eventually cause pathological expansion of fat pads.

Obesity is associated with insulin resistance and the metabolic syndrome. Obesity contributes to hypertension, high serum cholesterol, low HDL-c and hyperglycemia, and is independently associated with higher CVD risk. The risk of serious health consequences in the form of type 2 diabetes, coronary heart disease and a range of other conditions, including some forms of cancer, has been shown to rise with an increase in body mass index, but it is an excess of body fat in the abdomen, measured simply by waist circumference, that is more indicative of the metabolic syndrome profile that BMI. One of the current views integrating physiology and obesity is the idea that metabolic dysfunction arises from exposure of cells to an excess of nutrients independent of their composition (Wisse *et al.,* 2007).

Hypertension

Hypertension and Metabolic syndrome are highly prevalent diseases that present a global challenge (Tachebele *et al.*, 2014). In 2000, approximately one billion people worldwide (26.4% of the adult population) were estimated to have hypertension and this is likely to increase to over 1.5 billion by 2025 as a result of aging population in many developed countries, and an increasing incidence of hypertension in developing countries (Kearney *et al.*, 2005).

In Ethiopia the prevalence of hypertension is estimated to be 35.2% (Ala Alwan *et al.*, 2011). It is also estimated that around 20-25% of the world's adult population has metabolic syndrome and they are twice as likely to die from it; and they are three times more likely to have a heart attack or stroke compared with people without the syndrome (Ala Alwan *et al.*, 2011).

When hypertension and metabolic syndrome components co-exist in an individual they potentiate one another leading to synergism that increase the total CVD risk (Tachebele *et al*., 2014a). Hypertension is one of the major manifestations of the group of clinical abnormalities that characterize metabolic syndrome found in 30 to 40% of hypertensive individuals (Marchi-alves *et al.*, 2012). Hypertension is an important CVD risk factor with high global prevalence. It is one of the most commonly identified components of the metabolic syndrome (Wolf-Maier *et al*., 2003). When hypertension and other metabolic risk factors co-exist in an individual, they potentiate one another leading to a synergism that increases the total CVD risk well above that which results from the sum of the individual risk factors (Meigs *et al*., 1997).

Recognition of this fact has led to a reorientation with regard to risk stratification and management of hypertension (Kannel, 2000). Elevated blood pressure is commonly associated with the other lipid and non-lipid risk factors of the metabolic syndrome (Matsuda & Shimomura, 2013).

That hypertension enhances coronary artery disease risk is well established. A point of some dispute, however, is whether hypertension is the product of the "insulin resistance state." Because of its high frequency, hypertension could just occur commonly with other non-communicable disease risk factors (Nagae *et al.*, 2009).

Dyslipidemia

The dyslipidemia associated with metabolic syndrome, particularly involving elevated triglycerides, low HDL-c, and small dense LDL-c, is a key atherogenic component of the metabolic syndrome (Alipour *et al.*, 2012). the presence of a 'metabolic syndrome' and defined afflicted individuals by the presence of three of the following five characteristics: central obesity, hypertriglyceridemia, low serum levels of HDL-c, elevated blood pressure and either impaired fasting glucose or DM2 (Ford *et al.*, 2004). Among these diagnostic components, dyslipidemia associated with metabolic syndrome, particularly involving elevated tri-glycerides, low HDL-c and small dense LDL-c, is a key atherogenic component of metabolic syndrome, with the other components further exacerbating CVD risk (Grundy, 1998).

Atherogenic dyslipidemia, the core component of metabolic syndrome, clinically presents with elevated serum TG levels, increased small density LDL-c particles and decreased levels of HDL-c. Atherogenic abnormalities such a s high levels of ApoB, small HDL particles and increased remnant lipoproteins have also been demonstrated to be independently atherogenic (Grundy, 1998). Abnormal fatty acid metabolism and dyslipidemia play an intimate role in the pathogenesis of metabolic syndrome and cardiovascular diseases (Volek *et al.*, 2008). The availability of glucose and insulin predominate as upstream regulatory elements that operate (Shulman., 2014).

Dyslipidemia, the hallmark of the metabolic syndrome, is summarized as (a) increased flux of free fatty acids, (b) raised TG values, (c) low high density lipoprotein cholesterol values, (d) increased small, dense low density lipoprotein (LDL) values, and (e) raised Apo lipoprotein B (Apo B) values (Ginsberg & Huang, 2000).

Dyslipidemia is widely established as an independent risk factor for cardiovascular disease (Mahalle *el al.*, 2014). Low HDL cholesterol and hypertriglyceridemia have been found to be independently and significantly related to myocardial infarction/stroke in patients with metabolic syndrome (Ninomiya *et al.,* 2004). Additionally, a combination of high fasting glucose and low HDL cholesterol were shown to have primary predictive ability for coronary heart disease(Anderson *et al.*, 2004). Moreover, in the study of Sacco and colleagues, the role of HDL cholesterol values, as an important modifiable stroke risk factor, was further supported (Shaw, 1979).

The dyslipidemia in metabolic syndrome patients may be caused by a combination of overproduction of very low-density lipoprotein (VLDL) Apo B-100, decreased catabolism of Apo B containing particles, and increased catabolism of HDL-Apo A-I particles. These abnormalities may be the consequence of a global metabolic effect of insulin resistance. Although the underlying mechanisms for this pattern are not fully understood, a cascade of events has been proposed for the observed phenotype, which ties in with all of the abnormalities present in these disorders. The unraveling of the details of these cellular events has proceeded rapidly, but their physiologic relevance to lifestyle modification has been largely ignored (Burns *et al.*, 2012).

The "metabolic" dyslipidemia is characterized by elevated concentrations of triglycerides, low levels of HDL-c, and small, dense LDL-c particles (Mudd *et al.*, 2007). Dyslipidemia, especially elevated LDL-c, is a major modifiable risk factor for cardiac vascular diseases, and another metabolic syndrome (Klop *et al.*, 2013).

Physical Activity

Epidemiological studies have demonstrated that moderate-vigorous daily physical activity prevents both the incidence of chronic diseases and premature death (Darren *et al*., 2006). It is also well documented that habitual leisure-time activity prevents elevated blood pressure, insulin resistance, glucose intolerance (Misra *et al.*, 2005). elevated triglycerides, low levels of HDL and decreases body weight (Thompson *et al*., 2003), preventing the development of coronary heart diseases, type 2 diabetes and metabolic syndrome (Holme *et al*., 2007).

Changes in working styles and the development of unhealthy life habits have reduced the perceived importance of exercise, and experts increasingly suggest that physical inactivity was the most important public health problem of the twenty-first century (Chiang *et al*., 2014). Sedentary behavior is defined as any waking behavior with energy expenditure <1.5 metabolic equivalents whilst in a sitting or reclining posture (Black & Frost, 2011).

Evidence suggests that prolonged sitting is associated with an increased risk of CVDs (Ford & Caspersen, 2012),metabolic syndrome (Edwardson *et al*., 2012), certain cancers (Lynch, 2010), depression (Teychenne *et al.,* 2010) and musculoskeletal problems (Mörl & Bradl, 2013).

Increasingly sedentary lifestyles are putting greater numbers of people at increased risk of various conditions and diseases including overweight, obesity and metabolic-related syndromes. Overweight and obesity are associated with a higher prevalence of metabolism-related diseases (Fu *et al.,* 2008). Medical experts have revealed a clear correlation between the lack of physical activity and overweight, obesity and metabolism-related syndromes (Hollander & Mechanick, 2008). Several new studies suggest that breaking up sedentary time with periods of movement may help to mitigate the unhealthy effects of lack of regular movement (Healy *et al.*, 2008).

A lifestyle intervention designed to increase physical activity and decrease, or possibly maintain, bodyweight is another important approach for global CVD risk modification. Higher cardiorespiratory fitness and increased self-reported physical activity have been shown to be inversely related to CVD mortality and to incidence of IGT and T2D (Ardern *et al.*, 2005).

Although it is difficult to separate out the effect of exercise, independent of weight loss, increased physical activity appears to reduce CVD risk and incidence of T2D (Yates *et al.,* 2007). Thus, it should not be surprising that physical activity has been shown to predict incidence of metabolic syndrome in a dose-dependent manner; lower levels of activity increased incidence of metabolic syndrome and higher levels of physical activity protected against the development of metabolic syndrome (Laaksonen *et al*., 2002). Higher cardiorespiratory fitness also predicted lower incidence of metabolic syndrome in middle-aged women and men followed for an average of years (LaMonte *et al.*, 2005).

1.3 Significance of the Study

Currently non communicable diseases including cardiovascular diseases, cancer, diabetes, hypertension and respiratory diseases are increasing like an epidemic in the world with the highest burden in middle- and low-income countries as a result of behavioral and life style changes. Cardio metabolic diseases are the foremost causes of deaths around the globe and can be avoided long before becoming clinically apparent. A premature death from all non-communicable diseases finally converges to the cardiovascular deaths.

Those and others metabolic syndrome cause death before it diagnosed and recognized clinically. Cardiovascular disease includes a constellation of risk factors such as central obesity, high blood pressure, insulin resistance, abnormal cholesterol levels. These risk factors collectively increase the utilization of expensive healthcare resources.

Assessment of accurate predictors of a disease and its risk factor has a particular importance for early detection and or prevention of morbidity. These risk factors are increasing due to different reasons such as sedentary life style, aging, urbanization, increasing prevalence of obesity, smoking, less physical activities and drinking alarmingly in Ethiopia. These risk factors are more commonly practiced in urbanization area with sedentary life style follower populations like government institutions staffs which expend more working time by sitting.

Government office workers spend their working time with less physical activity because of the nature of their jobs. Knowing the risk factors and avoiding them is so important and it is the way to prevent deaths from metabolic syndrome. Evaluating the metabolic syndrome in government office workers and daily laborers is thus critical for the purposes of having significant clue or alarming about the component of metabolic syndrome. It also helps to determine whether prevalence differed according to occupational activity. However, Studies on the prevalence of the metabolic syndrome among office workers are limited in a developing country like Ethiopia and in other Sub-Saharan countries. Hence, this study was done to assess the prevalence and components of the metabolic syndrome among governmental office workers in Aksum town Tigray region, Ethiopia. Furthermore, this study attempted to investigate the demographic and lifestyle factors associated to the metabolic syndrome in the population. The output of such studies

could be used as a baseline and an eye opener for policy makers to design context specific interventions.

1.4 Statement of the problem

According to the World Health Organization WHO, 2017 report, Non- Communicable Diseases (NCDs) kill 40 million people (WHO, 2014). According to data from the National Health and Nutrition Examination Survey of 1999–2006, the age-adjusted prevalence of metabolic syndrome increased from 29.2 to 34.2 % in the world (Mozundar & Liguori, 2011).

Metabolic syndrome is gradually increasing in prevalence worldwide (Isomaa *et al.*, 2001), due to several factors, such as ageing of the population, increased life expectancy and obesity, sedentary and inadequate nutrition (Cipullo *et al.*, 2014). The prevalence of metabolic syndrome in Urbanized sub-Saharan African populations ranges from 0% to as high as about 50% (Fezeu *et al*., 2007). The burden of non-communicable diseases is increasing up to 30% of total deaths in Ethiopia (WHO, 2014). In low-income countries, like Ethiopia, these chronic diseases are a growing problem, 80% of chronic disease related deaths occur in low- and middle-income countries (Desta *et al.*, 2012).

There is limited data in Ethiopia on the quality of life and treatment outcome of government office workers and daily laborers in Ethiopia. The overall prevalence of metabolic syndrome, high blood pressure, hyperglycemia, dyslipidemia, metabolic syndrome and their determinants in Ethiopia based on evidence from the National NCDs STEPs survey, 2015 was 4.8% (Gebreyes *et al*., 2018). Likewise, according to the annual report of Aksum Town Health Office (ATHO, 2014), chronic respiratory diseases were the leading causes of morbidity for three consecutive years. Specifically, chronic respiratory diseases accounted for 31.99%, 29.05% and 29.42% of morbidity from 2004-2006 E.C. respectively (Negasi, 2018b). The study area focused on Aksum town because the environmental, social and technological rapid changes in Aksum town have resulted in a high proportion of such normal daily activity being displaced by time spent sedentary life (Owen *et al.,* 2010).

The assessment of metabolic syndrome in government office workers is not studied at the woreda level until now; There is misunderstanding and misconception toward the nature of metabolic

syndrome. For instance, people consider metabolic syndrome as the problem of the affluent class for that it is common to overhear the association of NCD incidence only with the rich (Negasi, 2018).

There is little information about the prevalence of metabolic syndrome or its components in government office workers (Sanchez-Chaparro *et al.*, 2008). There is a strong agreement that the health of workers, who comprise almost half the whole population, is an important health-related issue worldwide (World Health Organization, 2010). From a societal perspective, this also includes productivity costs, i.e., the costs of production loss due to illness and associated disability (Meerding *et al*., 2005). A sedentary lifestyle due to excessive work hours, smoking and drinking, and job stress are risk factors (Bernardo *et al.*, 2013). The lack of physical activity associated with excessive working hours is one of the most significant risk factors for chronic diseases of metabolic syndrome (Yap *et al.*, 2009). Both alcohol consumption and high-calorie diets are known risk factors for metabolic syndrome among office workers finally Changing their eating habits effectively reduced insulin levels (Maruyama *et al*., 2010).

Various studies have shown that office workers' job stress and job strain increases the risk of cardiovascular disease and metabolic disorders (Edwards *et al.*, 2012). In Ethiopia, particularly in the study area Aksum town, there was no information regarding the assessment and prevalence of metabolic syndrome among government office workers compared to daily laborers. This study aimed to assess the metabolic syndrome of government office workers in some randomly selected offices in Aksum town. Generally, this study primarily intended to provide additional timely and objective information about the current situation; and the overall quality of life in the study area. The information can be used as a base line evidence for planners, policymakers, researchers and organizations who are working on prevention of chronic non-communicable diseases. Evaluation of metabolic syndrome among the government workers of this study can add new insight in the management of the disease as it allows the quantification of the disease consequences according to the workers' perception and enables adjustment of medical decisions to their physical, emotional, and social needs. It also improves the adhesion to the therapeutic plan, the quality of the health care provided, and patient survival based on our findings. This study will make pragmatic recommendations that can be implemented for all the concerned bodies. This research can also serve as a baseline for future and further assessments. Resulting gaps and updates

identified could form a block of recommendations that will improve the lifestyle of the government office workers.

1.5 Hypothesis

Null Hypothesis: -

- There is no any association between the socio-demographic, behavioral characteristics and clinical factors with risks of metabolic syndrome.
- There is no any association/correlation or difference between the workers (Government office workers and daily laborers/ Farmers) with the magnitude risk of metabolic syndrome.

Alternative Hypothesis: -

- Socio-demographic, behavioral character, dietary habit of life, clinical factors (Lipid profiles and Fasting blood glucose) and Anthropometric parameters have effect on metabolic syndrome.

2. OBJECTIVES

2.1. General Objective: -

- To assess the association between working environment and metabolic syndrome among workers in Aksum Town, Central Zone, Tigray Region, Ethiopia.

2.2. Specific Objectives: -

- To determine the magnitude of metabolic syndrome and related risk factors among government office workers and daily laborers.
- To assess the lipid profile: TC, TG, HDL-C, and LDL-C of the study participants.
- To determine blood pressure patterns of study participants.
- To determine the fasting blood sugar level of the study participants.
- To evaluate body mass index of the study participants.
- To measure waist and hip circumferences of the study participant.
- To make comparison between parameters of office workers and daily laborers using different statistical methods.

3. MATERIAL AND METHODOLOGY

3.1 Study Population and Area

The study was conducted at Aksum town which is one of the ancient towns in Ethiopia, found in the central zone of Tigray regional state, 248 km away from Mekelle, the regional capital city. It is located 1024 km north of Addis Ababa, the capital city of Ethiopia. The source population was government offices' workers and daily laborers living in Aksum town. The study population was randomly selected government offices' workers and daily laborers residing in Aksum town.

3.2 Study Design and Period

Comparative cross-sectional study was conducted using WHO stepwise survey from September, 2020 up to August, 2021.

3.3 Inclusion and Exclusion Criteria

Inclusion Criteria

Selected government offices workers and daily laborers/farmers included in to the study in Aksum town during the study period provide that they are willing to participate in the study.

Exclusion Criteria

For both government office workers and daily laborers/farmers

- Workers who are not willing to participate in the study and unable to give informed consent
- Workers with Diabetes mellitus (DM)
- Workers who were on statin drugs,
- Pregnant women

4.4 Sample Size Determination

Sample size was determined based on the prevalence of metabolic syndrome with the main components of metabolic syndrome include (high blood pressure, hyperglycemia, and dyslipidemia) and their determinants in Ethiopia (Gebreyes *et al*., 2018). Evidences from the

National NCDs STEPS Survey, 2015 Gebreyes and his colleagues reported that the overall prevalence of metabolic syndrome in Ethiopia is 4.8 %. Prevalence is higher in female as compared to males (3.8% vs. 1.8%). Prevalence is higher in urban population than rural population (11.7% vs. 3.2%), increasing with increasing age group from 1.6% in age group 15–24 to 10.8% in age group 65 and above, prevalence was very high in obese patients compared to normal individuals (41% vs. 3.9%) and individuals with low level physical activities compared to high level physical activities (9.9% vs. 3.6%) (Gebreyes *et al.,* 2018). The required sample size was computed using single population proportion formula.

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

Where, P = 4.8% = 0.048 (positive prevalence); Estimate prevalence rate for the proportion of metabolic syndrome.

Z α/2 = Z-score at 95% confidence interval = 1.96; 1-P=q = 0.952 (negative prevalence)

q= 1-P = 1-0.048 = 0.952

E = the margin of sample error = 5% (0.05)

n= Minimum sample size from infinite population

Based on the above formula $n = (Z\alpha 2)^2\, P\,(1-P)\,/d^2 = (1.96)^2(0.048)\,(1-0.048)/\,(0.05)^2 = 70$**,** When it is calculated based on recent prevalence of metabolic syndrome in Ethiopia, it is 70 Since the total governmental office workers in Aksum town are less than 10,000 it needs same arrangement by using correction formula and adding 10% contingency for non -respondents was 77. However, for the current study, 100 participants (sample size) were used to infer to the total population.

4.5 Study Variables

4.5.1 Dependent Variables

- Blood glucose level (FBG)
- Diastolic and Systolic blood pressure
- Serum: TC, TG, HDL- c, and LDL-c
- Body Mass Index (BMI)
- Waist circumference (WC)
- Hip circumference
- Waist to Hip ratio (WHR)

4.5.2 Independent Variable

- Age
- Sex
- Alcohol consumption
- Exercise Habit
- Level of education
- Marital status
- Occupation status
- Place of residence
- Smoking

4.6 Data Collection

4.6.1 Questionnaires

Standardized questionnaire was prepared in English and Tigrigna (local language) to collect data on the socio demographic characteristic, residence, economic, dietary, behavioral measurement of dietary and behavioral risk factors like tobacco use, alcohol consumption, use of drugs and co-morbidity characteristics of the study participants per sample size.

4.6.2 Anthropometric measurements

Physical measurements such as weight, height, waist circumference, hip circumference and blood pressure were taken using standardized methods and adjusted equipment. Weight was measured in kilograms with light clothes and without shoes, the participant's height was measured in meters using height board with no shoe and in upright position, body mass index and waist to height ratio was calculated to determine the obesity status.

Body mass index measures body weight and height, and calculates with (Body weight (kg)/ Body height (m^2). Low BMI $\leq$ 18.49 kg/ m^2, Normal BMI 18.50-24.49 kg/ m^2, Overweight BMI 24.99-30 kg/ m^2 and Obese BMI $\geq$ 30 kg/ m^2. Waist circumference was measured in centimeter at the narrowest point between the lower costal border and the iliac crest with a constant tension tape. Waist hip ratio (WHR) calculated by the following formula, WHR = waist circumference in cm) / hip circumference in cm.

The WHR is the widely used indicator of abdominal obesity in population studies. measurement of blood pressure was done using a clinical validated Omron sphygmomanometer at the midpoint

of the lift arm. Recorded in the sitting position in the right arm, to the nearest 1 mmHg, after participant's rest for at least five minutes or 30 minutes for those who took hot drinks like coffee with two blood pressure readings were taken 5 min apart for all participant, then the mean blood pressure recorded and calculated.

4.6.3 Assessing Physical activity

Physical activity is defined as any bodily movement produced by skeletal muscles which require energy expenditure. Physical activity was categorized into vigorous and moderate and sedentary (low) activity.

A vigorous-intensity activity was defined as any activity that causes large increase in breathing or heart rate, if continued for at least 10 minutes (e.g., running, carrying or lifting heavy loads, digging or construction work) at least for three days per week.

Moderate-intensity activity was defined as any activity that causes small increase in breathing or heart rate, if continued for at least 10 minutes (brisk walking or carrying light loads). Or Three or more days of vigorous intensity activity of at least 20 minutes per day; or five or more days of moderate-intensity activity or walking for at least 30 minutes per day. Physical activity related to work, transportation and leisure time was assessed in terms of minutes that caused them breathless or feel palpitation. Low level physical activity involves a person not meeting any of the above-mentioned criteria for the moderate- or high-level categories.

4.6.4 Blood Sample Collection and Processing

Study subjects were currently permanent employees of CBE, Revenue, Finance, Health officers and daily laborers. Workplaces were selected based on their relatively high stability of workforce, willingness, commitment and supporting letters hierarchy to participate in the study.

After selected offices we are discussed and agree deeply with those subjects about the aim of the study, finally appointed to take the 5ml blood sample from each participant and to measure physical/anthropometric parameters.

All employees of the selected government office workers and daily laborers were invited at the morning 6:00 am to one selected finance office central zone Aksum Town site was came. Blood samples were collected after overnight fasting. Samples of 5 mL of blood were obtained from each participant employing by the campaign group of professional nursing, laboratory technician, investigators and supervisors. All the above activities were activated, arranged, programmed, supervise and mobilize by personal investigator (PI). After an informed consent obtained from a study participant, about 5mL of blood sample was drawn following minimum of eight hour fasting or early in the morning before breakfast with standardized serum separator tube from each participant by trained laboratory technologist. The process of blood sample collection is through aseptic/sterile technique.

Blood samples were collected, wait for 30 minutes for clot formation and centrifuged at 3000 rpm for 5 minutes using Rotanta 960 centrifuge in thermos stable condition in order to harvest the serum sample. The supernatant serum was transferred into nunc tube immediately and transported to central laboratory of Aksum University College of Health Science and Referral hospital and stored at 2-8 °C until analysis and the analysis was done at central laboratory of Adwa General Hospital using COBAS C 311 (Roche-Hitachi Germany) machine.

The collected aliquots of blood serum were used to determine participants' fasting glucose concentrations and lipid profiles. Serum triglycerides (TGs), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c), and fasting serum glucose (FSG) were measured and analyze at laboratory of Adwa General Hospital, Tigray Region, Ethiopia.

4.6.5 Biochemical analysis

Laboratory tests were performed for blood glucose, total cholesterol, triglyceride, LDL cholesterol and HDL- cholesterol using COBAS C 311 (Roche-Hitachi, Germany) clinical chemistry analyzer. All these tests were done the next day after STEPS 1 and 2 of data collections with minimum of 8 hours fasting. Laboratory test results were assessed and categorized according to the definition.

Glucose estimation

Glucose is the major carbohydrate present in the peripheral blood. Oxidation of glucose is the major source of cellular energy in the body. Glucose derived from dietary sources and is converted to glycogen for storage in the liver or to fatty acids for storage in adipose tissue. The concentration of glucose in blood is controlled within narrow limits by many hormones, the most important of which are produced by the pancreas (Tachebele *et al*., 2014a).

Test Principle: There are many principles of estimation glucose such as hexokinase, glucose dehydrogenase, Reduction method and GOD/POD however due to more accuracy, sensitivity and good stability. It was determined by GOD/POD enzymatic Method (Coxon & Schaffer, 1971).

Glucose $\xrightarrow{\text{GOD}}$ Gluconic Acid + H_2O_2 …..... **(1)**

H_2O_2 + 4-AAP with Phenol $\xrightarrow{\text{POD}}$ $H_2O + O_2$ + Pink dye color. …… **(2)**

The color intensity of pink dye at 530nm formed was measured directly proportional to the concentration of glucose

Lipid profile: - Serum triglycerides (TGs), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c) and low-density lipoprotein cholesterol (LDL-c), and fasting serum glucose (FG) were measured using the calibrated automated COBAS C 311 (Rochi-Hitachi Germany) chemistry analysis machine.

Total Cholesterol Estimation

Cholesterol: - is derived from lipids containing greater or equal to 27 carbons, which contains double bond at 5 and 6 carbons and contain OH^- at three carbons. It is asteroid with a secondary hydroxyl group in the carbon number three position and transported in blood stream which is synthesis in liver intestine and from dietary (Hopkins, 2004).

Principle: The method for the measurement of serum total cholesterol involves the use of three enzymes: cholesterol esterase, cholesterol oxidase and cholesterol peroxidase. Cholesterol esterase

is first hydrolyzed to release free cholesterol and triglycerides using cholesterol esterase. The free cholesterol is then oxidized by CHOD to generate H_2O_2. The hydrogen peroxide reacts with phenol and 4-aminoantipyrine in the presence of peroxide to generate a colored quinoid dye product, the absorbance of which is measured at 540nm, and is proportional to the concentration of total cholesterol in the original sample (Coxon & Schaffer, 1971).

Hydrolysis: HDL-c esters + H_20 $\xrightarrow{CHER}$ Cholesterol +RCOOH ……..……... **(1)**

Oxidation: HDL-c + O_2 $\xrightarrow{CHOD}$ Cholest-4-en-3-one + H_2O_2 ……. **(2)**

Oxidation: H_2O_2 + 4-AAP + Phenol $\xrightarrow{POD}$ Phenol quinone-imine dye + H_2O …. **(3)**

The color intensity of the blue dye formed at 540nm directly proportional to the cholesterol concentration of total cholesterol.

Triglyceride Estimation

Triglycerides: -Triglycerides are esters of the tri-hydric alcohol glycerol with 3 long-chain fatty acids. It is the most common of fat in the blood. They are partly synthesized in the liver and partly ingested in food. The determination of triglycerides is utilized in the diagnosis and treatment of patients having diabetes mellitus, nephritis, liver obstruction, lipid metabolism disorders and numerous other endocrine diseases (Nordestgaard & Varbo, 2014).

Test Principle: By Enzymatic Colorimetric or GOD/POD

Hydrolysis ⟶ **Phosphorylation** ⟶ **Oxidation**

The method is based on the enzymatic hydrolysis of serum or plasma triglyceride to glycerol and free fatty acid by lipoprotein lipase. The glycerol is phosphorylated by adenosine triphosphate in the presence of glycerol kinase to form glycerol-3-phosphate to for dihydroxyacetone phosphate and hydrogen peroxide. A red colored product is formed by the peroxide catalyzed coupling of 4-aminoantipyrin and phenol with hydrogen peroxide, the optical density at 540nm of which is proportional to the concentration of triglyceride in the sample (Klotzsch & McNamara, 1990).

Triglyceride + 3 H_2O $\xrightarrow{\text{LPL}}$ Glycerol + 3 RCOOH …… **(1)**

Glycerol + ATP $\xrightarrow[Mg^{2+}]{\text{Glycerol Kinase (GK)}}$ Glycerol-3- Phosphate + ADP. …… **(2)**

Glycerol-3-phosphat + O_2 $\xrightarrow{\text{GPOD}}$ Dihydroxyacetone phosphate + H_2O_2 …… **(3)**

H2O2 +4-aminophenazone + 4-chlorophenol $\xrightarrow{\text{POD}}$ 4- (p-benzoquinone-amino) - phenazone +2H_2O +HCL … **(4)**

Under the peroxidation the intensity to form a red dye color at 540 nm directly proportional to concentration of Triglyceride.

High Density Lipoprotein-Cholesterol Estimation

High density lipoprotein cholesterol: -is the cholesterol of HDL is responsible for the reverse transport of cholesterol from the peripheral cells to the liver. Here, cholesterol is transformed to bile acids which are excreted into the intestine via the biliary tract. Monitoring of HDL-cholesterol in serum is of clinical importance since an inverse correlation exists between serum HDL-cholesterol concentrations and the risk of atherosclerotic disease. Elevated HDL-cholesterol concentrations are protective against coronary heart disease, while reduced HDL-cholesterol concentrations, particularly in conjunction with elevated triglycerides, increase the cardiovascular risk. Strategies have emerged to increase the level of HDL-cholesterol to treat cardiovascular disease (Hopkins, 2004).

Principe: The cholesterol concentration of HDL cholesterol is determined enzymatically by cholesterol esterase (CHER) and cholesterol oxidase (CHOD). 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 Δ4-cholestenone and hydrogen peroxide. The color intensity of the blue quinone-imine dye formed is directly proportional to the HDL-cholesterol concentration. It was determined by measuring the increase in absorbance at 583 nm (Wilson & Spiger, 1973).

Hydrolysis: HDL-c esters + H_20 $\xrightarrow{CHER}$ Cholesterol + RCOOH ……. **(1)**

Oxidation: HDL-c + O_2 $\xrightarrow{CHOD}$ Cholest-4-en-3-one + H_2O_2 ……... **(2)**

Oxidation: H_2O_2 +4-AAP +Phenol $\xrightarrow{POD}$ Phenol quinone-imine dye + H_2O …… **(3)**

The color intensity of the blue quinone-imine dye formed at 540nm is directly proportional to the HDL-c cholesterol concentration.

Low density lipoprotein Cholesterol Estimation

Low density lipoprotein cholesterol: - is the cholesterol of LDL play a key role in causing and influencing the progression of atherosclerosis and, in particular, coronary sclerosis. The LDLs are derived from VLDLs (Very Low-density Lipoproteins) rich in triglycerides by the action of various lipolytic enzymes and are synthesized in the liver. The elimination of LDL from plasma takes place mainly by liver parenchymal cells via specific LDL receptors. Elevated LDL concentrations in blood and an increase in their residence time coupled with an increase in the biological modification rate results in the destruction of the endothelial function and a higher LDL-cholesterol uptake in the monocyte/macrophage system as well as by smooth muscle cells in vessel walls. The majority of cholesterol stored in atherosclerotic plaques originates from LDL. The LDL-cholesterol value is the most powerful clinical predictor among all of the single parameters with respect to coronary atherosclerosis (Volz & Riether, 2017).

Principle: -Homogeneous enzymatic colorimetric assay miscellaneous component of LDL-cholesterol is removed by using detergent and cholesterol ester is broken down to free cholesterol and fatty acids by cholesterol esterase. In the presence of oxygen cholesterol is oxidized by cholesterol oxidase to Δ4-cholestenone and hydrogen peroxide. Hydrogen peroxide in the presence of peroxidase reacts with 4- amino antipyrine to produced purple dye which is directly proportional to the concentration of LDL cholesterol measured photometrically at 585nm (Nauck *et al*., 2002).

LDL-Cholesterol esters + H_2O $\xrightarrow[CHER]{Detergent}$ LDL-cholesterol + RCOOH …… **(1)**

CHOD LDL-cholesterol + O_2 $\xrightarrow{CHOD}$ Δ 4 -cholestenone + H_2O_2 ……..... **(2)**

$2H_2O$ + 4-aminoantipyrine + HSDA +H + H_2O $\xrightarrow{Peroxidase}$ Purple Blue pigment + $5H_2O$... **(3)**

4.7 Data quality assurance

For each phase of the study design, data quality control techniques were practiced. the questionnaire was prepared in English version and translated to local language (Tigrigna). Data were collected digitally using personal digital assistants. The data collectors were professional laboratory technologists and nurses under the close supervision of investigators and were trained before data collection. The training sessions covered every detail of the study and the full range of skills involved in the study and addressed the objectives of the study. Blood sample collection was done through standardized, calibrated, and sterile technique. Questionnaire pretest was done prior to the concrete data collection process is being started to check the reliability of the data and to increase the quality of the data. Data collected in personal digital assistants (PDAs) was transferred to central server using internet file streaming system and was exported to Microsoft Excel to personal computer for analysis. The biochemical tests were analyzed on calibrated COBAS C 311 (Rochi-Hitachi, Germany). The tests were done by well trained and experienced professionals with strictly followed standard operating order (SOP). Manual double entry of biochemical tests results of were done to minimize errors.

Table 2 Components and Steps of Variables in Data Collection Used in the Study. Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

Steps	Core	Expanded	Remark
Step1: Behavioral	Basic demographic information, including age, sex, literacy, and highest level of education	Expanded demographic information including years at school, marital status, household income	
	Tobacco use, alcohol consumption, fruit and vegetable consumption, physical activity	Smokeless tobacco use, Past 7 days drinking, oil and fat consumption, History of blood pressure, treatment for raised blood pressure, History of diabetes, treatment for diabetes	

Step2: Physical measurement	Weight and height, waist circumference, blood pressure	Hip circumference	
Step3: Biochemical measurement	Fasting blood sugar and Lipid profile	Total cholesterol, Triglycerides, HDL-cholesterol, LDL-cholesterol	

4.8 Data processing and analysis

Under the supervision of principal investigator (PI) sociodemographic data, anthropometric measurements, and specimen collection were done by data collectors. The filled questionnaires were checked daily for its completeness and error. The specimen was collected, transported and stored according to the guideline and procedure. The suspected poor-quality specimen was rejected automatically. Participants were informed about confidentiality of their information and set up a temporary study clinic selective room in office of zone. Weighing and height scales were supervised, checked and calibrated against a zero reading after every individual measurement by principal investigator. Furthermore, during laboratory analysis, standard operating procedure was followed, and control samples were run.

After data was collected, statistical data analysis was conducted using statistical package for the social science (SPSS) version 25 software. Descriptive data analyses were presented in tables and/or graphs with means, proportions and frequency distributions. Bivariate and multivariate logistic regression analysis were used to determine the potential determinants of risk factors with metabolic syndromes. Chi-Square test was used to analyze the nominal variables. Multiple regression analysis was used to indicate the strength of association with their 95% CI upper and lower limit interval to indicate the significance association or P-value ≤ 0.05 at 95% confidence level was considered to be statistical significance in all analysis.

4.9 Ethical consideration

To conduct the research, ethical approval was obtained from Addis Ababa University, College of Health sciences, School of Medicine, Medical Biochemistry Department ethics and research committee (DRERC) with protocol number M.Sc. SOM/BCHM/04/2012 and meeting number 01/20. Collaboration letter for data collection was also obtained from the Government of the National Regional State Tigray-Bureau of Health (GNRST-BH) with protocol number GNRST-BH /348/1418/12; Aksum University College of Health sciences and Comprehensive Specialized Hospital (AKU/CHS-CSH/CARD) with protocol number AKU /CHS-CSH/3273/12/12, meeting number 014 and Finally, supporter letters was obtained from Government of the National Regional State Tigray, Aksum Town Health Office (GNRST-AKT-HO) with protocol number, GNRST-AKT-HO/198/2012. The objective of the study was briefly clarified and explained for each participant, before enrolling any of the eligible study participant. But when the study participants were illiterate the data collector (PI) read and took the sign or thump impression when they agreed. Sample and data were collected after informed consent had been obtained from the study participant. Confidentiality, anonymity, neutrality, accountability and academic honesty was maintained throughout the study. For example, by using codes. Finally, sample collection and laboratory analysis were performed by trained laboratory technologists along with the principal investigator following ethical steps and procedures

5. RESULTS

Socio-demographic Characteristics

Basic socio-demographic characteristics of the participants are provided in **Table 3** Out of 100 study participants, 50% were males. The Mean ± SD age in year of study participant was (41.160 ± 8.3 year) with the range (30-64) years and 55% were in the age range of 30-39% years and 45% were above 40 years. About 78% study participants attend their education from Primary cycle up to College/University level. Of the population 68 came from urban and 32 from rural areas. The marital status of the participants was 69% married and 31% single. Regarding monthly income of the study participants 41% had a monthly income above 5000 Ethiopian birrs. The religious of participants 90% were orthodox the rest 10% Muslim. Considering occupational status of the study population, 50% were government office workers.

Table 3 Socio-demographic Characteristics of Study Participant Stratified by Sex, Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

Characteristics		**Sex**	
		Male (%)	**Female (%)**
Age of respondent	30-39	23	32
	40-49	12	12
	50-59	14	6
	≥ 60	1	0
Marital status	Married	37	32
	Single	6	10
	Divorced	4	3
	Widowed	2	5
	Other	1	0
Level of educational status	Illiterate	4	2
	Read and write	9	7
	Primary education	13	12
	Secondary education	1	5
	College and above	23	24
Monthly income	1008-2500	1	0
	2501-5000	3	5
	5001-7500	7	9

	7501-9999	8	4
	≥10,000	6	7
Occupation status	House wife	3	15
	Governmental	25	25
	Non-governmental	2	3
	Private	20	7
Religion	Orthodox	47	43
	Muslim	3	7
	Others	0	0
Residence	Rural	21	11
	Urban	29	39

Anthropometry Characteristic of Study Subjects

Regarding SBP, 38% Government office workers and 46% daily laborers had normal value. Whereas with regards to DBP, 45% of daily laborers and 38% Government office workers had values in normal range.

Our result shows that 24% government office workers and 9% daily laborers had raised blood pressure. Among Government office workers of 12% of both sexes and from the daily laborers 6% male and 3% female were hypertensive. Among all the study participants about 6% were underweight, 22% were overweight, and 19% were found to be obese; but out of the total Government office workers 2% were underweight, 16% were overweight and 12% were obese.

The study in **Table 4** also showed that from the total participants 9% Government office workers and 2% of the daily laborers had waist circumference greater than the cut-off value. Regarding waist to hip ratio 8% of Government office workers and 3% of daily Laborers had WHR greater than the cut-off value.

Table 4 Anthropometric Result of Study Participants, Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=1 00).

Parameters	Sex of scale	Standard Value	Study Participants N (%)						Mean ± SD
			Governments			Laborers			
			M (%)	F (%)	T (%)	M (%)	F (%)	T (%)	
BP In (mmHg)	For Both Sex, Systolic	90-130	19	19	38	22	24	46	118.42 ± 12.95
		130-139	3	5	8	1	0	1	
		140-159	3	1	4	2	1	3	
		≥ 170	0	0	0	0	0	0	
	For Both Sex, Diastolic	60-85	19	19	38	22	23	45	78.090 ± 9.012
		85-89	0	1	1	0	0	0	
		90-99	5	3	8	3	2	5	
		≥ 100	1	2	3	0	0	0	
BMI in (Kg/m^2)	For Both Sex	≤ 18.49	1	1	2	2	2	4	24.739 ± 3.885
		18.5-24.4	10	10	20	16	17	33	
		25-29.99	7	9	16	2	4	6	
		≥ 30	7	5	12	4	3	7	
WC in (cm)	For Male only	< 80	3	-	3	9	-	9	84.580 ± 8.698
		80-89	11	-	11	11	-	11	
		90-102	3	-	3	0	-	0	
		≥ 102	8	-	8	2	-	2	
	For Female only	< 70	-	6	6	-	12	12	
		70-79	-	15	15	-	11	11	
		80-87	-	3	3	-	2	2	
		≥ 88	-	1	1	-	0	0	
	For Both Sex		Governments			Laborers		Total	
		< 102	17			23		40	
		< 88	24			25		49	
		Total	41			48		89	
		≥ 102	8			2		40	
		≥ 88	1			0		49	
		Total	9			2		11	
WHR (No unit)	For Male only	< 0.80	1	-	1	5	-	5	0.832 ± 0.061
		0.80-0.84	12	-	12	15	-	15	
		0.85-0.90	6	-	6	3	-	3	
		≥ 0.91	6	-	6	2	-	2	
	For Female only	< 0.75	-	7	7	-	11	11	
		0.75-0.79	-	13	13	-	8	8	
		0.80-0.85	-	3	3	-	5	5	
		≥0.85	-	2	2	-	1	1	
	Both Sex		Governments			Laborers		Total	
		< 0.91	19			23		41	
		< 0.85	23			24		47	
		Total	42			47		89	
		≥ 0.91	6			2		8	
		≥ 0.85	2			1		4	
		Total	8			3		11	

Biochemical Characteristic Fasting blood sugar and Lipid profile of Study Subjects

Among all participants, 18% participants had raised fasting blood glucose i.e., 11% Governments office workers and 7% daily laborers with mean value 97.71 ± 11.97mg/dL; **Table 5** shows 13% of government office workers and 7% daily laborers had high total cholesterol (Mean=159.36 ± 49.26). The study also showed that from the total population, 22% had raised fasting triglyceride; from which 15% were government office workers and 7% of daily laborers with P-value (P= 0.032**) and Mean Value of (140.07 ± 58.57). Nearly 19% of government office workers and 9% of daily laborers had a highly decreased HDL-cholesterol from the normal value with P-value (P= 0.023**) and Mean Value of (58.99 ± 10.74). From the total participants, 26% of governments office workers and 15% of daily laborers had high LDL-c with a mean value 95.82 ± 40.39mg/dL. This classification is based on the modified Criteria of NCEP ATP III.

Table 5 Blood Glucose and Lipid Profiles of Study Participants, Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

Metabolic Syndrome Parameters	Sex of scale	Standard Value	Study Participants N (%)						Mean ± SD
			Governments			Laborers			
			Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)	
FBG in (mg/dL)	Both Sex, Systolic	70-100	19	20	39	21	22	43	97.71 ± 11.97
		100-126	3	5	8	2	2	4	
		≥ 126	3	0	3	2	1	3	
TC in (mg/dL)	Both Sex	≤ 150	11	16	27	13	14	27	159.36 ± 49.26
		150-189	4	3	7	5	7	12	
		190-199	1	2	3	1	3	4	
		200-239	7	2	9	3	1	4	
		≥ 240	2	2	4	3	0	3	
TG in (mg/dL)	Both Sex	≤ 150	15	13	28	17	18	35	140.07 ± 58.57
		150-199	6	9	15	6	4	10	
		200-499	4	3	7	2	3	5	
		≥ 500	0	0	0	0	0	0	
LDL-c in (mg/dL)	Both Sex	< 100	13	11	24	17	18	35	95.82 ± 40.39
		100-129	3	7	10	4	3	7	
		135-159	7	5	12	2	3	5	
		≥ 160	2	2	4	2	1	3	
HDL-c in (mg/dL)	For Male only	<35	3	-	3	1	-	1	58.99 ± 10.74
		35-39	8	-	8	4	-	4	
		40-50	5	-	5	7	-	7	
		≥ 50	9	-	9	13	-	13	

	For Female only	< 45	-	2	2	-	2	2
		45-49	-	6	6	-	2	2
		50-60	-	10	10	-	8	8
		≥ 60	-	7	7	-	13	13
	Both Sex		**Governments**			**Laborers**		**Total**
		≥ 40	14			20		45
		≥ 50	17			21		44
		Total	31			41		72
		< 40	11			5		5
		< 50	8			4		6
		Total	19			9		28

Behavioral characteristics of participants

At the time of our study, there were no active smokers among the study participants, whereas 4% were previous smokers. The previous smokers at the time of study were found to be male government office workers. Similarly, the study also indicated that 39% of daily laborers and 42% of government office workers consumed alcohol, of which 44% were males. The proportion of study participants who consumed alcohol above three or more days per week was 35% government office workers and 16% daily laborers.

The present study in **Table 6** also revealed that from the total participants 62% were involved in vigorous-intensity activity (32% Male). From the total population daily Laborers were 43% and government office workers were 19%. Among the participants 17% of government office workers and 50% of daily laborers involved in moderate-intensity activity. Of the 100 participants, 33% government office workers and 50% daily laborers walk for at least 40 minutes daily (39% female). Finally, the study showed that 81% of study participant i.e., 31% government office workers and 50% of daily laborer's walk for at least 40 minutes per week. About 17% government office workers did not meet WHO recommendation on physical activity for health. Female study participants better met WHO recommendation of physical activity for health.

Table 6 Behavioral characteristics of Study Participants, Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

Risk Factors for Metabolic Syndrome	Scales	Study Participants N (%)					
		Government			Laborers		
		M (%)	F (%)	T (%)	M (%)	F (%)	T (%)
Do you ever smoke any tobacco	Yes	4	0	4	0	0	0
	No	21	25	46	25	25	50
Do you currently smoke any tobacco products	Yes	0	0	0	0	0	0
	No	25	25	50	25	25	50
Have you ever consumed an alcoholic drink?	Yes	23	19	42	21	18	39
	No	2	6	8	4	7	11
How frequently you had an alcoholic drink?	Daily	1	1	2	2	0	2
	5-6 Day	9	5	14	1	0	1
	1-4 Day	7	6	13	1	3	4
	1-3 Day	4	2	6	5	4	9
	<1 Day	2	5	7	12	11	23
	None	2	6	8	4	7	11
Does your work involve vigorous-intensity activity?	Yes	9	6	15	23	20	43
	No	16	19	35	2	5	7
Does your work involve moderate-intensity activity	Yes	10	7	17	25	25	50
	No	15	18	33	0	0	0
Do you walk for at least 40 minutes daily?	Yes	17	14	31	25	25	50
	No	8	11	19	0	0	0
Per week, how many days do you walk for at least 40 minutes?	Yes	16	17	33	25	25	50
	No	9	8	17	0	0	0

Dietary Life of the participant

Among the government office workers 6% consumed olive oil,7% Fruits, 20% vegetable with salad, 36% Legumes, 9% Fish, 19% Wine, 42% Meat and 37% White bread for three or more days per week. **Table 7** Daily laborers consumed 1% olive oil, 41% Fruits, 38% vegetable with salad, 45% Legumes, 4% Fish, 4% Wine, 20% Meat and 23% White bread three or more days per week.

Table 7 Dietary Life of the Study Participants, Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

How often do you consume?	Scales	Study Participants N (%)					
		Governments			Laborers		
		M (%)	F (%)	T (%)	M (%)	F (%)	T (%)
Olive oil (≥ 1 spoon/day)	Always	1	1	2	0	0	0
	Often	2	2	4	1	0	1
	Rarely	7	20	27	2	1	3
	Unknown	15	2	17	22	24	46
Fruit (≥ 1serving/day)	Always	2	2	4	12	13	25
	Often	2	1	3	8	8	16
	Rarely	17	21	38	4	3	7
	Unknown	4	1	5	1	1	2
Vegetables or salad (Z1 serving/day)	Always	4	4	8	9	11	20
	Often	5	7	12	10	8	18
	Rarely	15	12	27	5	4	9
	Unknown	2	1	3	1	2	3
Fruit(≥1serving/day) and vegetables (Z1 serving/day)	Always	3	4	7	11	11	22
	Often	6	7	13	7	9	16
	Rarely	14	12	25	6	3	9
	Unknown	2	2	4	1	2	3
Legumes (≥2 servings/week)	Always	8	15	23	15	14	29
	Often	9	4	13	7	9	16
	Rarely	5	5	10	2	2	4
	Unknown	3	1	4	1	0	1
Fish (≥ 3servings/week)	Always	3	1	4	1	0	1
	Often	3	2	5	2	1	3
	Rarely	11	21	32	19	4	23
	Unknown	5	1	6	3	20	23
Wine (≥ 1glass/day	Always	4	3	7	0	1	1
	Often	7	5	12	2	1	3
	Rarely	5	15	20	21	7	28
	Unknown	9	2	11	2	16	18
Meat (<1serving/day)	Always	13	11	24	4	4	8
	Often	9	9	18	7	5	12
	Rarely	2	4	6	13	14	27
	Unknown	1	1	2	1	2	3
White bread (<1/day) and rice (<1/week)] or whole-grain bread (>5/week	Always	8	13	21	5	4	9
	Often	11	5	16	8	6	14
	Rarely	5	6	11	11	13	24
	Unknown	1	1	2	1	2	3

Dietary Habit and Life of Cooking Oil

Regarding use of cooking oil by government office workers 5% used Olivas's oil, 19% Vegetarian Oil, 36% solid fat, 40% Butter, 22% Homemade oil, 10% Margarine, 9% Other oil and 4% Unknown oil for three or more days per a week; while **Table 8** in the case of daily Laborers 24% used Vegetarian Oil, 14% solid fat, 12% Butter, 37% Homemade oil, 3% Margarine, 20% Other oil and 15% Unknown oil for three or more days per a week.

Table 8 Dietary Habit and Life of Cooking Oil Utilization in House of Study Participant in Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

How Do you often Utilize?	Scales	Study Participants N (%)					
		Governments			Laborers		
		M (%)	F (%)	T (%)	M (%)	F (%)	T (%)
Olivas Oil	Always	1	1	2	0	0	0
	Often	2	1	3	0	0	0
	Rarely	2	3	5	7	6	13
	Unknown	20	20	40	18	19	37
Vegetarian Oil	Always	4	4	8	5	4	9
	Often	7	4	11	8	7	15
	Rarely	13	15	28	10	12	22
	Unknown	1	2	3	2	2	4
Solid Fat	Always	10	11	21	2	1	3
	Often	9	6	15	6	5	11
	Rarely	5	6	11	14	16	30
	Unknown	1	2	5	3	3	6
Butter	Always	12	14	26	2	1	3
	Often	9	5	14	5	4	9
	Rarely	2	4	6	13	19	32
	Unknown	2	2	4	5	1	6
Homemade oil	Always	2	5	7	11	13	24
	Often	8	7	15	8	5	13
	Rarely	12	11	23	4	6	10
	Unknown	3	2	5	1	1	2
Margarine	Always	2	1	3	1	0	1
	Often	5	2	7	1	1	2
	Rarely	10	19	29	10	16	26
	Unknown	8	3	11	13	8	21
Other Oil	Always	1	2	3	3	4	7
	Often	3	3	6	6	7	13
	Rarely	19	18	37	14	13	27
	Unknown	2	2	4	2	1	3
Unknown	Always	2	0	2	5	3	8
	Often	2	0	2	4	3	7
	Rarely	17	10	27	13	16	29
	Unknown	4	15	19	3	3	6

Measurement of Dietary Habit Life

When means of behavioral measurement of dietary life were observed, out of 100 participants above 41% government office workers and below 7% of daily laborers continuously ate fat meat and carbohydrate respectively. Regarding health diet in **Figure 3** both groups scored below 12% from the total participant of the study

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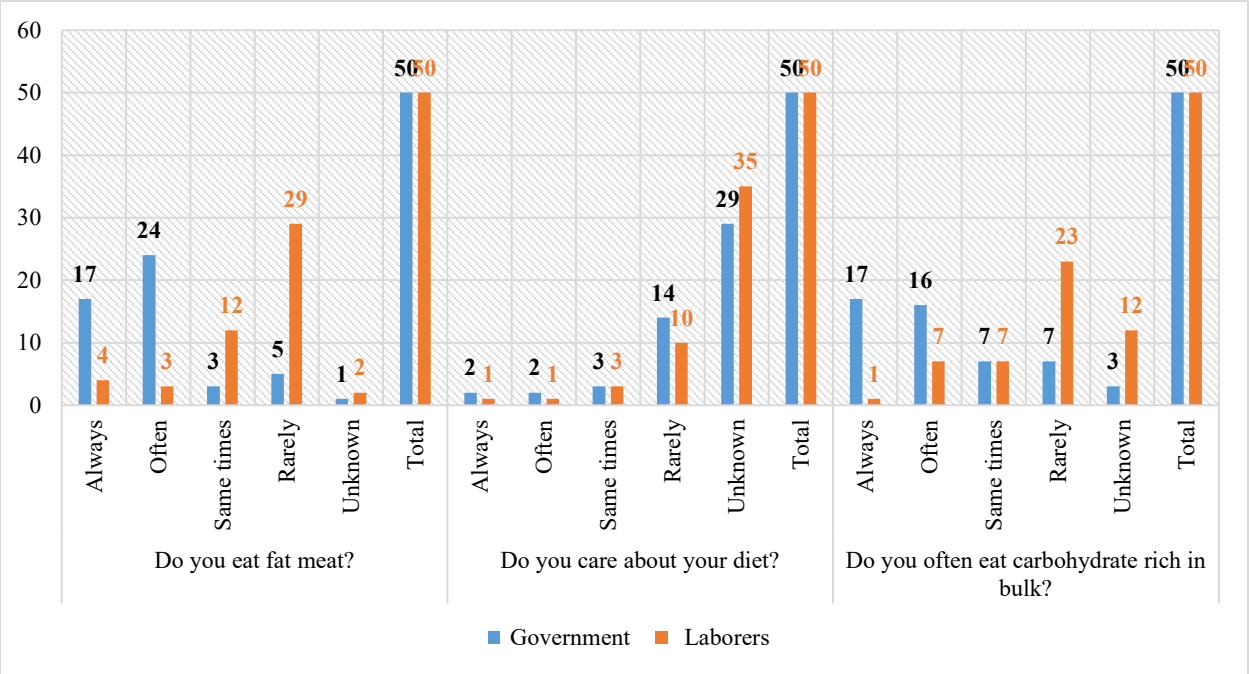

Figure 3: Dietary Habit and Life of Study Participants, Aksum Town, Centra Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

Categorical Values of FBG, lipid profile and Anthropometry parameters of Study participants

Out of the total 100 participants 18% had raised fasting blood glucose. Regarding lipid profile, 17%, 37%, 12% and 41% had raised TC, TG, HDL-c and LDL-c level respectively with serious dyslipidemia; **Figure 4** With regard to anthropometric measurements 47%, 13%, 19%, 16% and 17% of the study participant had above base value of BMI, WC, WHR, SBP and DBP respectively.

When comparing the two groups, among government office workers, 11%, 13%, 22% ,8%, 26%, 30%, 9%, 15%, 12% and 13% had abnormal range FBG, TC, TG, HDL-c, LDL-c, BMI, WC, WHR, SBP and DBP respectively according to NCETP- ATP III guide line.

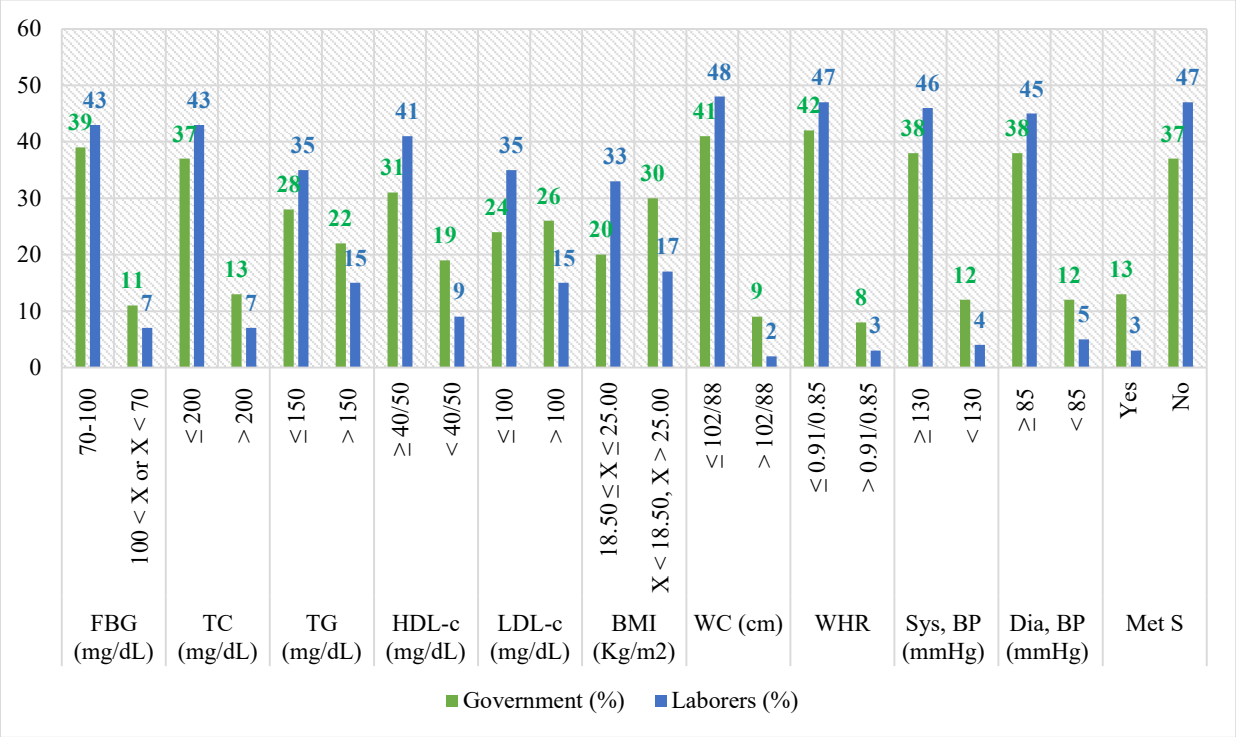

Figure 4: The Categorical Value of FBG, Lipid profile & Anthropometric of Study Participants, Aksum Town, Central Zone, Tigray Region, Ethiopia, August,2021(N=100).

Physical, Biological, Clinical and Behavioral Characteristics of Study Participants

Our study showed that, from the total participants the prevalence of hypertension, central obesity hyperglycemia and dyslipidemia were 16% systolic blood pressure (SBP, P=0.029), 17% Diastolic Blood pressure (DBP, P=0.037), 47% body mass index (BMI, P=0.009), 11% waist circumference (WC, P=0.025) and 11% waist circumference to hip ratio (WHR, P=0.021) and 18% Fasting blood glucose (FBG, P=0.298). Each lipid profile components were averagely above 10% out of the normal range with p-values of (TC= 0.362, TG= 0.172, HDL-c= 0.023 & LDL-c= 0.105) respectively. The P-Value, our data FBG, TC and LDL-c insignificant, while TG, HDL-c from the lipid profile and (BP, WC and BMI) from anthropometric measurements are significantly to

different statistical gap among greater number of government office workers more exposed to the risk of metabolic syndrome compared daily laborers.

Table 9 shows that more than 24% of hypertensives are government office workers. Almost 30% of the government office workers had abnormal BMI. From the total participants 18% had elevated Fasting blood glucose of which 11% were government office workers. One fifth (20%) of the total participants had elevated total cholesterol of which 13% were government office workers. From the total population 37% had hyper triglyceride of which 15% were daily laborers. Among the total participants 28% had decreased HDL of which 19% were government office workers. 26% of government office workers and 15% of daily laborers 15% had highly increased LDL-c.

When compared statistical data among the two group of workers our study, anthropometric values,17%, 2%, 3%, 4%, and 5% of daily laborers had abnormal range of BMI, WC, WHR, SBP and DBP respectively compared to government office workers. Meanwhile, of the government office workers 11%, 13%, 22%, 19% and 24% had abnormal range of FBG, TC, TG, HDL-c, and LDL-c level respectively compared to daily laborers. There were statically significant parametric differences between the two groups regarding BMI, WC, WHR, HDL, DBP and SBP. But there were nonsignificant differences in other vales like WHR, FBG, TC, TG and LDL-c.

The proportion of smokers at the time of study were 4% of government office workers and zero percent of daily laborers with (P-value, 0.041) significantly and alcohol consumption 42% of government office workers and 39% daily laborers (P=0.444) insignificantly.

This study also shows that, vigorous and moderate level physical activity of government office worker was only 15 % and 17 %, which is very low as compared to daily laborers which is 43% and 50% respectively. The difference was statistically status significant (p=0.001).

The proportion of the Behavioral Dietary life of study participant in **Table 9** fruit, salad and vegetable consumed by government office workers were only 23% and daily laborer were 41% (P=0.001). From the total participant 5% government office workers consumed olives and vegetable oil (P=0.022). The consumption of solid fat and butter was 38% government office workers and 13% daily laborers. Homemade and other oil intake government office workers were 28% and daily laborer were 31% for three or more days per a week statically significance with

(P=0.001). Out of, daily laborers were 7% and government office workers were 41% eaten fat meat for three or more days per a week with statically significance (P=0.001), while both workers were above 59% was not eaten carbohydrate for three or more days per a week (P=0.001). from the total participant only 16% care full (94% care less) about a type of dietary food statically insignificance with (P=0.218).

Table 9. Physical, Biological, Clinical and Behavioral Characteristics of Study Participants Aksum Town, Central Zone, Tigray Region, Ethiopia, August, 2021 (N=100).

S/N	Characteristics	Standard Value	Participants of Work Place			X^2	P-Value
			G (%)	L (%)	T (%)		
1	Sex	Male	25	25	50	0.001	0.579
		Female	25	25	50		
2	Age	30-39	23	32	55	4.773	0.189
		40-49	15	9	24		
		50-59	12	8	20		
		≥ 60	0	1	1		
3	Residents	Rural	21	11	32	47.059	0.001**
		Urban	29	39	68		
4	Monthly Income	1,008-2,500	1	0	1	100.00	0.001**
		2,501-5,000	3	5	8		
		5,001-7,500	7	9	16		
		7,501-9,999	8	4	12		
		≥ 10,000	6	7	13		
5	Do you ever smoke	Yes	4	0	4	4.167	0.041**
		No	46	50	96		
6	Alcohol Drinking Status of Respondent	Yes	42	39	81	0.585	0.444
		No	8	11	19		
7	Do you make Vigorous Physical activity level	Yes	15	43	58	23.457	0.001**
		No	35	7	42		
8	Do you make Moderate Physical activity level	Yes	17	50	67	82.667	0.001**
		No	33	0	33		
9	Do you Work involve Vigorous	Yes	19	40	59	18.231	0.001**
		No	31	10	41		
10	Do you Work involve Moderate	Yes	12	50	62	61.290	0.001**
		No	38	0	38		

11	Days of fruit, salad & Vegetable Intake per Week	≥ 3	23	41	64	16.420	0.001**
		< 3	27	9	36		
12	Olivas and Vegetable oil intake per week	≥ 3	12	12	24	5.263	0.022**
		< 3	38	38	76		
13	Solid fat and Butter intake per week	≥ 3	38	12	50	19.360	0.001**
		< 3	12	38	50		
14	Homemade and Other oil intake per week	≥ 3	11	20	31	4.96	0.026**
		< 3	39	30	69		
15	Days of Eat fat meat intake per week	Yes	41	4	45	26.813	0.001**
		No	9	47	55		
16	Days of eat Carbohydrate's intake per week	Yes	33	8	41	25.253	0.001**
		No	17	42	59		
17	The care full about daily diet	Yes	4	2	6	1.515	0.218
		No	46	48	94		
18	FBG in (mg/dL)	70-100	39	43	82	1.084	0.298
		100 < X < 70	11	7	18		
19	TC in (mg/dL)	≤ 200	37	43	80	0.832	0.362
		> 200	13	7	20		
20	TG in (mg/dL)	≤ 150	28	35	63	1.871	0.032**
		> 150	22	15	37		
21	HDL-c in (mg/dL)	≥ 40/50	31	41	72	5.198	0.023**
		< 40/50	19	9	28		
22	LDL-c in (mg/dL)	≤ 100	24	35	59	2.627	0.105
		> 100	26	15	41		
23	Total average dyslipidemia based on NCEP ATPII	≤ Two Factor	43	47	90	1.778	0.182
		> Two Factor	7	3	10		
24	BMI/Central obesity in (Kg/m^2)	18.5 ≤ X ≤ 25.0	20	33	53	6.784	0.009**
		18.50 >X > 25.00	30	17	47		
25	Waist Circumference in (cm)	< 102/88	41	48	89	5.005	0.025**
		≥ 102/88	9	2	11		
26	Hip to Waist ratio (No Unit)	≤ 0.91/0.85	42	47	89	2.554	0.110
		> 0.91/0.85	8	3	11		
27	Blood Pressure in (mmHg)	Systolic ≤ 130	38	46	84	4.762	0.029**
		Systolic > 130	12	4	16		
		Diastolic ≤ 85	38	45	83	4.336	0.037**
		Diastolic > 85	12	5	17		
28	Metabolic Syndrome	Yes	13	3	16	5.741	0.017**
		No	37	47	84		

*G=Government office workers, L= Dily laborers, T= Total, ** = significant (p <0.05*

6. DISCUSSION

A cross sectional study was conducted to assess the prevalence and associated factors among government office workers and daily laborers in Aksum town using the NCEP ATP III criteria. In this study, 16% (13% government office workers and 3% daily laborers) of participant had metabolic syndrome. Metabolic syndrome, defined as high blood pressure, increased blood glucose and triglyceride levels, decreased high-density lipoproteins, and abdominal obesity, contributes to the development of cardiovascular disease, stroke, and diabetes mellitus (Ford, 2005). However, absence of a uniform diagnostic criterion makes comparison between different study populations very difficult. Metabolic syndrome is a cluster of atherogenic risk factors that each one and in combination increase proportionally the risk for developing cardiovascular disease, stroke, and diabetes mellitus (Mozundar & Liguori, 2011). Generally, The prevalence of metabolic syndrome based on Adult Treatment Panel III (ATP III) criteria, varies from 7% to 58% from place to place (Martí, 2016).

The prevalence of metabolic syndrome results in this study is similar to reports from EPHI (16.7%) (Ababa, 2018), West Gojjam (17.3%) (Walle *et al*., 2021), working adults in Addis Ababa bank workers and teachers in Ethiopia (17.9%) (Gelaye *et al*., 2011), and Jimma town (16.7%) (Rajesh *et al*., 2016). But the current estimate was also higher than the prevalence estimated in Ghana (12.4%) (Ofori-Asenso *et al*., 2017), Philippine (11.9%) (Ranasinghe *et al*., 2017), and the global estimate (20–25%) (Kerie et al., 2019) and in Africa the prevalence of metabolic syndrome ranges from 17% to 25% (Okafor, 2012). The findings were also lower as compared to Madagascar (27.7%) (Kingue *et al*., 2017), South Asia (29.8%) (Aryal & Wasti, 2016), Eastern Ethiopia (20.1%), (Motuma *et al*., 2020), Mekelle (39%) (Gebremariam *et al.*, 2018), Greek (43.4%) (Athyros *et al*., 2010), and Nepal (52.7%) (Maharjan *et al*., 2013). The observed difference would be due to the variation in frequency of the components of metabolic syndrome around the globe; different factors such as urbanization, westernization of lifestyle including unhealthy diet and physical inactivity; bad habit; distribution of population age and sex (Kubota *et al*., 2017), It is also worth noting that the comparison is based on point estimate which may not reflect the true prevalence in the respective population with 95% level of confidence.

Socio-demographic characteristics of the study population

The study subjects' age was recorded based on their response and categorized into 30–39 years, 40–49 years, 50–59 years greater than 60 years of age groups based on WHO STEP wise (Werfalli *et al.,* 2016). The mean age of the participants 41 ± 8.31 years. The age ranges from 30-64 years for both workers of male and female; 45% of the participant were above the age of 39 with no significant difference across gender. This is in the line with the previous studies done both in developed and developing country which consistently reported that age associated with metabolic syndrome (Kuk & Ardern, 2010). The prevalence metabolic syndrome was highly age-dependent, this was evident especially with a sevenfold increase in prevalence metabolic syndrome from age group 20–29 years and above (Kâ *et al.,* 2018). Other studies also demonstrated that the risk of Met S increased as age increased (Walle *et al*., 2021). Sixty-nine percent of the study participants were married. The educational status which reflects about the lifestyle of the participant 47% were college and above graduate. When compare our study participant to other studies done in Ethiopia, larger sample size was used by (Tran *et al.*, 2011). Among working adults in Addis Ababa (n=1935) (Gebremariam *et al*., 2018). Among public employees in northern Ethiopia Mekelle town (n=1380), in West Gojjam (n=627) (Walle *et al.*, 2021). Our study was done in one town four office-based participants scope minimize to attain for quality data/information to attains the study while other studies was from different public institutions and residents in nearby the study area.

Anthropometric characteristics of the study population

The results revealed that obesity is much prevalent in the general population, obesity based on BMI, 6% were underweight, 22 % were overweight and 19% were obese (P= 0.009). This finding was higher than the result of the research conducted in Mekelle (4.1% obese and 26% overweight) and Northwest Ethiopia Jimma obese 5.1% and overweight 10.4% and EPHI, 44%. This makes the participants may be more vulnerable to metabolic syndrome, (Gebreyes *et al*., 2018), (Gebremariam *et al.*, 2018) and (Rajesh *et al.*, 2016). The mean BMI of the study population among government office workers and daily laborers was estimated to be 23.73±3.88 and there was no significant difference between men and women. The possible explanation for higher prevalence of overweight/obesity in our study may be due to the difference in physical activity, sample size, sedentary behavior and lifestyle.

Waist circumference is a measure of abdominal obesity and is one of the components of metabolic syndrome for NCEP ATP-III criteria. The mean WC of the study population was found to be 84.58 ± 8.69cm. There observed a significant difference in the mean WC existed between governments office workers and daily laborers (P=0.025**), women and men (P=0.028**), This could be one of the reasons for the higher prevalence of metabolic syndrome among female government office workers compared to male daily laborers in all age categories.

Waist-to-hip ratio has been used as a proxy measure for body fat distribution when investigating the health effects of fat distribution and the health risk increased with increasing ratio (Bigaard *et al*., 2004). Hypertension was the most seen criteria of metabolic syndrome among adult China and the United States (Zuo *et al.*, 2009). In this study hypertension the second most common criteria for metabolic syndrome of government office workers were 24% (12% SBP and 12% DBP) and daily workers were 9% (4% SBP and 5% DBP). Government office workers Mean value systolic and diastolic blood pressure were 118.42 ± 12.95 and 78.09 ± 9.01 respectively, but there was statistical significance among governments office worker and daily laborers (SBP, P=0.029; DBP, P=0.037) whereas the report from earlier studies was lower than the current study finding (Gebreegziabiher *et al.*, 2021). Prevalence of metabolic syndrome risk factors like SBP and DBP in our study are comparable with the study conducted (Walle *et al.*, 2021). The government office workers more twice hypertensive than daily laborers (SBP, P= 0.062 and DBP, P=0.078) so governments office worker are two-fold exposed to metabolic syndrome than daily laborers (Thorp *et al.*, 2012). Occupation types have been shown to affect the frequency of metabolic syndrome (Davila *et al.,* 2009). Ethiopia, showed hypertension was more prevalent in the urban than rural dwellers with rates of 32.7% and 12.9% respectively (Gebreyes *et al.*, 2018)

Biochemical characteristics of the study population

The most common metabolic syndrome component was reduced high-density lipoprotein cholesterol (HDL-c), followed by elevated blood pressure and elevated fasting glucose which is similar with the study in Jimma where hypertension, hyperglycemia, and low HDL-cholesterol are predominant components of metabolic syndrome but the rate of low-density lipoprotein is higher in this study which can be explained by high rate of abdominal obesity and overweight (Press, 2016).

The most prevalent dyslipidemia was lower HDL-cholesterol. Reduced HDL-c levels 28% were a common occurrence in our study participants next to central obesity 47% based on NCEP ATP III metabolic syndrome criteria. The prevalence of low HDL-c in our study was in line with study done among rural Southwestern Nigerian population (43.1%) (Martínez-Torres *et al*., 2017) and with study done among Saudi University employees (Amin *et al*., 2014). Decreased serum HDL-c level is a direct determinant factor and statistically significant (P= 0.023) the risk of metabolic syndrome. the mean HDL-c (58.99±10.72 mg/dL). This has an implication of adverse health effects in which low level of HDL in the body is associated with an increased risk of CVD, coronary heart diseases and death (Callaghan *et al*., 2011).

On the contrary higher prevalence of low HDL was observed in Ethiopian national survey 2015 (68%) and among public employees in northern Ethiopia (71.3%) (Tesfanchal *et al.*, 2020) & (Gebreyes *et al*., 2018). These results revealed that 19% of government office workers are more prone to develop metabolic syndrome compared to daily laborers having the frequency value 9% of the study. Low HDL-c level should be advised exercise regularly and treated with a low fat and low cholesterol diet.

Increased fasting blood glucose (FBG) concentration is a direct determinant of the so-called Met S according to NCEP ATP III criteria. The mean FBG of the study population was found to be 97.19±14.41 and therefor it was a highly dependent determinant of metabolic syndrome by NCEP ATP- III definition. Among the government office workers and daily laborers were 11% and 7% had value above the normal range respectively. However, the difference was not statically (P=0.444). popular

These findings provide further evidence that elevated blood glucose is associated with the incidence of several types of chronic diseases as well as metabolic syndromes (Nath *et al.,* 2005) Hyperglycemia may increase different chronic diseases and positive relationship between like cancer, diabetes Meletus, urinary tract infections, and a cystitis, has been reported (La Vecchia *et al*., 1991). The prevalence reported here 18% Fasting plasma glucose level, and 26% triglyceride component of metabolic syndrome were higher in government office workers compared to daily laborers; however, This work is in line with a study reported in Nigeria (Ayogu *et al*., 2019).

Raised serum TG (26%) with mean 140.06 ± 58.75mg/dl status observed in this study, is a cause for worry of metabolic syndrome and higher than 16.0% observed by (Cassani *et al*., 2009) among Brazilian industry workers and 32.8% reported by (Awosan & Ibrahim, 2013) among civil servants in Northern Nigeria. Obesity (both general and abdominal) contributes to hypertension, high serum cholesterol, hyperglycemia, and low HDL-c and is independently associated with higher risk of metabolic syndrome (Nonato & Minussi, 2016).

Above 15% of government office workers had abnormal total cholesterol, triglycerides or HDL-cholesterol levels in line with the reported (Alavi *et al*., 2015). Government office workers had 16% and daily laborers were 10% hypertriglyceridemia, this indicates that government's office workers are more exposed to risk of metabolic syndrome than daily laborers. There was found a significant difference in the mean TG level government office workers and daily laborers of the study population (P=0.032) in line with the study reported by (Strauß *et al.,* 2016).

The higher prevalence among government office workers may be attributed to lesser working hours because (Nakanishi *et al.*, 2001). Showed that the concentration of TG was lower among those who worked 9.0 hours a day or more than among those who worked < 9.0 hours a day (P = 0.031), daily laborers had more hours of work than government office workers (Yamaguchi *et al.*, 2018) also reported that higher job demands (in intensity and duration) were significantly associated with a lower risk of metabolic syndrome. This may be a result of energy expenditure associated with work. Serum Total cholesterol concentration is not a component of metabolic syndrome, but as it is having direct relation with serum HDL cholesterol level and therefore, it also can be considered as an indirect determinant. The mean total cholesterol level of the study population was 159.35±49.26 and it was more than the clinically accepted normal range of serum total cholesterol (≤ 200 mg /dL) and is a very serious risk factor for the development of metabolic syndrome. Of the total participant 20% had hypercholesterolemia and above 13% of government office workers were hypercholesterolemia.

Serum LDL cholesterol (LDL-c) concentration should be less than 100 mg /dL according to the general diagnostic criteria, but is not a direct determinant of metabolic syndrome as HDL-c. In the study population the mean LDL-c level was estimated as 95.82±40.39 indicating that the LDL- c level for government office workers had higher level compared to daily laborers were 26% and

15% respectively. There was no significant difference in the mean LDL-c level between government and daily laborers of the study population was insignificance (P=0.105).

Based on several studies, metabolic syndrome are closely related/associated to chronic kidney disease, obstructive sleep apnea syndrome, cerebral atrophy, which may trigger depression and cognitive impairment, hormonal imbalance (Alavi *et al*., 2015), to cardiovascular risk factors or diabetes, including abdominal obesity, triglyceride levels, total cholesterol (TC) high-density lipoprotein (HDL-c) cholesterol levels, low-density lipoprotein (LDL-c) cholesterol levels , and fasting plasma glucose levels (Akintunde & Oloyede, 2016).

Life style characteristic of the study population

About 96% of the study participants are currently non-smokers. Only 4% of government office workers were cigarette smokers (P=0.041). From the total study above two-thirds drank alcohol, and of these, 41% of Government office workers and 39% daily laborers consumed alcohol as the prominent lifestyle (P=0.444). Alcohol consumption was observed to be almost similar in both groups Thus, unhealthy lifestyles such as smoking and drinking are closely related to the risk factors for metabolic syndrome (Ryu *et al.*, 2016). From the total population were 58% and government office workers were 15% engaged in vigorous physical activities meanwhile fifty percent of daily laborers and 12% of government office worker participants are engaged in modern physical activities (P=0.001). Individuals with physical activities 53% showed less risk for metabolic syndrome than those who didn't do physical activities (Katzmarzyk & Herman, 2007). Supporting this finding, other studies showed that doing moderate and vigorous intensity of physical activity decreases the occurrence of metabolic syndrome (Walle *et al.*, 2021). A study conducted among working adults in Addis Ababa, Ethiopia reported that men who engaged in higher physical activity showed less the occurrence of metabolic syndrome 44% compared to those engaged in a low level of physical activity (Workalemahu *et al*., 2013). Another study conducted in Southwest Ethiopia reported that being physically inactive increases the chance of developing Met S by 2.61 times (Kerie *et al*., 2019). Government office workers usually lapse their time setting with less physical activity and lead sedentary lives. Sedentary life is the most prominent and independent factors of metabolic syndrome (Assah *et al*., 2011).

To our knowledge, this is the first study to examine the association between metabolic syndrome and lifestyle behaviors related to type of work, diet in Aksum Town, Tigray.

Our study also revealed that more than half 64% of study participants ate fruits, vegetable and salad three or more days a week, out of those 41% were daily laborers and Government office worker were 23% (P=0.001), according to the study conducted by (Gebremariam *et al*., 2018), in northern Ethiopia, Mekelle which was (0.3%). In this study participants who consume fruits and vegetables sufficiently had a lower prevalence of metabolic syndrome, as previously reported in Ethiopia (Gebremeskel *et al.*, 2019). Fruits and vegetables consumption provides dietary fiber and other essential nutrients that lower the risk of metabolic syndrome (Wube *et al.*, 2019). An inverse association between prevalent metabolic syndrome and intakes of fruit and vegetables has been reported previously (Lohsoonthorn *et al*., 2007). Consumption of diets high in fruit and vegetables has been associated with lower blood pressure and a better lipid profile (Tian *et al*., 2018). Among the population only 81% and daily laborer 45% consumed Legumes three or more days a week.

In this study red meat was eaten regularly by about 41% of government office workers and 4% of daily laborers. Red meat has been linked to increased risk of metabolic syndrome so participants could be advised to eat red meat in moderation. Evidence also supports the idea that a diet that's high in red meat and processed meats can raise metabolic syndrome (Zeraatkar *et al.,* 2019). White meat is high in saturated fat, which has been adversely associated with cholesterol, blood pressure, obesity and diabetes finally to the risk of metabolic syndrome (Appel *et al*., 2006). The continuity of meat intake per week by government office workers had 42% and daily laborers were 20% consumed three or more days per week (P= 0.001). Dietary patterns heavily loaded with red meat are positively associated with the likelihood of having metabolic syndrome (Panagiotakos *et al*., 2007). According to the food intake variable, from the total population 23% were daily laborers and 37% of government's office workers used white bread/rice/whole-grain bread as food three or more days a week. In terms of carbohydrate intake, government workers were 33% and there were fewer 8% daily laborers with metabolic syndrome in the excess carbohydrate group compared with 84 participants who did not suffer from metabolic syndrome (P= 0.001). There was a relationship between carbohydrate intake and metabolic syndrome in government respondents. Studies have shown that a "Western diet" pattern (characterized by high intakes of refined grains, red meat, high fat and high-fat dairy products,) is associated with increased risk of obesity, hypertension, insulin

resistance, and dyslipidemia, which are all components of metabolic syndrome (Mandob, 2017). The care full about daily diet, from the total only 6% participant involved, out of them 4% were government workers and 2% were daily laborers care full the rest was not care about food. Prevalent metabolic syndrome has previously been positively associated with consumption of Western (Esmaillzadeh *et al.*, 2007) and empty-calorie dietary (Lutsey *et al.*, 2008) patterns and inversely associated with consumption of a healthy dietary pattern (Esmaillzadeh *et al*., 2007).

Government office workers used 12% Olivas and vegetarian, 38% solid fat and butter, 11% homemade and other oil as compared to daily laborers had consumed solid fat and butter were 12%, homemade and other oil were 20% for three and more days per week with significance P-Value (P=0.001). The type of oil used for cooking is also found to be a factor which is significantly associated with metabolic syndrome. Using butter for food preparation increases the chance of developing metabolic syndrome as compared with those who use vegetable oil which is liquid at room temperature. High fat intake has been associated with greater risk of metabolic syndrome, similar to the current study, the finding of a study conducted in north Ethiopia showed significant association between the type of oil used for cooking food and metabolic syndrome. It is obvious that butter is an animal product which is rich in saturated fatty acid and risk for chronic diseases (Walle *et al.*, 2021) while oils which are liquid at room temperature are known to be mono saturated fatty acids and have lower risk of chronic diseases (Chowdhury *et al.*, 1970).

A review study has indicated that Mediterranean diet as a healthy diet rich in olive oil, fruits, vegetables, legumes, whole grains and fish reduced risk of metabolic syndrome (Esposito *et al*., 2013). There is evidence, a western pattern is characterized by high consumption sweet beverage, red and processed meat, hydrogenate fat, and sugar and low consumption of fruit, vegetables, fish and other healthy food was associated with increased components of metabolic syndrome (Amini *et al*., 2010).

The prevalence of metabolic syndrome in this study was (16%), 13% of government office workers and 3% daily laborers had a higher comparable with (20.3%) among German firefighters and office workers reported by (StrauB *et al.*, 2016).

7. CONCLUSIONS

In the current study high prevalence of metabolic syndrome is observed. Age, occupation, physical activity and type of oil used for cooking were significantly associated with metabolic syndrome. Therefore, there is a need for designing an intervention which focuses on promoting a healthy lifestyle like physical activity and using oils which are liquid at room temperature for cooking to prevent the risk of major metabolic syndrome.

It is possible to conclude the following the prevalence of metabolic syndrome was found to be high; hypertension, central obesity and followed by dyslipidemia were the most frequent components of metabolic syndrome. To prevent metabolic syndrome, we need to develop strategic plans to help government office workers to increase their regular leisure time, physical activity and develop a habit of eating fruits and vegetables.

This study also identified a correlation between excessive sitting-time (sedentary occupation) and increased risk of metabolic syndrome. Among the occupational categories government office workers are at an increased risk of getting affected with metabolic syndrome. Blood pressure, total cholesterol, low density lipoprotein and triglyceride was observed to increase with increase in age in the study population but, higher density lipoprotein cholesterol level decreased with age.

8. RECOMMENDATIONS

The following recommendations are suggested to further investigate and evaluate metabolic syndrome among workers

- Further studies could be conducted with larger sample size and incorporating sample as well as using more robust study design such as case control and cohort to establish the causality of the association between (anthropometric measurement & lipid profile) and metabolic syndrome of government office workers as well as daily laborers.
- Interventions need to be designed to address modifiable risk factors. Modifying the lifestyle like limiting consumption of alcohol, avoiding tobacco use, and avoiding cigarettes while promoting fruit and vegetable intake and increasing efforts to physical activity will be important components in preventing and controlling metabolic syndrome.
- Bringing awareness on health risks of behavioral factors and strengthening early detection and treatment of components of metabolic syndrome may be warranted in employees of public sectors like.
- These findings from our study will be beneficial as an input for policy makers, researchers and for the community in design and implementation of interventions for the prevention and control of metabolic syndrome.
- These findings indicate the need for evidence-based health promotion and disease prevention programs; and more robust efforts directed towards the screening, diagnosis and management of metabolic syndrome and its components among Aksum Town government office workers and daily laborers
- These findings also, accentuate the importance of reducing the overall sitting time and increasing physical activity in the workplace and highlight the need for public policies to address these issues and thus alleviate the burden of metabolic syndrome in terms of fiscal health premiums, corporate economic losses, and negative health outcomes related to workers' sedentary behaviors.
- Further study shall be done using more appropriate study design to show clear picture of risk factors in apparently healthy populations. This study will also give baseline information to other public and private organizations to wake up on screening schedule for government office workers for chronic diseases.

9. STRENGTH AND LIMITATION OF THE STUDY

The study included several demographics, behavioral character, clinical (FBG and Lipid profile), and anthropometric and biochemical parameters claimed to be associated with metabolic syndrome. The use of standard and calibrated instruments to make measurements, the requirement of reliability tests before data collection, and standardized training of data collectors was also a strength. In addition, it was assured that biochemical analysis was done in the laboratories that are implementing the laboratory quality management system and became accredited by Ethiopia Public Health Institution (EPHI) and Government of the National Region State Tigray-Bureau of Health to Adwa General Hospital and Aksum University College of Health Sciences Comprehensive Specialized Hospital.

The limitations of this study included **first**, relatively small sample size so, study finding may not be generalized to the broader Ethiopian population since study subjects consisted of participants of Aksum town. However, a relatively large sample size of the study was likely to make the findings reliable. **Second**, the study subjects were sampled based on voluntary participation; therefore, health-conscious individuals might be over-represented. **Third**, we used portable blood analyzers, which may not measure values that lie outside the measuring ranges of the analyzer. While these analyzers were properly calibrated, measuring whole blood instead of blood plasma might have affected the readings, as our targets were highlanders. **Fourth**, the utilization of a cross-sectional study design, fails to establish a temporal relationship between metabolic syndrome and its associated factors. **Fifth**, the cross-sectional nature of the study hampers any causal inferences. Furthermore, we only studied office workers and thus, the results cannot be generalized to other occupational groups. **Sixth**, some questions used in data collections of the study were mainly subjective in nature and could not show the exact status, especially physical activity, fruit and vegetable intake.

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ANNEXES

Annex I Participant Information sheet

Information sheet for the participants of the study entitled assessment of metabolic syndrome among government workers of some randomly selected office in Aksum central zone Tigray region, Ethiopia.

Addis Ababa University, College of Health Science School of Medicine, Department of Medical Biochemistry.

Principal investigator: Ephrem Mamo Gebremedhin

Main Advisors:

Dr. Solomon Genet Gebre (Associate Professor)

Dr. Solomon Tebeje Gizaw (Assistant Professor)

Co- Advisors: Mr. Mohammed Mehdi Abrar (MScs) (PHD candidate)

Name of sponsor: Aksum University College of Health Science-Referral hospital and Addis Ababa University College of Health Science, School of Medicine Department of Medical-Biochemistry.

You are invited to participate in a study to the assessment of cardio metabolic risks and major risk factors for chronic non-communicable diseases. Risk factors for these diseases include: serum (TG, HDL and LDL concentration), Tobacco use such as smoking, high rates of alcohol consumption, Low intake of fruit and vegetables, Waist circumference, Lack of exercise, raised blood pressure, Raised blood sugar, BMI, Obesity and High levels of fat in the blood.

You are selected as a candidate for this study because you met the criteria for inclusion as a participant. For the purpose of this study, the participants were asked to provide 4ml or 5 ml whole blood sample from the vein. This is the same procedure that the participant would undergo under normal circumstances. These samples were used for the same tests that the participants would require under normal circumstances, and no participant was subjected to any test he/she would not normally undergo as part of his/her required medical care. However, the samples taken for the purposes of the study was not be identified with the participant's name, and no information

regarding the participant's sample was used for any purpose other than the specific objective of the study. During the process of drawing blood for the purpose of performing the laboratory tests in question, the participant was feeling a small amount of temporary discomfort.

This study was alert health workers and decision makers to take appropriate measures to treat, prevent and control metabolic syndrome. The study was help to alert individuals to prevent and treat before the metabolic syndrome disease appears through avoiding risk factors. The study can also build capacity in metabolic syndrome research and was provide baseline information for further studies on the prevalence and risk factors metabolic syndrome for governmental office workers. However, the investigators cannot promise or guarantee that the participant was directly receive any benefit of the study. Any information that is obtained in this study regarding the participants was kept completely confidential.

Annex II Informed Consent Form

Introduction:

This form describes what participation in the survey of NCD risk factor assessment of metabolic syndrome among government office worker members.

Title of Survey:

Survey is on risk factors of chronic Non-Communicable Disease (NCDs and Prevalence of selected non communicable metabolic syndrome disease.

Risk factors for these CVDs include:

- Tobacco use such as smoking
- High rates of alcohol consumption
- Low intake of fruit and vegetables
- Lack of exercise
- Raised blood pressure
- Raised blood sugar
- Obesity
- High levels of fat in the blood.

Data Collection methods:

We were collected information from volunteer **100** study participants of governmental office workers in Aksum town Information was gathered through:

- Step 1- A face to face interview which was ask about lifestyle, behaviors and risk factor and Medical problems.
- Step 2- Measurements of height, weight, waist and blood pressure.
- Step 3- Blood sampling to test for conditions like diabetes (high blood sugar) a dyslipidemia by Total cholesterol, triglyceride, HDL-c and LDL-c levels in the blood.

The table below shows each of the steps involved. You were given time to consider your Participation.

Step	Action
1	We were describing the study in detail
2	You may ask any questions you and the child may have
3	We were asking you to sign consent form
4	You were asked to agree for the participation in step 1. This was involved survey team ask you confidential questions about your: ➢ Age ➢ Education ➢ Employment and income ➢ Tobacco and alcohol use ➢ Fruit and vegetable intake ➢ Physical activity ➢ History of diabetes and or raised blood pressure
5	You were then being asked to agree for step 2. This was involving survey team taking some simple measurements: Height Weight Waist and hip circumference Blood pressure and heart artery
6	You may also be asked to participate in steps 3. This was involved survey team taking a small amount of blood to test for sugar and fat levels in your blood. This may cause temporary discomfort to you but was not harm you in any other way

Timeframe:

It is estimated that step 1, 2 and 3 of the survey was take approximately 1 hour.

Benefits:

It was benefit among government office workers in Aksum town, central zone, Tigray Region, Ethiopia members through early identification of risk factors of Metabolic Syndrome and they were advised and recommended for further clinical Follow up.

Your rights: - It is your right to:

- Decline from taking part in the study
- Withdraw from the study at any time
- Decline to answer any question in the interview that you do not wish to answer.

Confidentiality:

Your participation and data provided was completely confidential. Your name was not be used in any report of the study.

Results:

The results of this study were used to help plan strategies in reducing the risk factors of metabolic syndrome in government offices workers

Ethical approval:

This study was received ethical approval from the Addis Ababa University College of Health Science, School of medicine Department of Medical Biochemistry and Aksum University College of Health Sciences and Referral Hospital.

Dear study participant Voluntary participation: Your participation is voluntary and you can withdraw from the study after having agreed to participate. You are free to refuse to answer any question that is asked in the questionnaire.

Read to study participant		Interview
Agreed		Refused

Name of study participant _____ Sign _____

Witness: _____ Sign _____

Annex III Questioner English Version

English Version questionnaire

1. Socio demographic data		
Variables		Response
1.1	Sex	A. Female B. Male
1.2	Age	---------- years
1.3	Educational status	A. Illiterate B. Read and write C. Primary education D. Secondary education E. College and above
1.4	Occupation	A. Housewife B. Governmental C. Non-governmental D. Private
1.5	Religion	A. Orthodox Christian B. Muslim C. Protestant D. Catholic E. Other -----
1.6	Residence	A. Rural B. Urban
1.7	Marital status	A. Married D. Widowed B. Single E. Other C. Divorced
1.8	Monthly income	----------Birr

2. Behavioral Characteristics		
2.1	Do you ever smoke any tobacco products, such as cigarettes, cigars or pipes?	A. yes B. No If the answer is No, go to question no 2.5
2.2	Do you currently smoke any tobacco products, such as cigarettes, cigars or pipes?	A. yes B. No
2.3	Do you remember how long ago it was?	In Years _____Or in Months _____ Or in Weeks_____
2.4	On average, how many do you smoke each day?	----------
2.5	Have you ever consumed an alcoholic drink such as Tela, Teji, Araki, Beer, Wine, and Whisky……?	A. yes B. No If no, go to question no 2.7
2.6	how frequently have you Had at least one alcoholic drink?	Daily --------- 5-6 days per week --------- 1-4 days per week ---------- 1-3 days per month ---------- Less than once a month ---------
2.7	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?	A. Yes B. No If the answer is yes how much time do you spend doing vigorous-intensity activities at work on a typical day? ------ If the answer is No, go to question no 2.9
2.8	In a typical week, on how many days do you do vigorous-intensity	Number of days _____

2.9	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?	A. Yes B. No If the answer is yes, how much time do you spend doing moderate-intensity activities at work on a typical day? ----- If the answer is No, go to question no 2.11
2.10	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days_____
2.11	Do you walk for at least 10 minutes continuously to get to and from places?	A. Yes B. No If the answer is yes, how much time do you spend on walking on a typical day? If the answer is No, go to question no 3.1
2.12	In a typical week, on how many days do you walk for at least 10 minutes continuously to get to and from places?	Number of days _____

3. Physical Measurements		
3.1	Height	In cm _____
3.2	Weight	In kg _____
3.3	BMI	In Kg/m^2 _____
3.4	Waist circumference	In cm _____
3.5	Hip circumference	In cm _____
3.6	Waist to Hip	No Unit _____
3.7	Blood Pressure	Reading one: DBP---------- SBP----------
		Reading two: DBP----------SBP----------

4. History of blood pressure and diabetes mellitus		
4.1	Have you ever had your blood pressure measured by a doctor or other health worker?	A. Yes B. No If it is No go to no 4.4
4.2	Have you ever been told by a doctor or other health? worker that you have raised blood pressure or Hypertension?	A. Yes B. No
4.3	Are you currently receiving any Drugs (medication) for high blood pressure prescribed by a doctor or other health worker?	A. Yes B. No If yes name of the drug---------- --------
4.4	Duration since the diagnosis of DM	1.<1 year 2.>1-5 year 3.5 -6year 4.6-10 year 5.>10 year
4.5	Treatment for the DM	A. Oral agents B. Insulin C. Oral agents + insulin
4.6	DM treatment combination	A. Single B. Double

5) Biochemical Measurements		
5.1	Fasting blood glucose	M mol /L _____ Mg/dL _____
5.2	Total Cholesterol	M mol /L _____ Mg/dL_____
5.3	Triglycerides	M mol /L_____ Mg/dL_____
5.4	HDL Cholesterol	M mol / L _____ Mg/dL _____
5.5	LDL Cholesterol	M mol / L _____ Mg /dL _____

6A. Behavioral Measurement of Dietary habit of life						
No	**Questions**	**Always**	**Often**	**Sometimes**	**Rarely**	**Never/ None use1d**
6A.1	How often do you utilize an olive oil (≥ 1 spoon/day) in your house?					
6A.2	How often do you consume fruit (≥ 1serving/day) in your house?					
6A.3	How often do you consume vegetables or salad (≥1 serving/day) in your house?					
6A.4	Do you often consume fruit (≥ 1serving/day) and vegetables (≥1 serving/day) in your house?					
6A.5	Do you often consume legumes (≥2 servings/week) in your house?					
6A.6	How often do you consume fish (≥ 3 servings/week) in your house?					
6A.7	Do you often consume Wine (≥ 1glass/day in your house?					
6A.8	How often do you consume meat (<1serving/day) in your house?					
6A.9	Do you often consume white bread (<1/day) and rice (<1/week)] or whole-grain bread (>45/week) in your house?					

6B. Behavioral Measurement of Dietary Habit of life						
No	**Questions**	**Always**	**Often**	**Sometimes**	**Rarely**	**Never/None use1d**
6B. 1	How often do you utilize an olive oil (≥ 1 spoon/day) for cooking in your house?					
6B. 2	How often do you consume vegetable oil for cooking in your house?					
6B. 3	How often do you consume solid fats for cooking in your house?					
6B. 4	How often Do you consume Butter for cooking in your house?					

6B. 5	Do you often consume Homemade oil product for cooking in your house?					
6B. 6	How often do you consume Margarine for cooking in your house?					
6B. 7	Do you often consume other oil for cooking in your house?					

6C. Behavioral Measurement of Dietary Habit of life						
No	**Questions**	**Always**	**Often**	**Some times**	**Rarely**	**Never/None used**
6C. 1	Do you often eat fat meat?					
6C. 2	Do you often care about your diet?					
6C. 3	Do you often eat carbohydrate rich in bulk?					

Annex IV ሓበርትታትን ቃለ-መሕትትን ብቋንቋ ትግርኛ

ሀ) ሓባሪሓደ፡- ሓበሬታት መምልኢ ተሳተፍቲ ሰነድ/ቅጥዒ/ ብትግርኛ

መምልኢ ሓበሬታ ተሳተፍቲ ሰነድ ተሳተፍቲ ዳህሰሳ ተመሓላለፈቲ ዘይኮኑ ሕማማት መቃለዕቲ ኩነታትን ምልክታት (ሜታቦሊክ ስይንድሮም) ኣብ መንግስቲ ሰራሕተኛታት፣ ብቅምሾ ዝተመረፁ ቤት ፅሕፈት ከተማ ኣኽሱም፣ ዞባማእኸል፣ ክልልትግራይ፣ ኢትዮጵያ ይኸውን።

ኣዲስ አበባ ዩኒቨርስቲ፣ ኮለጅ ጥዕና ሳይንስ፣ ቤት ትምህርት ሕክምና፣ትምርቲ ክፍሊ ሜዲካልባዮ-ኬሚስትሪ፡፡

መፅናዕቲ መፅነዓይ (ተመራማሪ) ኣካል፡- ኤፍሬም ማሙ ገብረመዲህን

ዋና ኣማኸርቲ (ኣድቫይዘራት)

-ዶ/ር ሶሎሞን ገነት ገብረ (ተሓባባሪ ፕሮፌሰር)

-ዶ/ር ሶሎሞን ተበጀ ጊዛው (ሓጋዚ ፕሮፌሰር)

ሓጋዚ ኣማኻሪ (ኮኦ-ኣድቫይዘር) -ኣይተ መሓመድ መህዲ ኣብራር (ካልኣይ ዲግሪ)

ስፖንሰር ኣካል፡- ዩኒቨርሲቲ ኣኽሱም ኮሌጅ ጥዕና ሳይንስ ኮምፕሬሲቭ ሪፈራል ሆስፒታል ምስ ኣዲስ አበባዩ ኒቨርሲቲ፣ ኮለጅ ጥዕና ሳይንስ፣ ቤት ትምህርት ሕክምና፣ ትምርቲ ክፍሊ ሜዲካል ባዮ-ኬሚስትሪ፡፡

ኣብ መፅናዕቲ ሜታቦሊክ ንምኽንያታት (ሜታቦሊክ ፋክተርስ) መሰረታዊ ኣጋለፅቲ ምኽንያታትን (ሪስክ ፋክተርስ) ፀናሕቲ ሕማማትን (ክሮኒክኢ-ተመሓላለፍቲ) ክሳተፉ ተዓዲሞም።

ኣጋለፅቲ ምኽንያታት ናይ ዞም ሕማማት እዚኦም ዝስዕቡ ይርከብዎም ሴረም (መጠን ትራይግላይሰራይድ፣ ኤች ዲ ኤልን፣ ኤል ዲ ኤልን) ፣ ትምባኾ ምጥቃምን ኣብነት ሽጋራ ምትካኽ፣ ልዑል መጠን ኣልኮል ምጥቃም፣ ትሑት መጠን ኣሕምልቲን ፍራፍረን ምውሳድ፣

ዙርያ ሽምጢ፣ ኣካላዊ ምንቅስቃስ ዘይምግባር፣ ልዑል ድፊኢት ደም፣ልዑል መጠን ሽኮር፣ ፣ ርጉዲ፣ ልዑል መጠን ስብሒ ኣብ ደም ምህላው።

ኣብዚ መፅናዕቲ እዚ ንኽሳተፉ(ፉ) ዝተመረፅ(ፃ)ሉ ምኽንያት ተሳተፍቲ ከማልእዎም ዝግበኦም መሰረታዊ መዐቐኒታት ስለ ዘማልኡ(ኣ) እዮም(የን)። ነዚ መፅናዕቲ ዕላማ፣ ተሳተፍቲ 5ሚሊ ዝኣክል ደም ንኽህቡ(ባ) ዝሕተቱ(ታ) ይኾኑ(ና)። እዚ ብምሃቦም(በን) ተሳተፍቲ ኣብ ጥዕነኦም(ኣን) ዝኾነ ዓይነት ተፅዕኖ ኣይበፅሖምን(ሐንን)። እዚ ቅምኾን ተመሳሳሊ ፈተነታት ዝውዕል፣ተ ሳተፍቲ ኣብ ስሩዕ ኩነታት ዘድልዮም ከይዲ ንዘየተዓናቅፍ ከም ዝኾነ ከምእውንን ዝኾነ ተሳታፊ ዝኾነ ዓይነት ኣብ ሂይወቱ/ታ ሓደጋ ከሰዕቡ ዝኽእል ፈተነ (ሙከራ) ኣይግበረሉን(ለንን)።

ይኹን እምበር ነዚ መፅናዕቲ ዕላማ ዝተወስዱ ቅምሱታት፣ ስም ተሳተፍቲ ከምኡ እውን ዝኾነ ዓይነት ናይ ተሳተፍቲ ውልቃዊ መረዳእታ ካብ ናይዚ መፅናዕቲ ዕላማ ወፃኢ ንኻሊእ ስራሕ ኣይውዕልን። ኣብ እዋን ምወሳድ ደም፣ ነቲ ዝተደለየ ዕላማ ቤተ ፈተነ፣ ተሳተፍቲ ግዝያዊ ሕማም ክስመየም(ዐን) ዝኽእል ዋላኳ እንተኾነ ዝኾነ ዓይነት ቐዋሚ ኣለኹታዊ ሳዕቤን ወይ ጉድኣት ግን የብሉን እዩ። እዚ መፅናዕቲ ሰራሕተኛታት ጥዕና ንኽሕልውን ከምእውን ገምገምቲ ኣካላት ኣድላይ ስጉምቲ ንምውሳድ ፣ ንምክልኻል ብተወሳኺ እውን ንምቁፅፃር ሜታቦሊክ ሲንድሮም ሪስክ ንምክልኻል ዘነቓቕ ሕይኽውን። እዚ ምርምር (መፅናዕቲ) ውልቐ ሰባት ን ክልኻልን ንምሕካምን ቅድሚ ሜታቦሊክ ሲንድሮም ምኽሳቱ፣ ንምውጋድ ኣጋለፅቲ ምኽንያታት (ሪስክፋክተርሰ) ዝሕግዝ ይኽውን። እዚ መፅናዕቲ (ምርምር) ንመፅናዕቲታት ሜታቦሊክ ሲንድሮም ዓቕሚ ዝፈጥርን ንቐፀልቲ ምርምራት ዝርገሐ ኣጋለፅቲ ምኽንያታት (ሪስክ ፋክተረሰ) ሜታቦሊክ ሲንደሮም ንመንግስታዊ ቤት ፅሕፈት ሰራሕተኛታት መሰረታዊ መረዳእታ ዘቕምጥይ ኽውን። ይኹን እምበር ተመራማሪ (ኢንቨስቲጌተር) ንተሳተፈቲ ቀጥታዊ ዝኾነ ጥቅሚ ወይረብሓ ከም ዝህልዎም ወይ ከምዝረኽቡ ቃልን ውሕስናን ኣይኣትወሎምን(ለንን)። ካብዚ ምርምር (ምፅናዕቲ) ዝተረኽቡ ምስ ተሳተፈቲ ዝተትሓሓዙ መረዳእታታት ሙለእ ብሙለእ ብምሽጥር ዝተዓቐበን ዝተሓለው ይኽው

ለ) ሓባሪ ክልተ ፡- መምልኢ ስምምዕነት ሰነድ /ቅጥዒ/

መእተዊ፡- እዚ ሰነድ እዚ መዕናዕቲታት ሪሰክ ፋክተርስ ኢ-ተመሓላለፍቲ ሕማማት ዳህሰሳ ሜታቦሊክ ሲንድሮም ኣብ ኣባላት መንግስታዊ ቤት ፅሕፈት ሰራሕተኛታትን መንግስታዊ ዘይኮኑ ናይ ጉልበት ሰራሕተኛታት (መዓልታዊ ሽቃሎ) ከተማ ኣኽሱም ይገልፅ፡፡

ርእሲ መፅናዕቲ፡- ናይዚ መፅናዕቲ ርእሲ፡-ዳህሳስ (ፈተሻ) ሱር-ሰደድ ተመሓላለፍቲ ዘይኾኑ ሕማማት ኣጋለፅቲ ኩነታትንን (ሜታቦሊክ ሲንድሮም) ዝርገሐ ኣብ ዝተመረፁ ኣባላት መንግስታዊ ቤት ፅሕፈት ሰራሕተኛታት ከተማ ኣኽሱም፡፡

ዕላማ እዚ መፅናዕቲ፡-

ነዞም ተመሓላለፍቲ ዘይኮኑ ሕማማት ኣጋለፅቲ ኩነታት

- **ትምባኾ ምጥቃም ንኣብነት-ሽጋራ ምትካኽ**
- **ልዑል መጠን ኣልኮል ምውሳድ**
- **ትሑት መጠን ኣትክልትን ፍራፍረን ምጥቓም**
- **ኣካላዊ ምንቅስቃስ ዘይምግባር**
- **ልዑል ድፈኢት ደም**
- **ልዑል መጠን ሽኮር**
- **ልዕሊ ዓቐን ርጉዲ**
- **ልዑል መጠን ስብሒ ኣብደም ምህላው**

ሜላ ኣተኣኻኽባ መረዳእታ፡-

መረዳእታና ኣብ ከተማ ኣኽሱም ካብ ዝርከቡ ናይ መንግስቲ ቤት ፅሕፈት ሰራሕተኛታትን መንግስታዊ ዘይኮኑ ናይ ጉልበት ሰራሕተኛታት (ሽቃሎ) ፣ 100 ፍቓደኛታት ዝእከብ ይኸውን። እቲ መረዳእታ ድማ ብኽምዚ ዝስዕብ ኣገባብ ድማ ይእከብ፡፡

ብርኪ 1. ቐጥታ ቃለ-መጠየቅ ብምግባር እንትኾውን ኩነታት መነባብሮ ፣ ባህርይ፣ ኣጋለፅቲ ነገራትን ኩነታትን ሕክምና ፀገማትን ይሕዝ።
ብርኪ 2. ናይ ቁመት ፣ ክብደት ፣ ሑቐን ድፈኢት ደምን የጠቓልል።

ብርኪ 3. ናይ ደም ቅምሾ (ናሙና) ንኹነታት ልዑል መጠን ሽኮር ኣብ ደምን ድይስ ሊፒደምያ ብልዑል መጠን ስብሒ ፣ ትራይ ግላይ ሰራይድስ ልዑልን ትሑት መጠን ኣብ ውሽጢ ደም።

እዚ ቀሚሉ ዘለኦ ሰንጠረዥ ሕድሕድ ዝተኻየዱ ብርኪታት የርእይ። ተሳተፍቲ ንምሕሳብውን ግዜይ ወሃቦም(በን) እዩ።

ብርኪ	ስራሕቲ
1	ብዛዕባ እቲ መፅናዕቲ ንተሳተፍቲ ብሰፊሑ ገለፃ (መግለፂ) ይግበረሎም
2	ዝኾነ ይኹን ዓይነት ሕቶ እንተሃልይዎም ክሓቱይ ኽእሉ እዮም
3	ብሰናይ ድልየቶም ኣብ ናይ ስምምዕነት ቅጥዒ ንኽፍርሙ ንሓቶም
4	ኣብ ብርኪ ሓደ ተሳታፊ ንኽኾኑ ፍቃዶም(ደን) ምሕታት (ይሕተቱ)። እዚ ከዓ ተሳታፊ ኣብቲ መፅናዕቲ ብዓርሰ እምነት ብዘይ ደንገርገርን ሕቶታት ክምልሱ ፃእሪ ምግባር ብተወሳኺ ኣብቲ መፅናዕቲ ንኽሳተፉ ሞራል ምሃብ። ዕድመ ብርኪ ትምህርቲ ናይ ስራሕ ኩነታትን ማሃያኦምን ኩነታት ትምባኾን ኣልኮላዊ መስተን ምጥቓም ምጥቓም ኣሕምልቲን ፍራፍረን ኣካላዊ ንጥፈታት ቅድሚ ሕዚ ዝነበረ ኩነታት ሕማም ሽኮርን ድፈኢት ደምን

5	ኣብ ብርኪ ክልተ ተሳታፊ ንኽኾኑ ፣ ፍቓደኛታት ምኻኖም(ነን) ምሕታት ብተወሳኺ ኣብቲ መዕናዕቲ ክሳተፉ ምግባር።። ቀለልቲ ዓቐናት ከም ቁመት ክብደት ዙርያ መዓንጣን መቐመጫን ፀቅጢ ደምን ውቅዒት ደምን
6	ከመኡ' ውን ኣብ ብርኪ ክልተ ተሳታፊ ንኽኾኑ ፣ ፍቃደኛታት ምኻኖም ምሕታት ብተወሳኺ ኣብቲ መዕናዕቲ ክሳተፉ ምግባር።። እዚ ከዓ መዕናዕቲታትን ፈተነታትን ንኣብነት ውሑድ መጠን ደም ብምውሳድ ፣ መጠን ስብሒን ሽኮርን ካብ ደሞም ብምውሳድ ዝልካዕ ይኽውን።ግዝያዊ ሕማም ክስመየም ዝኽእል ዋላኳ እንተኾነ ዝኾነዓይነት ቐዋሚ ኣለኦታዊ ሳዕቤን ወይ ጉድኣት ግን የብሉን።

ግዜ ሰሌዳ፡- ብርኪ1፣2ን 3ን ናይ እዚ መዕናዕቲ ክባቢ ሓደ ሰዓት ክውደኡ ይኽእሉ እዮም ተባሂሉ ይግመት።

ረብሓ (ጥቅሚ)፡- ኣብ ከተማ ኣኽሱም ዞባ ማእኸል ፣ ክልል ትግራይ ፣ ኢትዮጵያ ኣብ ዝርከቡ መንግስታዊ ቤት ፅሕፈት ሰራሕተኛታት ሱር ሰደድ ተመሓላለፍቲ ዘይኮኑ ሕማማት ኣጋለፅቲ ኩነታትንን (ሜታቦሊክ ሲንድሮም) ካብ ዝኾኑ ነገራት ንቐፃሊ ኣቐዲምካ ሕክምና ንምግባር ፣ ክትትልን ምኽርን ብምሃብ ተጠቐምቲ ይኾኑ

መሰላት ተሳተፍቲ፡- ተሳተፍቲ እዞም ዝስዕቡ መሰላት ኣለዎም (ን):

- ኣብቲ መዕናዕቲ ናይዘይ ምስታፍ
- ኣብ ዝኾነ ግዜ ካብቲ መዕናዕቲ ናይ ምቁራፅ
- ኣብ እዋን ቃለ-መሕተት ክምልስዎ ዘይደለዩ ነገር ናይዘይምምላስ

ዓርሰ እምነት ምህላው፡- ተሳተፍቲ ተሳትፈኦም(አን) ከመኡ'ውን ዝሃቡ/ባ/ና መረዳእታ ምሽጥራዊነት ዝተሓለወን ሙለእ ብሙሉእ ብምሽጥር ዝተሓዝን ዝተዓቐበን ይኸውን።`

ውፅኢታት፡-

ናይዚ መፅናዕቲ ውፅኢት ካብ ናይ ጥዕና ሓደጋ ኣጋለፅቲ ኩነታት (ሜታቦሊክ ሲንድሮም) ንምቅናስ ዝተዳለዉ ስትራተጂካዊ ትልሚታት ንምሕጋዝ ይጠቅም።

ስነ ምግባር ናይቲ መፅናዕቲ ብዛዕባ ምፅዳቅ፡-

እዚ መፅናዕቲ ካብ ኣዲስ ኣበባ ዩንቨርሲቲ ኮለጅ ጥዕና ሳይንስ፣ ቤት ትምህርት ሕክምና፣ ትምርቲ ክፍሊ ሜዲካል ባዮ-ኬሚስትሪን ኣኽሱም ዩንቨርሲቲ ኮሌጅ ጥዕና ሳይንስን ሪፈራል ሆሰፒታልን ስነ-ምግባራዊ ተቐባልነት ዝረኸበ ይኸውን።

ተሳትፎ ሰናይ ፍቃድ፡-

ተሳትፎ ተሳተፍቲ ብሰናይ ፍቃድ እንትኾን ድሕሪ ናይ ተሳትፎ ስምምዕነት ካብ እቲ መፅናዕቲ ክቋርፁ(ፃ) ይኽእሉ(ላ) እዮም(የን)። ኣብቲ ቃለ-መሕተቲ መምልኢ ቅጥዒ ንዘይደለይዎ ሕቶ ዘይምምላስ ወይ ናይ ምግዳፍ ነፃነት'ውን ኣለዎም(ወን)።

ናይ ተሳተፍቲ መፅናዕታዊ ንባብ	ቃለ-መሕተት
ተስማዕሚያም(ዐን)	ኣይተስማዕምዑን(ዓን)

ስም ተሳተፍቲ መፅናዕቲ ዝነጠፉ(ፋ).....ክታም_____

ምስክርነት .....ክታም_____

ሐ) ሓባሪ ሰለስተ፡- ቃለ-መሕትት ብቋንቋ ትግርኛ

1.ማሕበራዊ ዲሞግራፍያዊ (ድሕረ ባይታ) መረዳእታት		
ተራ ቁፅሪ	መለክዒታት መልሲ	
1.1	ፆታ	ሀ) ኣን ለ) ተባ
1.2	ዕድመ	----------ዓመት
1.3	ብርኪ ትምህርቲ	ሀ. ዘይተምሃረ/ት ለ. ምፅሓፍን ምንባብን ዝ/ት/ኽእል ሐ. ቐዳማይ ብርኪ ዝተምሃረ/ት መ. ካልኣይ ብርኪ ዝተምሃረ/ት ሰ. ዩንቨርሲቲን ልዕሊኡን
1.4	ስራሕ	ሀ ናይ ገዛ እመቤት ለ መንግስታዊ ሐ ዘይመንግስታዊ መ ናይ ውልቐ
1.5	ሃይማኖት	ሀ ኦርቶዶክስ ክርስትና ለ ሙስሊም ሐ ፕሮቴስታንት መ ካቶሊክ ሠ ካሊእ-----
1.6	መንበሪ ቦታ	ሀ ገጠር ለ ከተማ
1.7	ኩነታት ሓዳር	ሀ ዝተመርዐወ/ት ለ ዘይተመርዐወ/ት ሐ ዝሞተ/ታ መ ዝተፋተሐ/ት ሠ ካልኣ--------
1.8	ወርሓዊ መሃያ	----------ብር

2. ባህርይ ዝምልከቱ ሕቶታት		
2.1	ዝኾነ ዓይነት ውዕኢታት ትምባኾ ፣ ንኣብነት ሽጋራ ፣ ሽሻ ወይ ከዓ ፓይፕ ኣትኪኾም(ኦን) ወይተጠቂሞም(መን)ይፈልጡ(ጣ)ዶ?	ሀ እወ ለ ኣይፈልጥን መልሶም(ሰን) ኣትኪኽ ኣይፈልጥን እንተኾይኑ ናብ ሕቶ ቁፅሪ 2.5 ይቐፅሉ(ላ)
2.2	ኣብዚ ሕዚ እዋን ዝኾነ ዓይነት ውዕኢታት ትምባኾ ፣ ንኣብነት ሽጋራ ፣ ሽሻ ወይ ከዓ ፓይፕ የትክኹ ወይ ይጥቐሙ(ማ)ዶ?	ሀ እወ ለ ኣይጥቀምን
2.3	ምትካኽ ካብ ዝጅምሩ ክንደይ ዝኣክል ግዜ ከም ዝገበሩ ይዝክሩ (ራ) ዶ?	----------ዓመታት ወይ---------- ----------ወርሕታት
2.4	ብማእኽላይኣብመዓልቲክንደይግዜየትክኹ(ኻ)	----------
2.5	ኣልኮላዊ መስተታት ንኣብነት ስዋ፣ ሜስ፣ ቢራ፣ ወይን፣ ዊስኪይ-------ተጠቂሞም(መን) ይፈልጡ(ጣ)ዶ?	ሀ እወ ለ ኣይፈልጥን መ ልሶም(ሰን) ተጠቂመ ኣይፈልጥን እንተኾይኑ ናብ ሕቶ ቁጽሪ 2.7 ይቐፅሉ(ላ)
2.6	እንተ ወሓደ ሓደ ኣልኮላዊ መስተ ኣብ ክንደይ ግዜ ይጥቀሙ(ማ)?	ሀ መዓልታዊ ለ ኣብ ሰሙን ካብ 5-6 መዓልቲታ ሐ ኣብ ሰሙን ካብ 1-4 መዓልቲታ መ ኣብ ሰሙን ካብ 1-3 መዓልቲታ ሠ ኣብ ወርሒ ትሕቲ ሓደ መዓልቲ ----------
2.7	ዝሰርሕዎ ስራሕ ከቢድ ኣካላዊ ምንቅስቃስ፣ ምንቅስቃሳት ልዕሊ መጠን እስትንፋስ ወይ ከዓ ልዑልመጠን ውቅዒት ልቢ ዘስዕቡ ከም (ምሸካም ወይ ምልዓል ከበድቲ ሽኽምታት፣ ኳዕቲታት ወይ ከዓ ኮንስትራክሽን ስራሕቲታት) እንተወ ሓደ ን10 ደቓይቅብዘይምቁራፅዝኣክልኣለዎ(ወን)ዶ?	ሀ እወ ለ የብሉን መ ልሶም(ሰን)እወ እንተኾይኑ ኣብ ዝሰርሕለ(ላ) ዕለት ንኽንደይ ሰዓታት ከበድቲ ስራሕቲታት ብምስራሕ የሕልፍዎ(ፈኦ)-------?

		መልሶም (ሰን) የብሉ ንእንተ ኾይኑ ናብ ሕቶ ቁፅሪ 2.9 ይቐፅሉ(ላ)
2.8	ኣብ ውሽጢ ሰሙን ንኽንደይ መዓልቲታት ኣብ ስርሑም (ሐን) ክበድቲ ምንቅስቃሳት ይሰር(ሓ)?	---------- መዓልቲታት
2.9	ዝሰርሕዎ(ሐኦ) ስራሕ መጠናዊ ኣካላዊ ምንቅስቃስ፣ ምውሳኽ መጠን እስትንፋስ ወይከዓ መጠን ውቅዒት ልቢ ዘስዕቡ፣ ክም ምሽካም ቀለልቲ ክበድትን፣ እንተ ወሓደ ን10 ደቓይቅ ብዘይ ምቁራፅ ይሰርሑ (ሓ) ዶ?	ሀ እወ ለ የብሉን መ ልሶም(ሰን) እወ እንተኾይኑ ኣብ ዝሰርሕሉ(ሓሉ) ዕለት ንክንደይ ሰዓታት ማእኽላይ ክብደት ዘለዎም ስራሕቲታት ብምስራሕ የሕልፍዎ(ፈኦ)-------? መልሶም(ሰን) የብሉን እንተኾይኑ ናብ ሕቶቁፅሪ 2.11 ይቀፅሉ(ላ)
2.10	ኣብ ሓደ ሰሙን፣ ክንደይ መዓልቲታት፣ ናይ ክፉል ስርሑም(ሐን) መጠናዊ ክብደት ዘለዎም ስራሓቲታት ይሰርሑ(ሓ)?	----------መዓልቲታት
2.11	ካብ ቦታ ናብ ቦታ ንምኻድ እንተወሓደ ን10 ደቓይቅ ዝኣክል ብዘይ ምቁራፅ ይንቀሳቀሱ(ሳ) ዶ?	ሀ እወ ለ ኣይፋልን መ ልሶም (ሰን) እወ እንተኾይኑ ኣብ ዝንዓዝሉ(ዛሉ) ዕለት ንኽንደይ ሰዓታት ብምጉዓዝ የሕልፍዎ(ፈኦ)-------? መልሶም(ሰን) ኣይፋልን እንተኾይኑ ናብ ሕቶ ቁፅሪ 3.1 ይቐፅሉ(ላ)
2.12	ኣብ ሓደ ሰሙን ፣ ንኽንደይ መዓልቲታት ፣ እንተወሓደ 10 ደቓይቅ ካብ ቦታ ናብ ቦታ ብዘይ ዕርፍቲ ብምጉዕዓዝ የሕልፍዎ(ፈኦ)?	----------መዓልቲታት

3. ምንቅስቃስ ኣካላዊ ብቅዓት ዝምልከቱ ሕቶታት		
3.1	ቁመት	----------ሳሜ
3.2	ክብደት	----------ኪግ
3.3	ቦዲ ማስእ ንዴክስ (BMI)	----------ኪግ/ሜ^2
3.4	ዙሩያ መዓንጣ	----------ሳሜ
3.5	ፀቅጢ (ድፍኢት) ደም	---------ንባብ ሓደ------ንባብ ክልተ SBP_____SBP_____ DBP_____DBP_____

4. ድፈኢት ደምን ሕማም ሽኮርን ዝምልከቱ ሕቶታት		
4.1	ብዶክተር ወይ ከዓ ብኻሊእ በዓል ሞያ ሕክምና ድፈኢት ደሞም ተለኪያም(ዐን) ይፈልጡ(ጣ) ዶ?	ሀ እወ ለ ኣይፈልጥን መልሶም(ሰን) ኣይፈልጥን እንተኾይኑ ናብ ሕቶ ቅጽሪ 4.4 ይቀፅሉ(ላ)
4.2	ብዶክተር ወይ ከዓ ብኻሊእ በዓል ሞያ ሕክምና መጠን ፀቅጢ ደሞም ወሲኹ ወይ ከዓ ድፈኢት ደም ኣለዎም(ወን) ተባሂሎም(ለን) ይፈልጡ(ጣ) ዶ?	ሀ እወ ለ ኣይፈልጥን
4.3	ኣብዚ ሕዚ እዋን ብዶክተር ወይ ከዓ ብኻሊ እበዓል ሞያ ሕክምና ናይ ሕማም ድፍኢት ደም መድሓኒት ተኣዚዝሎም(ለን) ይጥቀሙ(ማ) ድዮም(ድየን)?	ሀ እወ ለ ኣይጥቀምን መልሶም(ሰን) እወ እንተኾይኑ ስም እቲ መድሓኒት_____
4.4	ሕማም ሽኮር ከም ዘለዎም(ወን) ካብ ዝፈልጡ(ጣ) ክንደይ ግዜ ገይሮም(ረን)?	1. ≤ 1 ዓመት 2. 1-5 ዓመት 3. 5-6 ዓመት 4. 6-10 ዓመት 5. >10 ዓመት
4.5	ንሕማም ሽኮር ዝወስድዎ(ሰደኦ) ሕክምና	ሀ ዝውሓጥ መድሓኒት ለ ኢንሱሊን ሐ ዝውሓጥ መድሓኒት + ኢንሱሊን
4.6	ናይ ሽኮር ሕክምና ጥምረት ዝውሰዱ ኩነታት	ሀ ሓደ መድሓኒት ለ ክልተ መድሓኒት

5. ውፅኢታት ቤተ ፈተነ		
5.1	ፋስቲንግ ብለድ ግሉኮስ	ሜጋ ሞል/ሊ (ሚሊግራም/ ዴሲ ሊትር) _____
5.2	ቶታል ኮለስትሮል	ሜጋ ሞል/ሊ (ሚሊግራም/ ዴሲ ሊትር) _____
5.3	ትራይ ግላይሰራይድ	ሜጋ ሞል/ሊ (ሚሊግራም/ ዴሲ ሊትር) _____
5.4	ኤች ዲኤል ኮሌስትሮል	ሜጋ ሞል/ሊ (ሚሊግራም/ ዴሲ ሊትር) _____
5.4	ኤል ዲኤል ኮሌስትሮል	ሜጋ ሞል/ሊ (ሚሊግራም/ ዴሲ ሊትር) _____

6ሀ ባህርታት አጠቓቕማ ዕለታዊ (ዝውትር) ምግቢ						
ተ.ቁ	ሕቶታት	ኩሉ ግዜ	ብዙሕ ግዜ	ሓደ ሓደ ግዜ	ሓል ሓሊ ፉ	አይ ፋል
6ሀ.1	ንኽንደይ መዓልቲታት እንተወሓደ ናይ አውሊዕ/ ዘይቲ (≥1 ማንካ አብ መዓልቲ) ንምግቢ ትጥቀም/ሚ?					
6ሀ.2	ንኽንደይ መዓልቲታት እንተወሓደ ናይ ፍራምረ (≥ 1 አብ መዓልቲ ይጥቀም) ከም ምግቢ ትጥቀም/ሚ?					
6ሀ.3	ንኽንደይ መዓልቲታት እንተወሓደ አሕምልትን ሰላጣን (≥1አብ መዓልቲ ይጥቀም) ንምግቢ ትጥቀም/ሚ?					
6ሀ.4	እንተ ወሓደ ንኽንደይ ግዜ ፍራምረ (≥ 1 አብ መዓልቲ ይጥቀም) ብተወሳኺ አሕምልቲ (≥ 1 አብ መዓልቲ ይጥቀም) ይጥቀሙ(ማ)?					
6ሀ.5	እንተ ወሓደ ንኽንደይ ግዜ ዓተርን ጥራምረን (≥2 አብ ሰሙን ይጥቀም) ከም ምግቢ ትጥቀም/ሚ?					
6ሀ.6	እንተ ወሓደ ንኽንደይ ግዜ ዓሳ (≥ 3 አብ ሰሙን ይጥቀም) ከም ምግቢ ተዘውትር/ሪ/?					
6ሀ.7	እንተ ወሓደ ንኽንደይ ግዜ ወይኒ (≥ 1 አብ መዓልቲ ሐደ ብርጭቆ ይጥቀም) ከም ምግቢ ተዘውትር/ሪ/?					
6ሀ.8	እንተ ወሓደ ንኽንደይ ግዜ ዝአክል ስጋ (≥ 1 አብ መዓል ቲይጥቀም) ከም ምግቢ ትጥቀም/ሚ?					
6ሀ.9	እንተ ወሓደ ንኽንደይ ግዜ [ፃዕዳ ሕምባሻ(ዳቦ) (<1 አብ መዓልቲ ይጥቀም) ብተወሳኺ ሩዝ (< 1 አብ ሰሙን ይጥቀም)] ወይ ፃዕዳ ስርናይ(>45/አብ ሰሙን) ከም ምግቢ ትጥቀም/ሚ?					

6ለ. ባህርታት አጠቓቕማ ዕለታዊ (ዝውትር) ዘይቲ ምግቢ						
ተ.ቁ	ሕቶታት	ኩሉ ግዜ	ብዙሕ ግዜ	ሓደ ሓደ ግዜ	ሓልሓሊፉ	አይፈለ
6ለ.1	ንኽንደይ ግዜ/መዓልቲታት/ እንተወሓደ ናይ አውሊዕ/ ዘይቲ (≥1 ማንካ አብ መዓልቲ) ንምግቢ ትጥቀም/ሚ?					
6ለ.2	ንኽንደይ ግዜ/መዓልቲታት/ እንተወሓደ ናይ ኣሕምልቲ/ኣትክልቲ ዘይቲ ንምግቢ ትጥቀም/ሚ?					
6ለ.3	ንኽንደይ ግዜ/መዓልቲታት/ እንተወሓደ ደረቅ ዘይቲ ንምግቢ ትጥቀም/ሚ?					
6ለ.4	እንተ ወሓደ ንኽንደይ ግዜ/መዓልቲታት/ ጠስሚ ንምግቢ ይጥቀሙ(ማ)?					
6ለ.5	እንተ ወሓደ ንኽንደይ ግዜ/መዓልቲታት/ ናይ ገዛ ዘይቲ ንምግቢ ትጥቀም/ሚ?					
6ለ.6	እንተ ወሓደ ንኽንደይ ግዜ/መዓልቲታት/ ናይ ካሊእ ዘይቲ ንምግቢ ትጥቀም/ሚ?					
6ለ.7	እንተ ወሓደ ንኽንደይ ግዜ/መዓልቲታት/ ምንም አይነት ዘይቲ ንምግቢ አይትጥቀምን?					

6ሐ. ባህርታት አጠቓቕማ ዕለታዊ (ዝውትር) ምግቢ						
ተ.ቁ	ሕቶታት	ኩሉ ግዜ	ብዙሕ ግዜ	ሓደ ሓደ ግዜ	ሓልሓሊፉ	አይፈለ
6ሐ.1	እንተ ወሓደ ንኽንደይ ግዜ/መዓልቲታት/ ዝአክል ስጋ ንምግቢ ይጥቀሙ(ማ)?					
6ሐ.2	ክንደይና ግዜ/መዓልቲታት/ ዘአክል ብዛእባ ምግቢ ጥንቃቀ አለካ/ኪ/?					
6ሐ.3	እንተ ወሓደ ንኽንደይ ግዜ/መዓልቲታት/ ዝአክል ሓይሊ ወሃብቲ ወይ ጥዑማት ምግቢ ተዘውትር/ሪ?					