



**Prevalence of Hypertension and Associated Risk Factors in Adults
of Kombolcha in South Wollo, northeast Ethiopia**

By

Biniem Hassen Abate

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Supervisor: Hassen Mamo (PhD)

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List of Acronym

AOR	Adjusted odds ratio
BMI	Body mass index
BP	Blood pressure
CI	Confidence interval
CSA	Central statistical Agency
CVDS	Cardiovascular disorders
DBP	Diastolic blood pressure
DDS	Dietary diversity score
DM	Diabets milletes
GPAQ	Global Physical Activity Questionnaire
HC	Hip circumference
HTN	Hypertension
NCD	Non communicable disease
NGO	Nongovernmental organization
ORS	Odds ratio
SBP	Systolic blood pressure
SPSS	Statistical package for social sciences
SD	Standard deviation
WHO	World Health Organization
WHR	Waist-to-hip ratio
WC	Waist circumference
WHtR	Waist- to-height ratio

Abstract

Hypertension (HTN) is an important public health challenge because of its connection with the risk of developing other cardiovascular diseases. To effectively control this disease it is necessary to understand the level of HNT in different settings and associated risk factors. This study, therefore, aimed at assessing the prevalence of HTN and related factors in Kombolcha, northeast Ethiopia. A cross-sectional multi-stage sampling design was used. Data collected using a two-step approach in accordance with the World Health Organization (WHO) procedure. Anthropometric and blood pressure measurements were done for the participants together with administering a structured questionnaire to gather data on socio-demographic, physical activity, dietary habit and nutritional status. Univariate and multivariate logistic regression models were used for data analysis. Out of 318 adults over the age of 20 years residing in Kombolcha town and its suburbs, 168(54.2%) were males and 140(45.8%) females. The prevalence of HTN was 30.7% (95% confidence interval (CI):1.96) with 30.2% male and 31.5% female. Age, sex, body mass index (BMI), walking or riding a bicycle for 1-4 days/week, having a single family size and dietary diversity score (DDS) were significantly associated with the risk of HTN (p-value <0.05). Specifically, Male sex is 3 times at increased risk of developing HTN than females (AOR: 3.255, 95% CI: 1.116-9.491, p: 0.031). Study subjects with higher BMI were found to be 2 times at risk of developing HTN than the study subjects with normal BMI (AOR: 4.128 95% CI: 0.042-0.385, p: 0.000). Study participants who walk or ride a cycle for 1-2 days/week were develop HTN 2 times than who walk or ride a cycle for more days/week (AOR: 2.760, 95% CI: 2.233-8.146, p: 0.000). Those study participants who had not do sport were develop HTN 5 times than who do moderately or vigorously for 20 minute days of the week. Study participants who have more sedentary lifestyle like by watching TVs, playing game, khat chewing was at higher risk of developing HTN(AOR: 2.649, 95% CI: 0.052-0.427, p: 0.000).) This study revealed a high prevalence of HTN; together with high prevalence of unhealthy dietary pattern, nutritional status and lifestyle behavior. This is an alarm for public awareness creation, regular community screening for HTN, and proper preventive and treatment measures in those with high blood pressure.

Keywords: lifestyle, body mass index, hypertension.

1. Introduction

Hypertension (HTN), also known as high or raised blood pressure (BP), is a global public health challenge (WHO 2013a). HTN is a chronic medical condition in which the BP in the arteries is elevated. The higher the pressure in blood vessels the harder the heart has to work in order to pump blood, thus making the heart to work too hard. It is popularly known as the “silent killer,” because it has no specific sign and symptoms in the initial stage.

Globally nearly 9.4 million people die every year due to high BP, and HTN is one of the most important causes of premature death (WHO 2013b). Complications and burden from raised BP result in multiple cardiovascular and renal outcomes, including ischemic heart disease, cerebrovascular disease, and chronic kidney disease is also growing worldwide, affecting approximately one billion people, a figure that is predicted to increase especially in low, lower middle-income countries than high-income countries (Hendricks *et al.* 2012). According to the World Health Organization (WHO), the prevalence of HTN is highest in the African Region at 46% of adults aged 25 years and above, while the lowest was found in the American Region (WHO 2008).

The present trend in increment of HTN seen in some groups of different societies is due to increased predisposition to factors, which lead to the development of HTN and other cardiovascular diseases (CVDs). HTN is a chronic non-communicable disease having modifiable and non-modifiable risk factors reported in many studies such as family history, race, genetics, old age, cigarette smoking, alcohol intake, obesity, physical inactivity, lifestyle, excessive salt, and dietary habits (Hendricks *et al.* 2012).

Furthermore, rapid changes in diets and lifestyles that have occurred with industrialization, urbanization, economic development and market globalization have accelerated over the past year. This is having a negative consequence on the health and nutritional status in the developing country like Ethiopia. With improvements in standard of life, food availability and diversity, and increased access to service obesity related non-communicable disease are on the rise (WHO 2003).

However, given the nationwide burden of communicable diseases and priorities set to combat these, there is scarcity of data on non-communicable diseases/disorders such as HTN in Ethiopia. It seems non-communicable diseases in general and CVD including HTN in particular are getting little attention as public health issue in both the general population as well as among the vulnerable group. The purpose of this study was, therefore, to estimate the burden of HTN and associated risk factors among adults living in Kombolcha city, northeast Ethiopia.

It is anticipated that the outcome of the study will offer up-to-date information on the status of HTN in the study area. It will help to know the prevalence and risk factors of the disease and thus form a basis for future assessments. In turn, this should enable relevant health policy makers and administrators to develop comprehensive and appropriate community-based health promotion strategies to encourage healthy lifestyles among its population, detect cases early enough, and choose appropriate intervention programmes.

2.Objectives

2.1. General objectives

The general objective of this study was to assess the Prevalence of HTN and its association with dietary pattern, body mass index, and life style factors among adults living in Kombolcha, South wollo, northeast of Ethiopia

2.2. Specific objectives

- To find out the prevalence of HTN among adults of Kombolcha, northeast ethiopia.
- To evaluate association of socio-demographic factor and HTN among adults of Kombolcha, Northeast Ethiopia
- To determine the association of body mass index, behavioral risk factors and HTN among adults of Kombolcha, Northeast Ethiopia

3. Literature review

3.1 HTN

HTN is also called as high or raised BP. It refers to a condition in which the blood vessels have persistently elevated pressure. The pressure exerted when the heart muscle contracts is systolic blood pressure (SBP) and that when the heart muscle relaxed is diastolic blood pressure (DBP). According to the WHO, an adult individual (age 18 years and more) is diagnosed as hypertensive when the systolic value is at least 140mmHg and the diastolic exceeds at least 90mmHg (<http://www.blood-pressure.to/who-HTN.html>). Transient increases in BP by conditions such as pregnancy or drugs are not included. Normal BP at rest is within the range of 100-140mmHg systolic and 60-90mmHg diastolic.

BP is determined by the amount of blood the heart pumps (cardiac output) and the amount of resistance to blood flow in the arteries (peripheral vascular resistance), it is determined by the diameter and stiffness of the arteries. The more blood the heart pumps and the narrower the arteries, the higher the BP. Consequently high BP requires the heart to work harder than normal to circulate blood through the blood vessels. BP is regulated by a negative feedback mechanism. The exact pathogenesis of HTN is not clearly understood in the majority of cases. It is believed that the different environmental and genetic factors interact at different levels of BP regulation to result in persistent elevation of BP (Lifton *et al.* 2001).

3.2 Epidemiology of HTN

In the year 2000, nearly one billion people or 26% of the adult population of the world had HTN, out of one billion people 333 million hypertensive people are found in high-income countries, and 639 million was recorded in low-income countries. However, the authors found variable rates of HTN in different regions as low as 3.4% (men) and 6.8% (women) in rural India and as high as 68.9% (men) and 72.5% (women) in Poland (Kearney *et al.* 2004). More recently in 2008, worldwide, approximately 40.0% of adults aged 25 and above had been diagnosed with HTN (WHO 2013a). The WHO has suggested that the prevalence of CVD and HTN was increasing rapidly in sub-Saharan Africa.

The current prevalence of HTN in many low-income countries, particularly in urban societies was as high as those seen in developed countries (Addo *et al.* 2007). Studies in sub-Saharan Africa reported that HTN was the most prevalent risk factor for CVD. The crude prevalence of HTN ranged from 19.0% in Tanzania to 32.0% in Namibia. The age-adjusted prevalence was 19.3% in Nigeria, 21.4% in Kenya, 23.7% in Tanzania, 38.0% in Namibia and 18.2% in Sudan (Henderics *et al.* 2012, Soumeiya *et al.* 2008). A survey on detection, management, and control of HTN in 12 villages in Ashanti, Ghana established an adult prevalence rate of 28.7% overall and comparable in men and women, but higher in semi-urban villages (32.9% versus 24.1%), and increased with age (Francesco *et al.* 2004). In other study in Ghana showed that the prevalence of HTN ranged from 19 to 48% (William *et al.* 2010). A national cross-sectional study in Tunisia established the prevalence of elevated BP was 35.1% (Hajir *et al.* 2012). Moreover, a community-based study in Uganda showed the age-standardized prevalence of HTN was 30.5 % (Wamala *et al.* 2009). A study in Eritrea reported that the prevalence of HTN in the general population was 16%, with the highest levels in unemployed people and local merchants (24.0%) and the lowest levels (7.1%) in students (Mufunda *et al.* 2006).

In Ethiopia, few studies on HTN epidemiology have been undertaken. A community-based cross-sectional study in urban Addis Ababa showed that the age-adjusted prevalence of HTN was 31.5% among males and 28.9% among females (Tesfaye *et al.* 2009). In another similar community-based survey in Gondar, northern Ethiopia the prevalence of HTN was 28.9% (Awoke *et al.* 2012). A comparative study (Getahun *et al.* 2010) in Butajira, south-central Ethiopia showed HTN prevalence significantly higher among khat chewers (13.4%) than non-chewers (10.7%)

3.3 Impact of HTN

CVD is the number one cause of death in the world in that in 2012 alone CVD killed 17.5 million people with over half 9.4 million caused by HTN-related complication (WHO 2013b). The WHO report estimates 15-20% of all adults are affected by HTN worldwide.

HTN known as silent killer as it shows no symptoms at primary stage. Even though it is simple to diagnose and usually can be controlled by healthy diet, regular exercise, medications, untreated HTN will cause serious condition.

Specifically, HTN is a risk factor for CVDs like coronary heart disease and stroke, HTN is the single most important risk factor for stroke. HTN is responsible for at least 45.0% of deaths due to heart disease, over 40.0% of deaths in people with diabetes and 51.0% of deaths due to stroke (WHO 2013a) demonstrating that HTN is the leading risk factor for death and disability globally. Aside from contributing to the burden of heart disease and stroke, HTN also contributes to the burden of kidney failure, cerebrovascular disease, ischemic heart disease and congestive heart failure and premature death and morbidity (Vande *et al.* 2013).

HTN is related with insulin resistance, obesity, carbohydrate tolerance, atherosclerosis and hyperuricacidemia (Mamo and Oli 2001). HTN affects the structures and functions of small muscular arteries, arterioles and other blood vessels and can cause damage at variable rate to various target organs including kidney, brain and eye, related with the end stage of renal disease and to be the cause of stroke (Lee *et al.* 2010).

In Ethiopia, high BP results in left ventricular hypertrophy, it is a characteristic of hypertensive heart disease and an important cause of heart failure. It leads to 50.0% heart failure, a condition associated with repeated hospitalizations and high in hospital mortality (Walelelign *et al.* 2016).

3.4 Management of HTN

For management of HTN early diagnosis is necessary. HTN should be evaluated using history, physical examination and selective testing before getting on treatment. The time of first diagnosis of HTN, past antihypertensive medications use, symptoms of coronary heart disease, heart failure, stroke, transient ischemic attack and others history of a patient need to be assessed as part of HTN diagnosis. Patients should be allowed to sit for 5 minutes before beginning BP measurements. A BP reading is taken with a pressure cuff (sphygmomanometer) with the cuff at a heart level. The average of at least two BP measurements, spaced 1-2 minutes apart should be taken. The diagnosis of HTN should preferably be confirmed at an additional patient visit, usually 1-4 weeks after the first measurement.

In addition to BP measurement tests for primary and secondary and tertiary level healthcare are required. Tests for primary care include hemoglobin and/or hematocritne measurement, fasting plasma glucose, and urine analysis. At secondary and tertiary care levels the following additional tests should be done: lipid profile, total cholesterol, high density lipoprotein, triglyceride, electrolytes, serum potassium, creatinine (Bunker *et al.* 2014).

It is well established that in patients with elevated BP that lowering BP reduces cardiovascular events and reduces premature mortality. The timing and intensity of interventions is determined by numerous factors including the severity of HTN, the patient's absolute CVD risk and the presence of associate clinical conditions or end organ damage (Collins *et al.* 2016). There are several strategies for achieving curative goals: lifestyle modifications, pharmacological modifications and general strategies for hypertensive therapy.

3.4.1 Lifestyle modifications

Implementation of healthy lifestyles by all individuals is critical in the prevention of high BP and an obligatory part of the management of those with HTN. Lifestyle modifications decrease BP, enhance antihypertensive drug effectiveness and decrease cardiovascular risk. Patients with pre-HTN and no forceful indication (including heart failure, prior myocardial infarction or stroke, high coronary risk status, diabetes mellitus, chronic renal disease) respond well to lifestyle modifications and usually do not need drug therapy. For all other abnormal BP categories, drug therapy is indicating if target BP is not achieved by lifestyle modification alone (Chobanian *et al.* 2003). Lifestyle modifications include cessation of smoking, weight reduction and physical exercise, reduction of salt intake and other dietary changes. Hypertensive patients should also be advised to eat more fruit, vegetables, and fish and also reduce their intake of saturated fat and cholesterol. Thus, sedentary patients should be advised to take up modest levels of aerobic exercise on a regular basis such as brisk walking for at least 30 minutes per day, most days of the week (Chobanian *et al.* 2003).

3.4.2 Pharmacological therapy

Initiation of BP lowering therapy (pharmacological on top of non-pharmacological) is decided considering the following factors: the level of SBP and/or DBP, the level of total CV risk, presence of target organ damage like stroke, rising creatinine and others (Francesco *et al.* 2004). All individuals with BP at or above 160/100 mmHg should have drug treatment and receive specific lifestyle advice to lower their BP and risk of CVD. Those with lesser degree of raised BP (140-159/90-99) with target organ damage should undergo drug treatment and be given specific lifestyle advice to lower their BP and risk of CVD. Individuals with BP below 160/100mmHg but no target organ damage need to be stratified and managed according to their cardiovascular risk. Those with 10-year risk of CVD greater than 20% should be initiated with drug treatment.

3.5 Risk Factors for HTN

3.5.1 Socio-demographic characteristic

In the literature, HTN gradually increases during adult life and highest in old-age populations with significantly higher prevalence in men than women. Also it is a general trend that HTN increases significantly with increasing age by a prevalence of about 10% each decade of life; 6.2% in those in 18-24 age groups and 59% in 65 years and above (WHO 2013a). A systematic meta-analysis shows that in Ethiopia the prevalence of HTN is 31.5% in males and 28.9% in females in age group ≥ 25 , 26.2% in males and 19.4% in females in aged ≥ 31 years and, 26% in males and 30.3% in females ≥ 35 years old (Kiberet and Mesfine 2015).

A study conducted on University of Gondar students showed a positive association between sex and HTN in which the risk of HTN increases three times with being men (Takele and Henok 2014). A cross-sectional study result from northwest Ethiopia, Bahir dar town shows that the odds of developing HTN among respondents aged 41-50 years and greater than 50 years were more than two- and seven-times as likely compared to respondents aged less than 40 years, respectively (Anteneh *et al.* 2015). Thus, during ageing the chance of developing HTN is higher since people are less physically active and their body organ performance declines.

A study in southwest Ethiopia based at Jimma University indicates that a family history of HTN was found to be a strong risk factor of HTN (Esayas *et al.* 2013). A study from southern Ethiopia, Durame also showed that people who had family history of HTN were also found to be four times at higher risk of HTN than those without family history of HTN (Helelo *et al.* 2014). This is because family members may share similar lifestyle and genetic factors which cannot be easily distinguished.

3.5.2 Body Mass Index

Body Mass Index (BMI) is calculated from weight and height. As suggested by the US National Institutes of Health and WHO, the normal BMI for an adult over 18 years is less than or equal to 18.5-24.9kg/m². BMI that is greater than this puts one at risk of obesity related diseases such as HTN. Being overweight and obesity are the most important public health problems, one of which is causative factors to HTN (James *et al.* 2011). In the recent studies, overweight people were at higher risk of HTN compared to those with normal BMI. This finding was in line with previous reports from Tunisia, Portugal, and sub-Saharan African countries. A study done in sub-Saharan countries shows that BP was found to be associated with BMI, independently predicted BP level in all study populations (Hendriks *et al.* 2012).

There was a high prevalence of Hypertension in overweight (50.8%) in the Portugal study (Dores *et al.* 2012). A cross-sectional hospital based study report in Jimma indicates that BMI over 25kg/m² was found to be a strong predictor of HTN since the chance of getting HTN is eight times higher for obese people (Esayas *et al.* 2013). A similar study in Addis Ababa indicates that being obese is significantly associated with HTN compared to having normal BMI, this implies that obese people have a 5.5 times higher risk of HTN compared to those with normal BMI (Tesfaye *et al.* 2008).

3.5.3 Lifestyle (Behavioral) factors

Lack of physical activity and unhealthy dietary habits are important modifiable risk factors for HTN. Study in association of smoking and khat use with high BP among adults in Addis Ababa, showed that daily current smoking and regular khat chewing significantly increased mean diastolic BP (Tesfaye *et al.* 2006). About 81% of the rural study population reported regular

alcohol consumption. Previous research indicated that heavy alcohol consumption was a risk factor for high BP (Hillbom *et al* 2011, Akhmedjonov and Suvankulov 2013). Study done in Uganda reported that alcohol users were more likely to be hypertensive compared to participants reporting to have never used alcohol (Wamala *et al.* 2009).

A study from southern Ethiopia Durame shows that adults who did not eat vegetables for more than three days on their weekly menu were about two times likely to be hypertensive than those eat daily (Helelo *et al.* 2014). Another study in Bahirdar town shows that respondents who added salt to food in addition to the normal amount that was added to the food during cooking were more than three-times as likely to have HTN compared to those who did not added additional salt (Takele and Henok 2014). Smoking, affecting arterial stiffness and wave reflection this have a significant effect on central blood pressure, which is more closely related to target organ damage than brachial BP this will exposed people to develop HTN and hypertensive smokers develop severe forms of HTN, including malignant and Reno vascular HTN. This effect is due to an accelerated atherosclerosis (American Heart Association 2014).

Regular exercise reduces the risk for many diseases, including HTN and has reported to lower BP even in people who have normal BP (Kelley and Tran 2005). A study in India shows that sedentary people have a 20–50% increased risk of HTN compared to more active people (Blair *et al.* 2004). A study from northwest Ethiopia shows that people who do not walk for at least 10 minutes continuously on daily basis were about three times highly likely to be hypertensive (Awoke *et al.* 2012). Another study from southern Ethiopia Durame showed that people who did not walk at least for 10 minutes continuously on a daily basis were about eight times more likely to be hypertensive (Helelo *et al.* 2014).

According to WHO, guidelines and the American College of Sports Medicine there are two types of physical exercises, which are moderate physical exercises like brisk walking, tennis, weight lifting (<20kg), dancing, for at least 30 or up to 60 minutes per day to a total of 150-300 min/week and vigorous physical exercises like gymnastic, volleyball, football, basketball, running, swimming, weight lifting (>20kg), riding bicycle, at least 20–30 min/day to a total of 75–150 min/week (WHO 2014). People who do not take enough exercise are more likely to have or to develop HTN (American Heart Association 2014). However because of urbanized and

modernized people are not engaged in daily physical activity such as walking as a means of transport rather they prefer to use motorcycles or cars. In addition to this, most of the occupational jobs in urban area are done by sitting for long hours. This type of physical inactivity exposed the urban rich communities to HTN.

4. Materials and Methods

4.1 Study area

The study area was Kombolcha City which is situated at 11°5'N 39°44'E latitude and 11.083°N 39.733°E longitude in northeast Ethiopia with an elevation between 1842 and 1915 meters above sea level. Kombolcha is 375km to the north of Addis Ababa. It is bordered by Kalu District in the east and south, Dessie Zuria District in the west and southwest, Tehulederie District in the north and Dessie City in northwest (Fig 1). According to the Kombolcha Meteorological Agency, Kombolcha city is characterized by an average annual rainfall 1030mm³ and temperature 20.1°C. Kombolcha is subdivided into 11 small units named *kebeles* (6 'urban' and 5 'suburban') having an area of 124.5km² (12450 hectares). Based on the 2014 Ethiopian Central Statistics Agency population projection, the City had total population estimate of 115,000 of whom 55,968 were men and 59,033 women (68.76% 'urban' and 31.24% 'suburban' inhabitants).

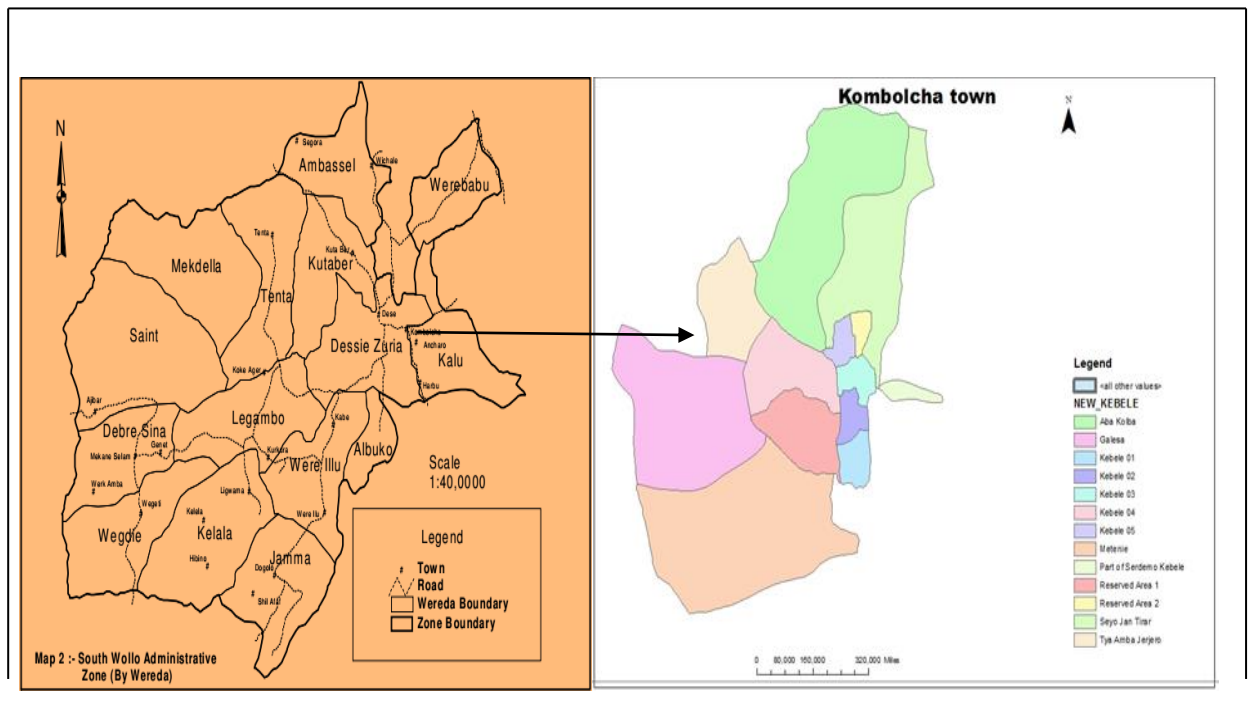


Fig 1. Map of study area

4.2 Study design and population

A community-based cross-sectional study design was employed to assess the prevalence of HTN and associated risk factors among adults living in Kombolcha city. Therefore, all adult residents of the city formed the sampling population. Out of the 11 *kebeles* of the city, 5 (3 ‘urban’ (Kut’eba, Shewaber, Piasa) and 2 suburban (Abakolba, Fatoager)) were randomly selected (lottery method) first by clustering urban and suburban *kebeles* and taking into account the population size of each. Pregnant women, people with diabetes, age <18 years, who lived in the study area for <6 months, seriously ill, or homeless were excluded from the study.

4.3 Sample size

The sample size was calculated by using open EPI-Epidemiological calculator (version 3.04.04) using single population proportion formula, $n = Z^2 \times (p(1 - p)) / m^2$, where ‘Z’ is standard normal distribution curve value for the 95% confidence interval (CI) having a value of 1.96 and ‘m’ 4% margin of error (0.04). Since there was no previous study to estimate the prevalence (p) of HTN in Kombolcha a study in a nearby city (Gondar city) which recorded 14% at 95% CI (Moges *et al.* 2014) was adopted. A sample size of 318 was determined considering a non-response rate of 10%.

Sampling procedures

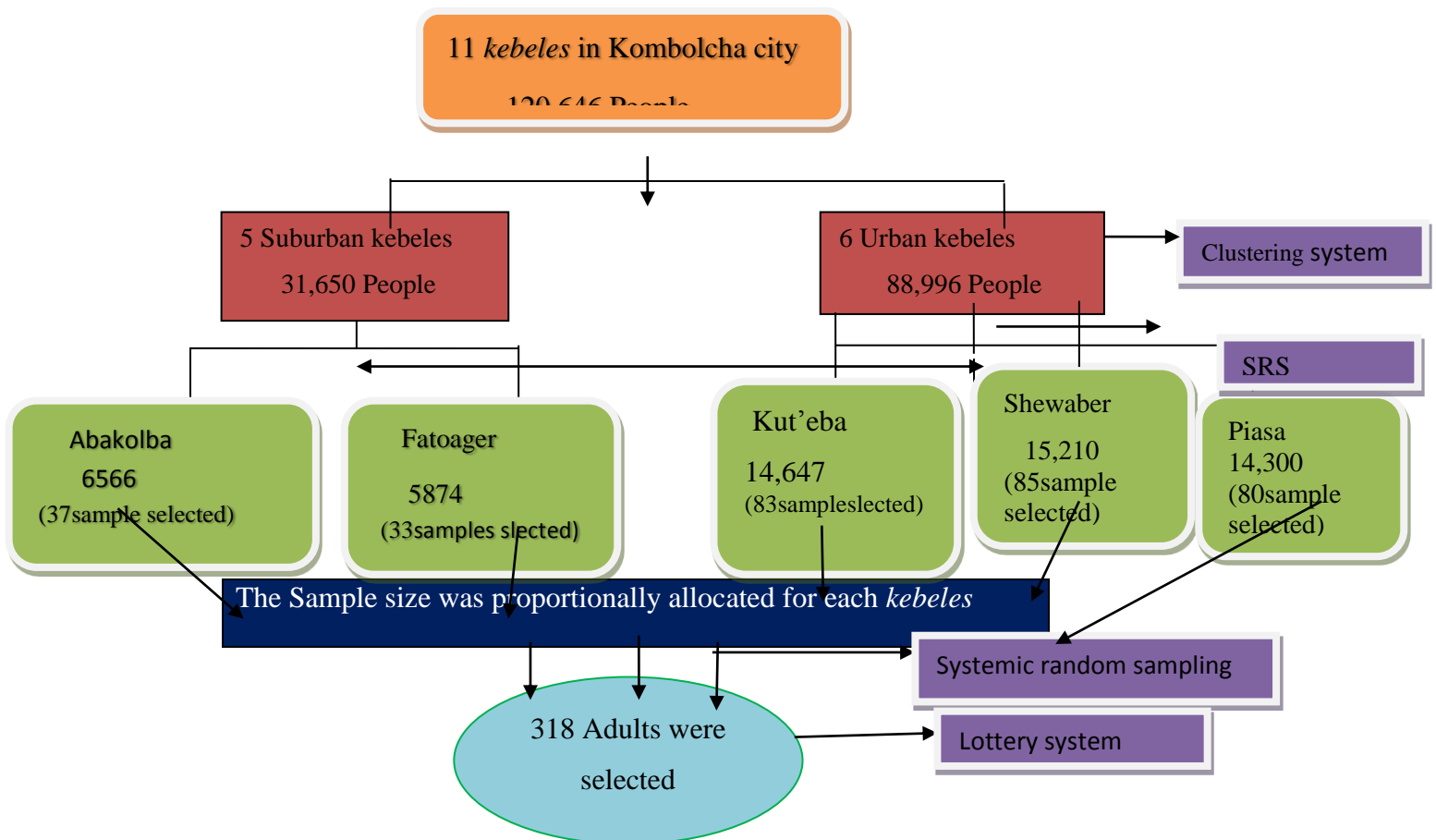


Fig 2. Sampling procedure flow chart

4.4 Sampling procedure

A multistage sampling strategy was used to select study participants. First, clusters (*kebeles*) were selected using simple random sampling. Secondly, the calculated sample size was allocated to selected *kebeles* using proportional to population size. Households were selected within each cluster using the systemic random sampling based on K^{th} values calculated for each *kebele*. Finally, one individual was selected out of the eligible adults in each household using simple random sampling (lottery system).

4.5 Data collection and procedure

4.5.1 Physical measurements

Anthropometric measurements were obtained from the participants wearing light clothing and no footwear. Body weight was measured to the nearest 0.1kg using UNICEF seca digital weighing scale (Germany) and height to the nearest 0.1cm in a standing position using a portable stadiometer (Germany). Waist circumference was measured to the nearest 0.1cm, using a constant tension tape, directly over the skin or over light clothing, at the level of the midpoint between the inferior margin of the last rib and the iliac crest in the mid-axillaries line (Gibson *et al.* 2005). Waist and hip circumferances were measured with a flexabel steel metric tap at the nearest 0.5cm.

Blood pressure (BP) was measured using aneroid sphygmomanometer (Omron Healthcare, Inc., Bannockburn, Ill) on right hand at sitting position, three measurments were taken with intervals of 3 minutes between conscutive measurments. In addition, participants were asked whether they were taking any medications for the treatment of HTN. Average systolic blood pressure (SBP) and diastolic blood pressure (DBP) were determined from the second and third measurments.

4.5.2 Questionnaire

Pretested structured questionnaire (interview) was used to collect data about socio-demographic characteristics (age, sex, income, residence, family size, education, occupation and related variables), dietary habit, level of exercise (activity at work, travel to and from place, recreation activities, time spent on a typical day, sport), life style factors (alcohol use, khat (*Catha edulis*

chewing, salt use) was assessed. The questionnaire was prepared in accordance of the WHO steps instrument for chronic disease risk surveillance (WHO 2012), the Global Physical Activity Questionnaire (GPAQ) Analysis Guide (WHO 2011) and Guidelines for Measuring Household and Individual Dietary Diversity (FAO 2012).

4.6 Data quality control

Questionnaire originally prepared in English was translated into Amharic (participant language) for field work and back to English for checking language consistency. Data was collected by house-to-house visit. BP measurements were done by local health professionals. A digital weighing scale was used to reduce frequent calibration. On daily basis collected information was reviewed and possible errors returned to the data collectors for correction.

4.7 Data management and analysis

Data was entered and statistical analysis performed using Statistical Package for Social Sciences (SPSS) version 21.0 software (IBM Corporation, Chicago). Data analysis was performed by one way analysis of variance (ANOVA) statistical test to determine the association of anthropometric measurements and BP. Further, univariate and multivariate logistic regression models were used to test the association between HTN and independent variables (socio-demographic, dietary factors, exercise level and anthropometric measurements). Odds ratio (OR), crude and adjusted, were calculated with 95% confidence intervals (CI). $P \leq 0.05$ was considered statistically significant.

4.8 Ethical considerations

Local and the study health center administrations were consulted and an approval was granted. Consent was obtained from each participant. The confidentiality of collected information was ensured throughout the process. BP and anthropometric measurements were done by health professionals. Participants found to be hypertensive were counseled by the health professional who took the measurements.

5. Results

5.1 Socio-demographic and clinical characteristics

A total of 318 respondents participated in this study with a response rate 100%. But, only 312 (169 males and 143 females) had analyzable data (Table 1). Regarding socio-demographic characteristics, the ratio of male-to-female was 1.18 with 54.2% males and 45.8% females having a mean age of 38.29 ± 10.88 years ranging from 21-65. Majority 106(34.0%) of the respondents were in the age category 31-45 years. Most of the population 230(73.7%) were urban in residence and the rest suburban. Majority of the participants 134(42.9%) were civil servants followed by merchants 136(43.6%) and the rest farmers and most 191(61.2%) married. Grade 8 or 10 complete and those having a qualification of certificate and above were 132(42.3%), 70(22.4%), and 110(35.3%) respectively. Majority of the participants (89.3%) had two household members and the rest 10.7% had three and above. Most of the participants (58.9%) had history of HTN and other related diseases among family members.

Table-1 Socio-demographic and clinical characteristics of the study participants among adults in Kombolcha, north east Ethiopia (n=312)

Socio-demographic characteristic	Alternatives	Number	Percent (%)
Sex	Male	169	54.2
	Female	143	45.8
Age	< 30 years	85	27.2
	31-45 years	140	44.8
	> 46 years	87	27.9
Residence	Urban	230	73.7
	Sub urban	82	26.3
Occupation	Farmer	42	13.5
	Employed	134	42.9
	Merchant	136	43.6
Marital status	Unmarried	67	21.5
	Married	191	61.2
	Divorced	54	17.3
Educational status	Primary education	132	42.3
	Secondary education	70	22.4
	Certificate and above	110	35.3
Family size	Single	24	7.7
	Two	152	48.7
	Three and above	136	43.6
Family history	Yes	28	9
	No	284	91

5.2 Dietary diversity score

The dietary diversity food groups reported by study participants in the past 24 hours of recruitment are presented in table 2. All the major types of food groups are available in the local market year round. When asked, the majority (99.0%) reported that they had consumed cereals,

pulses, condiments and 96.2% had used sugars and fast foods. While oil/fats, milk and milk products, meat, fish, poultry and fruits were consumed by 43.3, 38.1, 33.7 and 26% respectively.

Table 2 Proportion of study participants who consumed different food groups in the past 24 hours at the time of the survey, 2017 (n=312)

Food groups	Frequency	Percentile
Cereals, grains, breads	309	99
Roots and tubers	165	52.9
Pulses	309	99
Vegetables	195	62.5
Fruit	81	26
Meat, fish, poultry	105	33.7
Milk and milk products	119	38.1
Sugar (sweet food and soft drinks)	300	96.2
Oil, fats, butter	135	43.3
Condiments (spices, salt)	309	99
Diet diversity score of the study participants (DDS)		
Mean \pm standard deviation = 6.5+1.9		

The IDDS of the study participants shown in figure 3 was recorded by adding the type of food groups they used during the study period in the past 24 hours recalling, which categorize in to high and low according to the guideline set by FAO (2012).

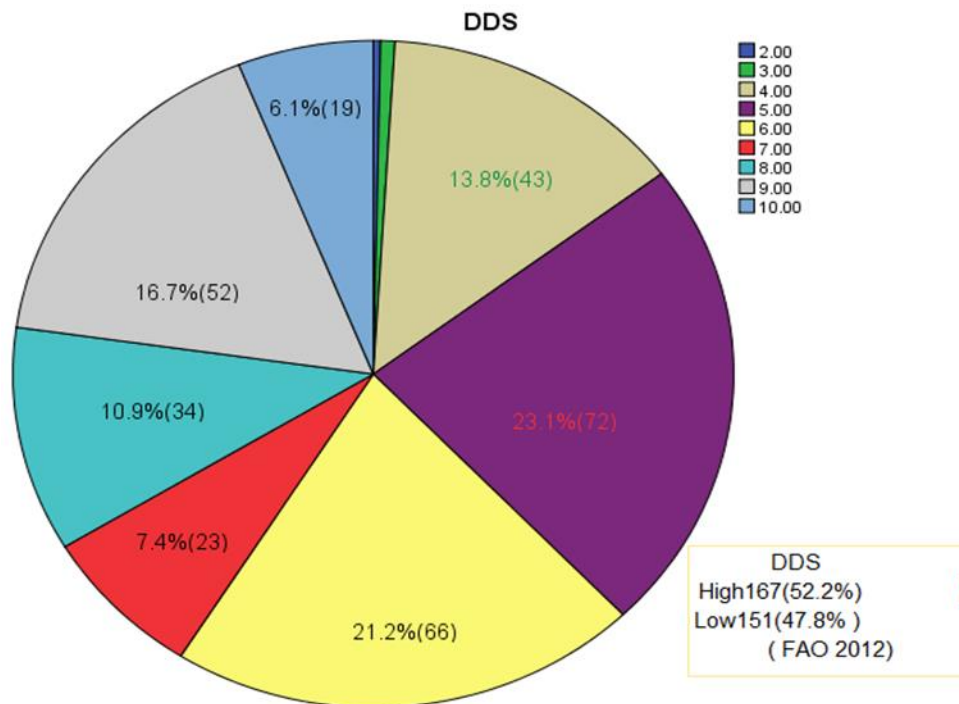


Fig.3 IDDS of the study participants

5.3 Body mass index status

The BMI of the respondents ranged from 18.21 to 36.94 kg/m², with a mean of 25.7±2.4kg/m². The mean BMI of the male respondents was found to be (23.5 ±3.3 kg/m²), whereas that of the female respondents was 24.1 ±4.4kg/m². Overall, 140(44.03%) of subjects had BMI <25.0kg/m², and 178(56.0%) had BMI ≥25.0kg/m². One hundred forty four (45.4%) subjects were overweight and 28(9.6%) were obese (Fig 4). In addition, higher proportions of females than males were overweight (47.6% versus 45%), and a higher proportion of females were obese (11.9 % females versus 6.5% males). On sex classification abdominal obesity occurred among 32.2% females and 24.8% males .

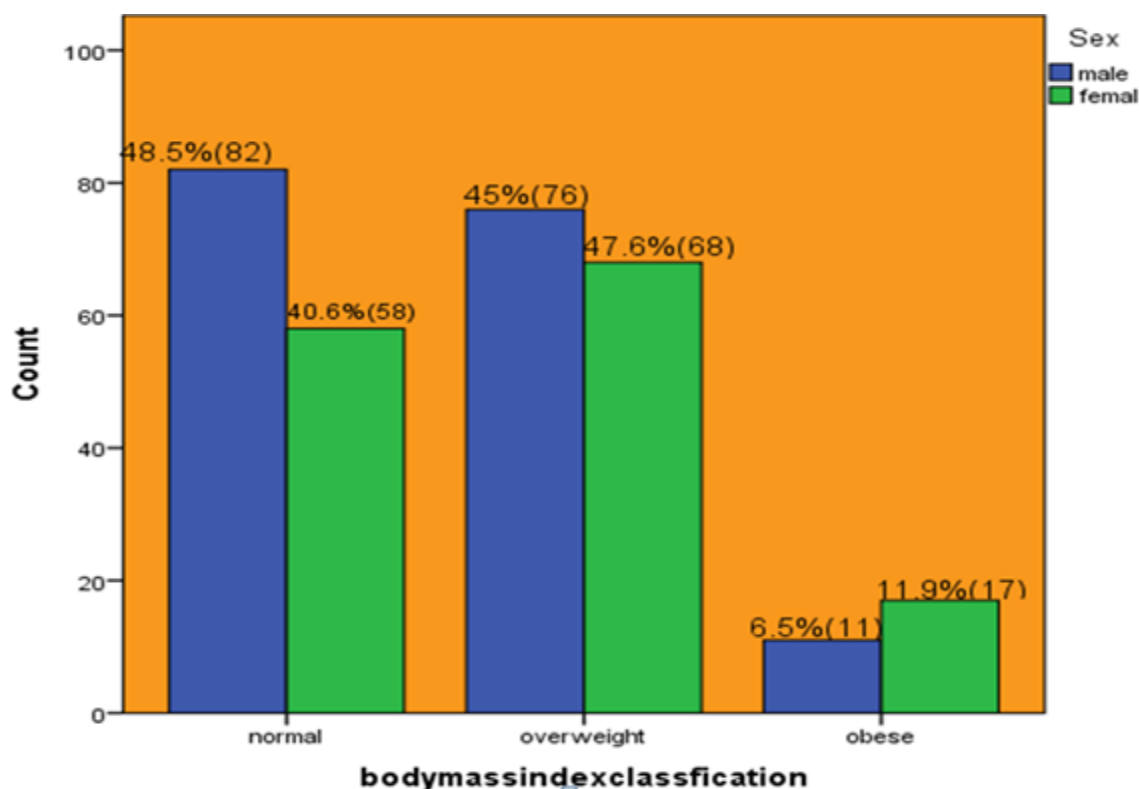


Fig 4. Body mass index classification of study participants

5.4 Physical activity level and Sedentary Behavior

Physical activity related to job, sport, walk or movement, sedentary behavior and lifestyle behavior was summarized in the table 3 below as well. Seventy six (24.4%), 212(67.9%) were performing moderate intensity activity and light activity work respectively. Whereas 24(7.7%) were performing vigorous activity work at least for 20 minutes continuously per week. Thirty

two (10.3%) and 280(89.7%) participants walk or ride a bicycle for 1-4 and 5-7 days (for 20 minutes each day) per week, respectively. The result of physical exercise related to sport indicated that 212(67.9%) of the participants were not doing any type of moderate or vigorous intensity sport activities whereas 76(24.4%), 24(7.7%) were involve in moderate and vigorous physical activities respectively. The duration of sedentary activity on a typical day were >120, 60-120 and <60 minutes for 253(81.1%), 51(16.3%) and 8(2.5%) participants respectively.

Table-3 Physical activity level, Life style and Sedentariness of the study samples in Kombolcha city, northeast Ethiopia (n=312)

Parameter	Variables	Alternatives	Number	Percent
Physical activity related to	Occupation	Light	212	67.9
		Moderate	76	24.4
		Vigorous	24	7.7
	Walking or bicycle	1-4 days	32	10.3
		5-7 days	280	89.7
	Sport	NO	212	67.9
		Moderate	76	24.4
		Vigorous	24	7.7
	Sedentary lifestyle	<60min/day	8	2.6
		61-120min/day	51	16.3
>121min/day		253	81.1	

5.5 Behavioral characteristics

As summarized in Table 4 below, 61(19.6%) participants reported that they smoke cigarette during the study period 251(80.4%) didn't ever smoke. Similarly, 215(68.9%) chew khat (*Catha edulis*) continuously for a long period of time daily whereas 97(31.1%) responded that no consumption of khat (*Catha edulis*). Most (96.2%) use salt in their diet and only 12(3.8%) have no habit of using salt. Whereas 228(73.1%) were not users of alcoholic drinks and 84(26.9%) reported almost daily intake.

Table-4 Behavioral factors of the study samples in Kombolcha city, northeast Ethiopia (n=312)

Behavioural factors	Cigarette smoking	Yes	61	19.6
		No	251	80.4
	Chat chewing	Yes	215	68.9
		No	97	31.1
	Binge drinking	Yes	84	26.9
		No	228	73.1
	Addition of salt	Yes	300	96.2
		No	12	3.8

5.6 Anthropometric and BP measurements

While 139(44.6%) participants were overweight, the prevalence of obesity was (9.6%: 30/318). Concerning the Waist circumference, 92(29.5%) were in the category of ‘substantially increased risk’, 87(27.9%) increased risk’ and 133(42.6%) at ‘low risk’ for HTN as per the WHO categorization. Similarly, based on WHR 172(55%) of the individuals were under ‘increased risk’ for developing cardiovascular diseases. Risk classification with WHtR showed that 165(53.2%) and 81(26.2%) participants had ‘high risk’ and ‘substantially increased risk’, respectively (Table 5).

Table 5 Anthropometric and BP measurements of the study samples based on their gender (N=318)

Variable	Alternatives	Sex		Total, n(%)	p-value
		Male, n(%)	Female, n(%)		
Abdominal obesity	Present	42(24.8)	46(32.2%)	88(28.2%)	0.018*
	Absent	127(75.2)	97(67.8%)	224(71.8%)	
BMI	Normal	85(59.4)	58(40.6)	143(45.8)	0.000*
	Overweight	73(52.5)	66(47.5)	139(44.6)	
	Obese	11(36.7)	19(63.5)	30(9.6)	
WC	Low risk	82(61.7)	51(38.3)	133(42.6)	0.478
	Increased risk	37(42.5)	50(57.5)	87(27.9)	
	Substantially increased risk	50(54.3)	42(45.7)	92(29.5)	
WHR	Low risk	42(30)	98(70)	140(44.9)	0.075
	Substantially increased risk	127(73.8)	45(26.2)	172(55)	
WHtR	Low risk	22(13.1)	42(29.6)	64(20.6)	0.138
	Increased risk	88(52.4)	77(54.2)	165(53.2)	
	Substantially increased risk	59(34.9)	23(16.2)	81(26.2)	
SBP	Normal	99(58.6)	78(54.5)	177(56.7)	0.000*
	Pre-HTN	34(20.1)	34(23.8)	68(21.8)	
	HTN	36(21.3)	31(21.7)	67(21.5)	
DBP	Normal	127(75.1)	102(71.3)	229(73.4)	0.000*
	Pre-HTN	10(5.9)	15(10.5)	25(8.0)	
	HTN	32(18.9)	26(18.9)	58(18.6)	

*The sex adjusted anthropometric and BP measurements cutoff values were considered for each group, BP: blood pressure, DBP: diastolic blood pressure, SBP: systolic blood pressure, BMI: body mass index, WC: waist circumference, WHR: waist-to-hip ratio, WHtR: waist-to-height ratio, n: number, *statistically significant

5.7 Prevalence of HTN

The mean SBP of the study population was 129.6 ± 13.7 mmHg and that of DBP was 83.9 ± 8.2 mmHg. A total of 96 (30.7%) individuals were hypertensive, at 95% CI. HTN prevalence in males was 30.2% (51/169) and among females 31.5% (45/143) with no statistically significant difference (tables 5). There was some variation in the prevalence of systolic and diastolic BP, 67(21.5%) subjects had systolic HTN and 58(18.6%) had diastolic HTN.

Although higher BMI was found to associated higher risk of HTN among obese participants compared to the normal participant the relationship just below the statistical level of significance (COR 4.13, 95% CI 0.042-0.385, $p=0.05$) (Table 6). Participants who were having occupationally light activity were significantly more likely to have HTN than those engaged in moderate and vigorous intensity activities (COR 2.509, 95% CI 1.192-5.283, $p=0.015$). Those who walk or ride (a bicycle) for only 1-2 days for about 15 minutes each day on weekly basis were two times more hypertensive than those their counterpart (COR 1.870, 95% CI 2.233-8.146, $p<0.0001$). Participants doing sport moderately or vigorously for 20 minutes continuously per day within a week were less likely to develop HTN than participants who don't do sport (COR 5.135, 95% CI 2.068-10.749, $p<0.0001$). Participants whose duration of sedentary activity or time spent by sitting on a typical day for longer than 120 minutes were at twice greater risk of being hypertensive compared with those with lesser sedentary duration (COR 2.149, CI 0.052-0.427, $p<0.000$).

Sex, BMI, walking or riding for 1-2 days per week, sport and sedentary lifestyle were statically significant independent predictors of HTN in the multivariate model (Table 7). Specifically, being a male was 3 times increased risk of developing HTN than being a female (AOR 3.255 95% CI 1.116-9.491, $p=0.031$). Participants with higher BMI were found to be 4 times at increased risk of developing HTN than those with a normal BMI value (AOR 4.128, 95% CI 0.042-0.0385, $p<0.0001$). Similarly, those who walk or ride only for 1-2 days/week were 2 times higher risk for HTN than those who walk or ride more than two day (AOR 6.760, 95% CI 2.233-8.146, $p<0.0001$). Those who could do vigorous/moderate sport activity at least for 20min/day were at 5 times lesser risk of developing HTN than those who couldn't do sport (AOR 5.135, 9% CI 2.068-12.749, $p<0.0001$). Those who pass longer period of time by sitting like watching television, chewing khat, playing game for more than 120min/day were nearly three times at higher risk of being hypertensive than their counterpart (AOR 2.649, 95% CI 0.052-0.427, $p<0.0001$).

Table 6 Univariate logistic regression analysis of socio-demographic, dietary, lifestyle and nutritional status of adults in Kombolcha in relation to HTN, December-May 2017 (N=318)

Variables	Alternatives	n(%)	HTN, n(%)	COR	95% CI	P-value
Sex	Male	169(54.2)	51(30.2)	0.941	0.581-1.524	0.806
	Female	143(45.8)	45(31.5)	1		
Age (year)	18-30	85(27.2)	13(15.3)	1	0.146 -0.486 0.430-0.876	0.222 0.257
	31-45	140(44.8)	45(32.1)	0.144		
	46 and above	87(27.9)	48(43.7)	0.249		
BMI	Normal	143(45.8)	7(4.9)	1	0.002-0.029 0.042-0.385	0.087 0.000*
	Overweight	139(44.6)	63(45.3)	0.608		
	Obese	30(9.6)	26(86.7)	4.128		
WC	Low risk	133(42.6)	34(25.6)	1	0.315-0.993 0.395-.961	0.057 0.325
	Increased risk	87(27.9)	27(31)	0.559		
	Substantially increased risk	92(29.5)	35(38)	0.733		
WHR	lower risk	140(44.9)	41(29.3)	1	0.542-1.431	0.609
	substantially increased risk	172(55)	55(32)	0.881		
WHtR	low risk	66(20.6)	19(28.8)	1	0.280-1.116 0.278-0.854	0.099 0.062
	increased risk	165(53.2)	43(26.1)	0.559		
	substantially increased risk	81(26.2)	34(42)	0.487		
Occupation	Light	183(67.9)	80(43.7)	2.509	1.192-5.283 0.595-1.374	0.015* 0.195
	moderate	95(24.4)	14(14.7)	0.582		
	vigorous	34(7.7)	2(5.9)	1		
Walking or riding bicycle	1-2 days/week	32(10.3)	26(81.25)	1.860	2.233-8.146	0.000*
	3-4 days/week	280(89.7)	70(25)	1		
Sport	No	212(67.9)	94(44.3)	5.135	2.068-12.749 0.018-5.098	0.000* 0.410
	moderate	76(24.4)	1(1.3)	0.307		
	vigorous	24(7.7)	1(4.2)	1		
Sedentary lifestyle (min/day)	<60	8(7.7)	0(0)	1	0.45-0.363 0.052-0.427	0.057 0.000*
	61-120	51(24.4)	4(7.8)	0.127		
	>121	253(67.9)	92(36.4)	2.149		
Cigarette smoking	Yes	61(19.6)	28(45.9)	0.438	0.246-0.779	0.067
	No	251(80.4)	68(27.1)	1		
Khat chewing	Yes	215(68.9)	92(42.8)	0.058	0.020-0.162	0.078
	No	97(31.1)	4(4.1)	1		
Binge drinking	Yes	84(26.9)	45(53.6)	0.250	0.147-0.424	0.087
	No	228(73.1)	51(22.4)	1		
Salt use	Yes	300(96.2)	88(29.3)	4.818	1.414-16.413	0.078
	No	12(3.8)	8 (66.7)	1		
Residence	Urban	230(73.7)	71(30.9)	0.982	0.568-1.697	0.949
	Suburban	82(26.3)	25(30.5)	1		
Occupation	Farmer	42(13.5)	11(26.2)	1	0.377-1.792 0.678-1.894	0.622 0.634
	Employed	134(42.9)	44(32.8)	0.822		
	Merchant	136(43.6)	41(30.1)	1.333		
Marital status	Unmarried	67(21.5)	21(31.3)	1	0.565-1.871 0.345-1.703	0.928 0.514
	Married	191(61.2)	61(31.9)	1.028		
	Divorced	54(17.3)	14(25.9)	0.767		
Education	Grade 8 complete	132(42.3)	37(28)	0.738	0.427-1.275 0.426-1.547	0.276 0.527
	Grade 10 complete	70(22.4)	21(30)	0.812		
	Certificate & above	110(35.3)	38(34.5)	1		
Household size	Single	28(9.0)	15(53.6)	1.119	0.444-2.817 0.588-1.605	0.811 0.909
	Two	210(67.3)	68(32.3)	0.971		
	Three & above	74(23.7)	12(16.2)	1		
Family history to HTN	Yes	184(58.9)	15(8.1)	0.346	0.158-0.759	0.008
	No	128(41.1)	81(63.3)	1		
DDS	Low	169(54.2)	51(30.2)	0.147	0.086-0.251	0.058
	High	143(45.8)	45(31.5)	1		

DDS: dietary diversity score, ETB: Ethiopian Birr, Min: minute, BMI: body mass index, WC: waist circumference, WHR: waist-to-hip ratio, WHtR: waist-to-height ratio, n: number of people, COR: crude odds ratio, HTN: HTN, CI: confidence interval, *statistically significant, %: percentage

Table 7 Multivariate logistic regression analysis of HTN by socio-demographic, dietary pattern, lifestyle, and nutritional status of adults in Kombolcha, December-May 2017 (N=312)

Variables	Alternatives	n(%)	HTN, n(%)	COR	AOR	95% CI	P-value
Sex	Male	169(54.2)	51(30.2)	0.941	3.255	1.116-5.491	0.031*
	Female	143(45.8)	45(31.5)		1		
Age	20-34	85(27.2)	13(15.3)	2.62	1	0.146 -0.486	0.222
	35-45	140(44.8)	45(32.1)		0.144		
	46 and above	87(27.9)	48(43.7)		0.249		
BMI	Normal	143(45.8)	7(4.9)	0.008	1	0.002-0.029	0.087
	Overweight	139(44.6)	63(45.3)		0.608		
	Obese	30(9.6)	26(86.7)		4.128		
WC	Low risk	133(42.6)	34(25.6)	0.559	1	0.315-0.993	0.057
	Increased risk	87(27.9)	27(31)		0.559		
	Substantially higher risk	92(29.5)	35(38)		0.879		
WHR	Low risk	140(44.9)	41(29.3)	0.881	1	0.542-1.431	0.609
	Substantially higher risk	172(55)	55(32)		0.881		
WHtR	Low risk	66(20.6)	19(28.8)	0.872	1	0.280-1.116	0.099
	Increased risk	165(53.2)	43(26.1)		0.559		
	Substantially higher risk	81(26.2)	34(42)		1.789		
Occupational physical activity	Light	183(67.9)	80(43.7)	8.427	4.509	1.192-5.283	0.067
	Moderate	95(24.4)	14(14.7)		2.765		
	Vigorous	34(7.7)	2(5.9)		1		
Walking or riding a bicycle	1-2 days	32(10.3)	26(81.25)	19.5	6.760	2.233-8.146	0.000*
	3-4 days	280(89.7)	70(25)		1		
Sport	No	212(67.9)	94(44.3)	9.32	5.135	2.068-12.749	0.000*
	Moderate	76(24.4)	1(1.3)		0.307		
	Vigorous	24(7.7)	1(4.2)		1		
Sedentary lifestyle	<60 min/day	8(7.7)	0(0)	0.000	1	0.045-0.363	0.057
	61-120 min/day	51(24.4)	4(7.8)		0.127		
	>121 min/day	253(67.9)	92(36.4)		0.149		
Cigarette smoking	Yes	61(19.6)	28(45.9)	0.438	0.438	0.246-0.779	0.067
	No	251(80.4)	68(27.1)		1		
Khat chewing	Yes	215(68.9)	92(42.8)	0.011	0.058	0.020-0.162	0.078
	No	97(31.1)	4(4.1)		1		
Binge drinking	Yes	84(26.9)	45(53.6)	0.250	0.250	0.147-0.424	0.087
	No	228(73.1)	51(22.4)		1		
Use of salt	Yes	300(96.2)	88(29.3)	7.091	4.818	1.414-7.413	0.078
	No	12(3.8)	8 (66.7)		1		
Residence	Urban	230(73.7)	71(30.9)	0.982	0.982	0.568-1.697	0.949
	Suburban	82(26.3)	25(30.5)		1		
Occupation	Farmer	42(13.5)	11(26.2)	0.822	1	0.377-1.792	0.622
	Civil servant	134(42.9)	44(32.8)		0.822		
	Merchant	136(43.6)	41(30.1)		1.333		
Marital status	Unmarried	67(21.5)	21(31.3)	1.304	1	0.565-1.871	0.928
	Married	191(61.2)	61(31.9)		1.028		
	Divorced	54(17.3)	14(25.9)		1.341		
Educational status	Grade 8 complete	132(42.3)	37(28)	0.738	0.738	0.427-1.275	0.276
	Grade 10 complete	70(22.4)	21(30)		0.812		
	Certificate and above	110(35.3)	38(34.5)		1		
Family size	Single	28(9.0)	15(53.6)	1.119	1.119	0.444-2.817	0.811
	Two	210(67.3)	68(32.3)		1.152		
	Three and above	74(23.7)	12(16.2)		1		
Family history of HTN	Yes	184(58.9)	15(8.1)	0.346	0.346	0.158-0.759	0.068
	No	128(41.1)	81(63.3)		1		
DDS	Low	169(54.2)	51(30.2)	19.42	0.147	0.086-0.251	0.058
	High	143(45.8)	45(31.5)		1		

DDS: dietary diversity score, ETB: Ethiopian Birr, Min: minute, BMI: body mass index, WC: waist circumference, WHR: waist-to-hip ratio, WHtR: waist-to-height ratio, n: number of people, COR: crude odds ratio, AOR: adjusted odds ratio, CI: confidence interval, *statistically significant, %: percentage

6. Discussion

The prevalence of HTN in the present study is 30.7% which is comparable to previous similar community-based studies in Ethiopia. Reports from Addis Ababa (Tesfaye *et al.* 2009) and Gondar, north Ethiopia (Awoke *et al.* 2012) showed 30.2% and 28.3% HTN respectively. The result of the current study is in line with the WHO's 2009 estimate of HTN prevalence in Ethiopia for the year 2008 which was 35.2%. Further, the present result is in agreement with results from other sub-Saharan Africa record. For instance, 31.0% prevalence of HTN was reported in rural and urban populations of Abia State, Nigeria (Ogah *et al.* 2013).

The prevalence of HTN in this study was higher than what was obtained in Jimma (21.3%), southwest Ethiopia (Sisay *et al.* 2012). Another study conducted in Bahir Dar town in northwest Ethiopia the prevalence of HTN was 25.1% (Anteneh *et al.* 2015). In a study that assessed the relationship between socio-economic status and HTN among teachers and bankers in Addis Ababa found HTN prevalence 19.13% and 21.8% for bankers and teachers, respectively (Fikadu and Lemma 2016). Other reports from southern Ethiopia (Giday and Tadesse, 2011) found HTN prevalence of 10.1% and in Vietnam a relatively high figure (14.1%) was recorded (Van *et al.* 2006). The HTN prevalence in this study was also higher than the 23.9, 21.4, 23.7, 21.4 and 29.3% from Jordan (Shishani *et al.* 2013), Kenya, Tanzania, Nigeria and the United States respectively (Ong *et al.* 2007, Henderiks *et al.* 2012). Discrepancies in HTN reports could be because of difference in the study population which in our study the participants are mainly in urban setting with potentially higher risk because of lesser exercise and other lifestyles behaviors.

From the multivariate logistic regression analysis which was summarized in Table 7 sex, BMI, walking or riding a bicycle for 1-4 days/week, sport activity and sedentary activity were statically significant predictors of HTN. The 30.2% and 31.5% proportion hypertensive male and female participants, respectively, is comparable with other studies like Tesfaye *et al.* 2009 who reported 31.5% for men and 28.9% for women in Addis Ababa. A meta-analysis report for Ethiopia shows that the prevalence of HTN among males was 20.6% and females 19.2% Ethiopia (Kiberet and Mesfine 2015). The same authors in their systematic review targeting the literature between January 2000 and April 2015 demonstrated that the rate of HTN prevalence in

Ethiopia varied widely, with the highest rate of 31.5% in males and the lowest (0.8%) in females overall between 20-30%.

Contrary to our finding, prevalence of HTN was higher among females (79.6%) compared to males (74.4%) in a survey of HTN in an older adult population in Nigeria (Ahaneku *et al.* 2011). In a survey of HTN amongst herdsmen living in Tibet, China HTN prevalence among males was 66.1% and females 48.3% (Zhao *et al.* 2012) with significantly higher in men than women.

Overweight and obesity, including abdominal obesity, were more prevalent among females, while elevated blood pressure was high in both males and females. Around a half of the adult Population has sedentary lifestyle. These can be explained by Urbanization which brings an Increasing use of motorized transport and sedentary types of occupation such as office work. Also has influence on shifting dietary and lifestyle behaviors.

In present study the prevalence of overweight was 44.6% out of which 43.2% male and 46.2% female and overall obesity 9.6% (6.5% male and 13.3% female). This finding shows a considerably high prevalence of overweight and obesity among female sex in Kombolcha. The 2011 Ethiopian Demographic and Health Survey (CSA 2012) showed that women in Addis had the highest prevalence of overweight (22.2%) across the country. However, this figure was lower than our estimate of 46.2%. Out of 44.6% overweight adults of Kombolcha 45.3% were HTN. From 9.6% obese, 86.7% of them are positive for HTN. Overweight and obesity, including abdominal obesity, were more prevalent among females, while elevated BP was high in both males and females.

Most participants (67.9%) practiced sedentary lifestyle (TV watching, game playing, khat chewing) and positively associated with HTN, more than half of the adult population has sedentary lifestyle, out of this 36.4% were with HTN. These can be explained by modernization which brings an increasing use of motorized transport and sedentary types of occupation like office work.

Walking or riding a bicycle 1-2 days/week was found to be statistically significant association with odds of HTN which is in agreement with a similar study from Hawassa (Ayalew *et al.*

2012). This finding might be explained by decrease the strength of heart muscle and blood vessels among this group. Sport activity was positively associated with the odds of HTN, participants who can't do sport were exposed 2 times for HTN than their counter parts probably due to accumulation of lipids in blood vessels that could damage blood vessels as well as heart muscles.

Although history of smoking, sedentary lifestyle 'khat' chewing and religion, socio economic status were independently associated with hypertension in many studies, no such association were found in this study. This may be due to the low prevalence of these factors in the study subjects. In general, the study found high prevalence of HTN along with increased prevalence of overweight and obesity which are high risk-factors for developing other CVDs as well.

This study has certain limitations. It was a restricted population survey with a relatively small sample size which could have inherent sampling bias making it difficult to generalize the findings for Kombolcha residents as a whole. Further, the study involves only anthropometric and BP measurements without biochemical tests due to cost, time and other related constraints. Woman might not self-report their alcohol-drinking and smoking habits which are undesirable behaviors within the community.

However, the major strength of this study was that it followed the WHO stepwise approach to NCDs risk factor surveillance studies in a given population. The survey used a modified version of the standard WHO risk factor questionnaire. It utilized several data quality control measures such as careful training of data collectors recruited as qualified health professionals (nurses and health assistants) who were already familiar with the process. It also used calibrated measurement instruments.

7. Conclusion and recommendation

7.1 Conclusion

This study has found a prevalence of hypertension that is higher than previously reported in urban populations in the country, but comparable to similar populations in other parts of Africa. sex, BMI, sedentary activity, sport, walk or ride was observed as significant risk factors for the prevalence of hypertension in the studied population.

Data demonstrated an alarming rate of increasing weight, raised BP, physical inactivity and spreading of sedentary behavior among adults in the study site. In Ethiopia especially in urban area because of urbanization, physical activity is not at moderate amount. Peoples in urban are uses taxis, motor cycles to move from place to place. In Ethiopia, traditionally people believe that being overweight is the sign of living a good life but it is one of modifiable risk factor for hypertension. People who have high income are their dietary habit is mostly fatty foods. Delicious traditional foods in Ethiopia have high amount of salt. These all are risk factors together with minimal physical activity are possible explanations for higher hypertension in urban populations of Ethiopia.

7.2 Recommendations

From the findings of the study, the following recommendations are suggested:

- ◆ Screening of high-risk urban and suburban working populations can be undertaken as a means of early intervention.
- ◆ A broader population-based survey is needed to adequately assess the national prevalence and burden of hypertensions as well as explore the interactions of the various risk factors observed in this study.
- ◆ Strengthen health education and promotion using national and local TV and radio stations encourage civil societies to use social media for awareness creations and establish school and Non-school clubs who create awareness for behavioral change.
- ◆ Encourage donors, bilateral organization and international NGOs to work on interventions for prevention of risk factors of hypertension. Therefore, If corrective actions are not taken, there will be intolerable health consequences among the population in recent future.

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9. Annexes

Annex 1: Written consent form

Date:

Code of Study participant:

English version of participant's consent and Information sheet

Hello. My name is _____ and I am here on behalf of Biniam Hassen, a post graduate student from AAU, I am here to collect information about the prevalence of HTN and its association with nutritional status, lifestyle and behavioral factors among adults living in Kombolcha, Northeast of Ethiopia. I am invited you to participate in the study which would you require your response to an interview on some related issue and measuring height, weight, waist circumference, hip circumference and BP. All information given by you will be kept strictly confident. Your participation is purely voluntary and you are not obligate to answer.

Could I have your permission to continue?

If yes, continue the interview.

If no, pass to the next participant.

For any questions you have, you can contact the principal investigator by: 0913454195

Name (participant)_____ Signature _____ Date _____

Name (Wittiness)_____ Signature _____ Date _____

Name (Investigator)_____ Signature _____ Date _____

Annex 2 Amharic version of the consent form

የዉል ስምምነት ቅፅ

መለያ ኮድ-----

ቀን-----

ስሜ _____ይባላል። እዚህ የመጣሁት

በአዲስ አበባ ዩኒቨርሲቲ የሳይንስ ፋካልቲ የዙዮሎጂካል ትምህርት ክፍል የድህረ ምረቃ ተማሪ የሆነውን ቢንያም ሀሰን ወክዬ ስለ ደም ግፊት ብዛት እና ከመጠን ያለፈ ውፍረት መኖር እና ተያያዥ መንስኤዎች በኮምፕሌክስ ከተማ አስተዳደር ውስጥ በሚኖሩ አዋቂዎች ላይ ለሚጠናው ጥናት መረጃ ለመሰብሰብ ነው። በቃለ መጠይቁ እንዲሳተፉ እጠይቃለሁ ። ለሚጠናው ጥናት የተወሰኑ ጥያቄዎች እጠይቅሁለሁ/ እጠይቅሻለሁ ። በዚህ መጠይቅ የምግብ አመጋገብ ባህሪ ፣ ስለ አካላዊ እንቅስቃሴና የምታሳልፈውን/ የምታሳልፈውን ጊዜ በተመለከተ እጠይቅሁለሁ/ እጠይቅሻለሁ። ከዚህ በተጨማሪ የአንተ/ የአንቺን ክብደት ፣ ቁመት፣ የወገብ ዙሪያና የዳሌ ዙሪያ መጠን እለካለሁ ። ከአንተ/ች የማገኘውን መረጃ በምስጢር እጠብቃለሁ።ከአንተ/ች የምሰበስበው መረጃ ከአንተ/ች ስም ጋር አይያያዝም ። በዚህ ጥናት ውስጥ ለመሳተፍ በቅድሚያ የተሳታፊውን ፈቃደኝነት አንጠይቃለን ።

በዚህ ጥናት ለመሳተፍ ፈቃደኛ ነህ/ሽ? 1.አዎ 2.አይደለሁም

መልሱ“የለም” ከሆነ አመስግነው መጠይቁን ያቁዋርጡ።

ፊርማ-----ቀን-----

Annex 3 English Version of the Questionnaire

Date_____

Code No_____

This interview was about socio-demographic, physical activity, Anthropometric and BP measurements, and dietary pattern. It will help the researcher to find out participant characteristics, knowledge, attitude and practice of the participant towards HTN. All information given in the interview will be handled confidentially. Please, circle the letter of participant choice, or write the figure Part

Part-1-socio demographic and economic characteristics of respondents

Name of town-----, Kebela-----

S.N	Socio-demographic information	Response	C0de
11	Sex	A.Male B.Femal	
12	Residence	A.Urban B. sub urban	
13	Age	-----	
14	Family History	A. Yes B. no	
15	Occupation	A.Farmer B.Employer C.Trader	
16	Marital status	A.Married B.Unmarried C.Separate/divorced	
17	Education status	A.Grade 8 th completed B.Grade 10 th completed C.Certificate & above	
18	Family history to HTN	A. yes B.no	
19.	Family size	A.single B.two C.three and more	
20	Use of salt	A.yes B.no	
21	Currently drink alcohol	A.yes B.no	
22	Currently smoke Cigarette	A.yes B.no	
23	Currently chew Khat (<i>cat edulis</i>)	A.yes B.no	

Part II. Physical activity interview/questionnaires

Physical Activity related interview		
<p>Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer the following questions even if you don't consider yourself to be a physical active person.</p> <p>Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/ training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment, carrying or lifting [Insert other examples if needed]. In answering the following questions 'Vigorous-intensity activities' are activities that require hard physical effort and cause large increase in breathing or heart rate. 'Moderate-intensity activities' are activities that require moderate physical effort and cause small increase in breathing or heart rate.</p>		
Question	Response	Code
Work		
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? [insert example]	A. yes B. no, if no go to D4	D1
In a typical week, on how many days do you do vigorous intensity activities as part of your work?	Number of days {-----}	D2
How much time do you spend doing vigorous-intensity activities at work on an atypical day?	Hours:minutes [---,---] : [---,---]	D3
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? [Insert example if necessary]	A. yes B. no, if no, go to D7	D4
In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days [-----]	D5
How many times do you spend doing moderate-intensity activities at work on a typical day?	Hours:minutes [---,---] : [---,---]	D6

Travel to and from Places		
<p>The next questions exclude the physical activities at work that you have mentioned.</p> <p>Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to worship, to recreation, to learn and other.</p>		
		CODE
How would you travel to and from places?	A. on foot B. by motorized transport if you say B, go to D2	D7
What type of motorized transport system would you use?	A. pedal cycle B. bajjage C. service bus	D8
Would you use a pedal cycle for at least 10 minutes continuously to travel to or move place?	A. yes B. no, if no go to D4	D9
In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places	No of days ()	D10
How much time do you spend walking or bicycling for travel on a typical day?	Time (-----,-----) Hours minutes	D11

Recreational activities		
<p>Ask the next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure). [Insert relevant terms]</p>		
Do you do any vigorous-intensity sports, fitness recreational activities and leisure like (running or football) that causes large increases in breathing or heart rate for at least 10 minutes continuously? [insert example]	A. yes B. no If no go to D16	D13

In a typical week, on how many days do you do vigorous intensity sports, fitness or recreation (leisure) activities?		D14
How much time do you spend doing vigorous intensity sports, fitness or recreation (leisure) activities on a typical activities?	Hours :minutes [-----:-----]	D15
Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heartrate such as ,[cycling, swimming, vollyball] for at least 10 minutes continously? [Insert example if nessorry]	A, yes B. no, If no go to	D16
In a typical week, on how many days do you do moderate - intensity sports, fitness or recreation (leisure) activities?	Number of day [-----]	D17
How much time do you spend doing moderate intensity sports, fitness or recreation (leisure) activities on a typical day?		D18
Do you cheaw khat?	A.yes ,If yes go to D21 B.no	D19
In a typical week on how many days do you chew khat?	Hours :minutes [-----:-----]	D20
Sedentary behaviour		
The following question is about sitting or reding at work, at home, getting to and from places, or with friends include time spent sittings at desk, sitting with friends,traveling in car, bus,bajage,reading, watching television,game playing, khat chewing but do not include time spent sleeping. [Insert example if needed]		
How much time do you usually spend sitting or reading on a typical day	Hours :minutes [-----:-----]	D21

Part IV. Dietary assessment In the past 24 hours

FOOD ITEMS (<i>examples</i>)	Food groups (definitive)	No of times consumed	Code
Rice, wheat, maize , maize porridge, sorghum, millet pasta, bread and other cereals	Main staples		E1
Cassava, potatoes and sweet potatoes, other tubers, plantains			E2
Beans. Peas, groundnuts and cashew nuts	Pulses		E3
Vegetables, relish and leaves	Vegetables		E4
Fruits	Fruit		E5
Beef, goat, poultry, pork, eggs and fish	Meat and fish		E6
Milk yogurt and other diary	Milk		E7
Sugar and sugar products	Sugar		E8
Oils, fats and butter	Oil		E9
Spices, salt, fish power, small amounts of milk for tea.	Condiments		E10

Part V. Anthropometric measurements

S.N	Measurements	Response	Code
001	Weight	In kilogram(kg)-----	
002	Height in centimeter	In centimeters-----	
003	Waist circumference	In centimeters-----	
004	Hip circumference	In centimeters-----	
005	Blood pressure Systolic pressure Diastolic pressure	mmHg----- mmHg-----	

Annex 4 Amharic version of questionnaire

የመጠይቁ መለያ ቁጥር-----
 መጠይቁ የተካሄደበት ቀን-----/-----/-----
 ቀበሌ----- ከተማ-----

ክፍል አንድ:- ማህበራዊ ና ዲሞክራሲያዊ ሁኔታ

ተራ ቁጥር	ጥያቄዎች	መልስ	ከጽ
11	ጾታ	ሀ/ ወንድ ለ/ ሴት	
12	መኖርያ	ሀ/ከተማ ለ/ገጠር	
13	እድሜ		
14	የቤተሰብ ቁጥር	ሀ/ አንድ ለ/ሁለት ሐ/ሶስትናበላይ	
15	የስራ አይነት	ሀ/ገበሬ ለ/የግል ተቀጣሪ/ፋብሪካሰራተኛ ሐ/ነጋዴ	
16	የጋብቻ ሁኔታ	ሀ/ያገባች ለ/ያላገባ ሐ/የተፈታ/ች	
17	የትምህርት ደረጃ	ሀ/ስምንተኛ ያጠናቀቀ ለ/አስር ያጠናቀቀ ረ/ ስርትፍኬት ና በላይ	
18	የደም ግፊት በዘርዎ አለ	1 አዎ 2. አይደለም	
19	አልኩል ይጠጣሉ	1 አዎ 2. አይደለም	
20	ጫት ይቅማሉ	ሀ/ አዎ. ለ/ አልቅምም	
21	ምግብዎ ላይ ጨው ይጠቀማሉ	1 አዎ 2. አይደለም	
	ሲጋራ ያጨሳሉ	1 አዎ 2. አይደለም	

ክፍል ሁለት-አካላዊ እንቅስቃሴ

አካላዊ እንቅስቃሴ			
ከዚህ ቀጥሎ የተለያዩ እንቅስቃሴ በማድረግ የሚያሳልፏቸውን ጊዜያት በተመለከተ እጠይቅዎታለሁ ::			
ጥያቄ	መልስ	አለፉ	መለያ ቁጥር
ስራዎ ብርቱ ጉልበት የሚጠይቅ ተግባር ወይም ቶሎ ቶሎ መተንፈስን ወይም ፈጣን የልብ ምት ሊያስከትል የሚችል ተግባር ያለማቋረጥ በ.ያንስ ለ20 ደቂቃ ይጠይቃል	1 አዎ 2. አይደለም		D1
አብዛሀኛውን ጊዜ በሳምንት ስንት ቀን ብርቱ ጉልበት የሚጠይቅ ተግባር ያከናውናሉ	የቀን ብዛት		D2

ብርቱ ጉልበት የሚጠይቁት ተግባራት በሚያከናውኑባቸው ቀናት ለምን ያህል ጊዜ ይሰራሉ	ሰዓት፣ ደቂቃ		D3
ስራዎ መጠነኛ ጉልበት የሚጠይቅ ተግባር ወይም መጠነኛ የመተንፈስ ወይም የልብ ምት ፍጥነት ሊያስከትል የሚችል ተግባር ያለማቋረጥ ቢያንስ ለ20 ደቂቃ ይጠይቃል	ሀ/አዎ ለ/የለም		D4
አብዛሀኛውን ጊዜ መጠነኛ ጉልበት የሚጠይቁ ስራዎችን በሳምንት ስንት ቀን ያከናውናሉ	የቀን ብዛት		D5
መጠነኛ ጉልበት የሚጠይቁ ተግባራትን በሚያከናውኑባቸው ቀናት በአንድ ቀን ለምን ያህል ጊዜ ይሰራሉ	ሰዓት፣ ደቂቃ		D6
ከቦታ ቦታ እንቅስቃሴ			
ከዚህ ቀጥሎ ከቦታ ቦታ ሲንቀሳቀሱ በብዛት የሚጠቀሙባቸውን መንገዶች እጠይቅዎታለሁ ::			
ከቦታ ቦታ የሚንቀሳቀሱበት መንገድ	ሀ/በ እግር/ሳይክል ለ/በትራንስፖርት/ባጃጅ		D7
ከቦታ ቦታ በሚንቀሳቀሱበት ጊዜ ለ20 ደቂቃ ያለማቋረጥ በእግርዎ ወይም በብስክሌት ይሄዳሉ ::	ሀ/አዎ ለ/የለም		D8
በሳምንቱ ውስጥ ስንት ቀን ከ20 ደቂቃ ያላነሰ ያለማቋረጥ በእግርዎ ወይም በብስክሌት ይሄዳሉ ::	የቀን ብዛት (-----)		D9
በቀን ውስጥ ምን ያህል ሰዓት ሳያቋርጡ የእግር ወይም የብስክሌት ጉዞ ያደርጋሉ	ሰአት (-----)		D10
ከመዝናናትና ከስፖርት ጋር የተለያዩ እንቅስቃሴዎች			
ከፍተኛ የልብ ምት ወይም የአተነፋፈስ ፍጥነት መጨመር ሊያስከፍት የሚችል ስፖርት ቢያንስ ለ10 ደቂቃ ያክል ሳያቋርጡ ይሰራሉ	ሀ/ አዎ ለ/ አይደለም		D11
አብዛሀኛውን ጊዜ በሳምንት ስንት ቀን ከፍተኛ የልብ ምት ወይም የአተነፋፈስ ፍጥነት መጨመር ሊያስከፍት የሚችል ስፖርት ቢያንስ ለ10 ደቂቃ ያክል ያለማቋረጥ ይሰራሉ	የቀን ብዛት -----		D12
ስፖርት ከሚሰሩባቸው ቀናት ውስጥ በአንዱ ቀን ሳያቋርጡ ለምን ያክል ጊዜ ከፍተኛ የልብ ምት ወይም የአተነፋፈስ ፍጥነት መጨመር ሊያስከፍት የሚችል ስፖርት ይሰራሉ	ሰዓት፣ ደቂቃ		D13
መጠነኛ የሆነ የልብ ምት ወይም የአተነፋፈስ ፍጥነት መጨመር ሊያስከፍት የሚችል ስፖርት ቢያንስ ለ10 ደቂቃ ያክል ሳያቋርጡ ይሰራሉ	ሀ/አዎ ለ/የለም		D14
አብዛኛውን ጊዜ በ ሳምንት ስንት ቀን መጠነኛ የሆነ የልብ ምት ወይም የአተነፋፈስ ፍጥነት መጨመር ሊያስከፍት የሚችል ስፖርት ቢያንስ ለ10 ደቂቃ ያክል ያለማቋረጥ ይሰራሉ	የቀን ብዛት -----		D15
ስፖርት ከሚሰሩባቸው ቀናት ውስጥ በአንዱ ቀን ሳያቋርጡ ለምን ያክል ጊዜ መጠነኛ የሆነ የልብ ምት ወይም የአተነፋፈስ ፍጥነት መጨመር ሊያስከፍት የሚችል ስፖርት ይሰራሉ	ሰዓት፣ ደቂቃ		D16
Sedentary behaviour			
አብዛኛውን ጊዜ በ ቀን ለ ምን ያክል ጊዜ ተቀምጠው ያሳልፋሉ(ለምሳሌ፡ ቲቪ ሲያዩ፣ጌም ሲጫወቱ፣ ጫት ሲቅሙ.....)			D19

Annex 5 Operational definitions and cutoff points for Body Mass Index and Hypertension (WHO 2012, WHO 2011)

1. Waist-to-hip ratio (WHR) is obtained by dividing the waist to the hip circumference.
2. Body Mass Index (BMI) is obtained by dividing weight (kg) to height (m) square.
3. The BMI cutoff points: “underweight”: $<18.5\text{kg/m}^2$; “normal weight”: $18.5\text{--}24.9\text{kg/m}^2$; “overweight”: $25\text{--}29.9\text{kg/m}^2$; “obese”: $\geq 30\text{ kg/m}^2$
4. Abdominal or central adiposity : $\text{WHR} \geq 1$ for male and ≥ 0.85 for female
5. Hypertension: sustained high BP ($\text{SBP} \geq 140$ or $\text{DPB} \geq 90\text{mmHg}$) or reported regular use of antihypertensive medications
6. Pre-hypertensive-SBP is 120-139 mmHg and DBP 80-89mmHg
7. Dietary diversity score: obtained by summing the number of food groups consumed during last 24 hour recall.(FAO 2010). The cutoff points out of nine food groups:
“low”: $< \text{six}$; “high ”: $\geq \text{six}$

10. Declaration

I, the undersigned, declare that thesis is my original work and has never been presented for a degree before and all source materials used are duly acknowledged.

Name Biniem Hassen

Signature _____

Date August, 2017

11. Statement of the Supervisor(s)

This thesis has been approved for submission to the Department of Zoological Sciences for public defense.

Name Hassen Mamo (PhD)

Signature _____

Date_____