PREVALENCE AND RISK FACTORS OF CARDIOVASCULAR DISEASE AMONG ADULTS RESIDING IN GILGEL GIBE FIELD RESEARCH CENTER JIMMA, SOUTH WEST ETHIOPIA: A COMMUNITY BASED CROSS-SECTIONAL STUDY, 2017.

BY: KASSAHUN HAILE (BSC. PHO)

RESEARCH RESULT TO BE SUBMITTED TO THE DEPARTMENT OF EPIDEMIOLOGY, INSTITUTES OF HEALTH, JIMMA UNIVERSITY, IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF THE DEGREE OF MASTER OF GENERAL PUBLIC HEALTH, 2017.

FEB, 2017 G.C
JIMMA, ETHIOPIA

PREVALENCE AND RISK FACTORS OF CARDIOVASCULAR DISEASES AMONG ADULTS RESIDING IN GILGEL GIBE FIELD RESEARCH CENTER, JIMMA, SOUTH WEST ETHIOPIA: A COMMUNITY BASED CROSS-SECTIONAL STUDY, 2017.

BY: KASSAHUN HAILE (B.Sc.)

ADVISORS:

1. ABRAHAM HAILEAMLAK (MD, FACP, PROFESSOR)
2. DESTA HIKO (B.Sc., ASSISTANT PROFESSOR OF EPIDEMIOLOGY)

FEB, 2017 G.C
JIMMA, ETHIOPIA

Abstract

Background: Chronic diseases including cardiovascular diseases are becoming common in developing countries. In Sub-Saharan Africa there is inadequate data on the burden of cardiovascular diseases due to low financial allocation and priorities mainly focusing on child and maternal health as well as communicable diseases. Even though national data is not adequately available in Ethiopia, small-scale studies show that CNCDs are emerging as public health problems. The prevalence of NCDs especially CVDs are increasing due to changes in lifestyles. **Objective:** To determine the prevalence and identify risk factors of cardiovascular disease among adults residing in Gilgel Gibe field research center, Jimma, South west Ethiopia, 2017. **Methods**: Data were extracted for this particular study from a population-based cross-sectional study which was conducted at Gilgel Gibe Field Research Center among adults of both sexes to measure the prevalence of common chronic non-communicable diseases, Southwest Ethiopia, conducted from September 2008 to January 2009. Based on the inclusion and exclusion criteria a total of 1731 individuals aged 15-64 years who were participated in the previous survey were selected and included in this study. Data were exported from EpiData version 3.1 to SPSS for Windows version 20.0 and analyzed. Both descriptive and analytical statistical methods (frequency distribution, cross tabulation and summery measures) were displayed. Bivariate logistic regression was done to identify candidate variables at $p<0.25$ at 95% CI. Multivariate logistic regression (backward stepwise: LR) was done to control confounders and identify independent predictors of the outcome variable at $p \leq 0.05$ at 95% confidence interval. **Result:** A total of 1731 study subjects were included in this study. Off those, about 873(50.4%) and 858(49.6%) study participants were males and females, respectively. The overall prevalence of cardiovascular disease was found to be 46/1731(2.7%). The specific reported prevalence of cardiovascular disease was found to be: 9(1.2%) for current khat chewers, 11(5.5%) for raised blood triglycerides. Current Khat chewing (AOR=3.67, 95 CI: 1.69, 7.95), and hypertriglyceridemia (AOR= 2.42, 95% CI: 1.20, 4.88) were found to be the independent predictors of cardiovascular disease in the study population. **Conclusion:** Cardiovascular disease and its risk factors were widely distributed among the study population. In the study population current khat chewing and elevated blood triglycerides were found to be independently associated risk factors for cardiovascular disease. Appropriate preventive and health promotive measures should be designed to prevent and control the problem in the study area.

Acknowledgments

First of all I would like thank God and his mother St. Marry helping me throw-out my work. Secondly, my special gratitude and appreciation goes to my advisors, Professor Abraham H/Amlak (MD**,** FACP) & Mr. Desta Hiko (B.Sc., assistant professor of epidemiology) for their timely advice, unreserved encouragements and provision of constructive comments and guidance in the throw-out this research work. Thirdly, I am very grateful to Gilgel Gibe field research team that allowed me to conduct this recently hot issue on CVD and its risk factors at GGFRC, & delivering all relevant materials that helped me to conduct this research work.

Fourthly, I would like to acknowledge the study subjects, data collectors, supervisors my colleagues who consulting me on these issues.

Last, but not least my heartfelt gratitude also goes to Jimma University for giving me this golden post-graduation opportunity in masters of general public health.

Contents

List of Tables

List of Figures

Abbreviations / Acronyms

AIDS: acquired immune deficiency syndrome

AOR: adjusted odds ratio

BMI: body-mass index

CHD: chronic heart disease

CHF: congestive heart failure

CI: Confidence interval

CNCDs: chronic non-communicable diseases

CVD: cardiovascular diseases

DALYS: disability adjusted life year

DBP: diastolic blood pressure

DE: data extractors

DL: deciliter

FBG: fasting blood glucose

GGFRC: Gilgel Gibe research center

HDL: high density lipoprotein

HWR: hip to waist ratio

ICD: international classification of diseases

JU: Jimma University

JUSH: Jimma University Specialized hospital

L/MIC: Low-and middle-income countries

LD: low density lipoprotein

MET: metabolic energy expenditure

MM: Mill moll

NCD: non- communicable diseases

PI: principal investigator

RHD: rheumatic heart disease

SBP: systolic blood pressure

STEP: chronic disease surveillance project

USA: united States of America

WHO: World Health Organization

1. Introduction

1.1 Background

Chronic non-communicable diseases are chiefly due to preventable and modifiable risk factors such as, high blood cholesterol, high blood pressure, obesity, physical inactivity, unhealthy diet, tobacco use and inappropriate use of alcohol (1). Cardiovascular disease is the one among the chronic diseases which is defined as a group of diseases that involves the heart or blood vessels. There are many diseases in this classification; however they are classified based on the major burden on human health as ischemic or coronary heart disease (IHD), stroke and hypertensive heart disease or congestive heart failure (CHF) (2).

The high burden of CVD in the developing countries are attributable to the increasing incidence of atherosclerotic diseases, which may be in relation to urbanization and higher risk factor levels, relatively early age at which they manifest, large sizes of the population, and the high proportion of individuals who are young adults or middle-aged in these countries. The development of CVD is increased by major risk factors (dyslipidemia, hypertension, diabetes (DM) and smoking). These risk factors are independently associated with CVD and are common among adults both in the developed and developing countries(3)**.** In every part of the world epidemiologic transition is taking place, among all races, ethnic groups, and cultures has resulted in the global rise in cardiovascular disorders (CVD) **(**4**).**

1.2 Problem Statement

Globally non-communicable diseases (NCDs) are the leading causes of death, more people die each year than all other causes together. Nearly 80% of NCD deaths occur in low- and middle-income countries(5)**.** Throughout the world cardiovascular disease (CVD) is a major cause of disability and premature death. Atherosclerosis is the underlying pathology, which develops over many years and is usually advanced by the time symptoms occur, generally in middle age(6)**.** According to WHO 2010 report, Out of 57 million deaths occurring in the world, 36 million (63%) were due to NCDs. Globally cardiovascular disease is the leading causes of death (17 million, or 48% of NCD deaths) (7)**.** According to WHO estimates, Ischemic heart disease and cerebrovascular disease causes substantial long-term morbidity and are the major causes of all disease burden (as it is measured by disability-adjusted life-years [DALYs] lost(8)**.**As a result of

the changing urbanization and westernization lifestyle in SSA non-communicable diseases like coronary heart disease increasing particularly in urban areas, the magnitude and pattern of cardiovascular diseases together with their risk factors are changing. Epidemiological shift is facing in the region which is from AIDS to cardiovascular diseases being the leading cause of death. Even thought, the USA has higher rates of CVDs currently, these are declining compared to the rates in SSA **(9).**

Even if, cardiovascular diseases have high medical and economic burden in the world, it has not been emphasized. Over the coming decades in SSA, morbidity and mortality from cardiovascular disease are increasing (10)**.**

In SSA lack of lack of research on CVD leads to insufficient data on the disease burden due to poor funding and reduced local expertise. Although some data from the continent demonstrate a relatively low burden in urban patients, on the other hand WHOs committee for Africa stated that the burden is rapidly increasing in the continent, and now it becomes a public health problem throughout Africa. The important cardiovascular diseases in adults in SSA are arterial hypertension, stroke, cardio-myopathies and rheumatic heart disease. In African children rheumatic heart disease, cardio-myopathy and untreated congenital heart diseases are also common (11)**.**

The burden of premature mortality and disability due to cvd impose a risk to human, social and economic development **(12).** Cardiovascular diseases are believed to be the problems of wealthy societies, but they represent an under reported and neglected burden on health in the developing countries and one that is ever-increasing **(13).** Deaths from CVDs are higher in SSA than the other regions in the world. It was estimated that in 2015 CVD was projected to be the leading cause of death in all income groups **(14).**

In Ethiopia, Routine health care reports are incomplete and unreliable. This leads to lack of understanding on causes of death and the real magnitude of disease or its pattern. Hence, due to the health system giving greater emphasis for infectious diseases, it fails to be responsive to emerging health problems (CNCDs) **(15) .**However, declining mortality rates, and increasing urbanization and rising life expectancy have been observed in the country **(16).**

In Ethiopia, NCD are estimated to account 34% of all deaths, and CVD covers 15% in all age groups in 2008(WHO2010a)**.** The largest proportion of causes of death is due to cardiovascular disease (CVDs) compared to the other chronic diseases. In the country there is lack of an integrated or topic-specific policy action plan which is currently operational for CVDs as it is becoming increasing **(17).**

Even though, national data is not adequately available in Ethiopia, small-scale studies show that CNCDs are emerging as public health problems. The prevalence of NCDs especially CVDs are increasing due to changes in lifestyles and this proportion is projected to increase to be 43.2% by 2030 (i.e.41.2% rise from the level in 2005) **(18).**

A study conducted during 2008/2009 in the area among adult population to determine the prevalence and risk factors of CNCDs reported that the overall prevalence of CNCDs in the study population was 8.9%. Among the common CNCDs cardiovascular disease accounts 3% which is highest in magnitude in the study population compared to others**.** In addition to this**,** the observed prevalence of HTN and MD was greater than self-reported prevalence. This indicates that the real magnitude of cardiovascular diseases could have been higher because of both are intermediate risk factors for cardiovascular diseases **(13).**

1.3 Significance of the study

The few existing reports in Ethiopia are health facility based which do not show the magnitude of cardio-vascular diseases at community level. Very limited community based studies tried to show the magnitude of the problem on specific diseases. Due to lack of data showing the real burden of cardiovascular disease in the developing world in general and in Ethiopia in particular, there is no clear ground and guidance for policy makers to plan and implement intervention strategies. Therefore, this study was conducted to determine the prevalence and associated factors of CVD in a community setting to be a basis for decision making and policy formulations. Moreover, this study will serve as baseline information for further studies at national level.

Generally the trend of CNCDs including CVDs is increasing in Africa including Ethiopia. Most of CNCDs have common risk factors and inter related to each other. Therefore, the Gilgel Gibe

field research team did not studied specifically on the prevalence and associated risk factors for cardiovascular diseases in the study population, so this study identified the prevalence and associated risk factors of cardiovascular diseases in the study population.

2. Literature Review

Globally non-communicable diseases (NCDs) are the leading causes of death, more people die each year than all other causes together (5) among the common chronic NCDs in the world cardiovascular disease (CVD) is a major cause of disability and premature death (17 million, or 48% of NCD deaths) particularly ischemic and cerebrovascular heart diseases causes substantial long-term morbidity and are the major causes of all disease burden (as it is measured by disability-adjusted life-years (6-8). Behavioral risk factors such as physical inactivity, tobacco use and unhealthy diet explain nearly 80% of the CVD burden (2).

A review conducted in SSA identified that lifestyle factors such as diet and smoking contribute to the increasing rates of CVD. Obesity is predominant risk factor for women compared to men, while smoking remains a risk factor for men. Urbanization, poverty and lack of government programs and infrastructure for healthcare drive this epidemic and hampers proper prevention, surveillance and treatment efforts **(19).**

In Ethiopia, 34% of all deaths were due to NCD off which CVD covers 15% in all age groups in 2008 (17). The four behavioral risk factors (physical inactivity, inadequate intake of fruits and vegetables, alcohol consumption and cigarette smoking) together with physical risk factors (overweight, obesity, raised blood pressure) as well as substance abuse/misuse were widely prevalent in Ethiopia (47).

A community based survey conducted in 2008/9 reported that the prevalence of CVD in the study area were 3% and associated risk factors i.e. smoking 9.3%, alcohol consumption 7.3%, consumption of fruits and vegetables below adequate level 27.0%, low level physical activity (16.9%), khat chewing (38.6%), 9.3% for hypertension, 2.6% for overweight, 33.3% central obesity, 10.7% for high total cholesterol and 7.7% for raised triglyceride (13, 30).

2.1 Non-modifiable risk factors of cardiovascular diseases

2.2 Age and sex

A survey conducted among study participants of age > 40 in china, reported that the overall self-reported prevalence of CHD and stroke was 6.1% (95% CI, 5.5%-6.8%) and 3.7% (95% CI, 3.4%-4.0%), respectively. either in men or women similar increased trends of age-specific prevalence with age growing for both CHD and stroke **(20).** A study in Tehran among adult population reported that self-reported history of CHD was 21.8% in a population of age≥30 years and women were more affected than men. Independently associated variables with CHD were age and female sex **(21).**

2.3 Modifiable risk factors for cardiovascular diseases

The common risk factors for cvd among adults in Australia and middle-income country reported were poor diet, physical inactivity (women than men), current daily smoking (more men than women), excessive alcohol consumption (men than women), obesity , high BP, high blood cholesterol levels and diabetes in the study population. Heart diseases increased dramatically with age (22-23).

The other risk factor for cvd was Khat chewing which was found to be an independent risk factor for AMI that is Khat chewers (moderate) were at 7.62 times higher risk of developing cvd than their counter parts (24-25).

A study in India among adults reported that the prevalence of smoking among males was (44.6%) and urban adults were more affected by smoking and low physical activity. The risk of CAD increased with smoking (26) in addition to this obesity, hypertension and diabetes Miletus were the associated risk factors for cvd i.e. CVD was increased with diabetes and hypertension (27).

A study in Ethiopia among adults reported that the prevalence of HTN was higher among males than females but females were more overweight than males. Females (31%) were more physically inactive than males (17%) (28, 29). The prevalence of risk factors of cvd reported from a previous study conducted among adults were smoking cigarette (all kinds) at the time of the study; >18 % males were smokers, (more smokers were from rural (10.6%) than urban

(5.3%)), for alcohol consumption 7.1%(men (8.7%) were more drinker than women (5.7%) and among urban than rural residents), for low fruit and vegetables consumption 27%(urban men and rural women were more low fruit and vegetable consumption than others), for low level of physical activity 16.9% (urban women (24.8%) were more inactive than others), for Current Khat chewing 38.6% (higher for urban men (49.9%), for RBP 9.3% (higher among urban than rural area and among men than women, with highest). Eighty three (2.6%), (1.5% men and 3.5% women) of the study subjects had BMI ≥ 25 kg/m2. central obesity was 33.3% (30-31).

2.4 Other socio-demographic risk factors for cardiovascular disease

2.4.1 Socio-economic status and cardiovascular diseases

Low income and low education were found to be associated with significantly higher risk of developing CVD compared to their opposite. Those with no tertiary or a trade's education had higher 5-year CVD risk compared with university education **(**32).

A study conducted in 2008 by using questionnaire to identify Socioeconomic determinants of NCDs among the Cypriot population with a total sample of 465 adult participants, reported that in terms of education,54.8% of participants were middle-level (high-school) graduates, 24.9% university/college graduates and 20.2% had elementary education. There was a statistically significant negative correlation between family income and CVD **(**33). Study conducted to identify the association of socioeconomic profiles with cardiovascular risk factors in Irana among adults reported that higher income level increased the likelihood to develop CVD (34).

3. Conceptual Framework

Conceptual framework which is adopted from similar studies done on CVDs

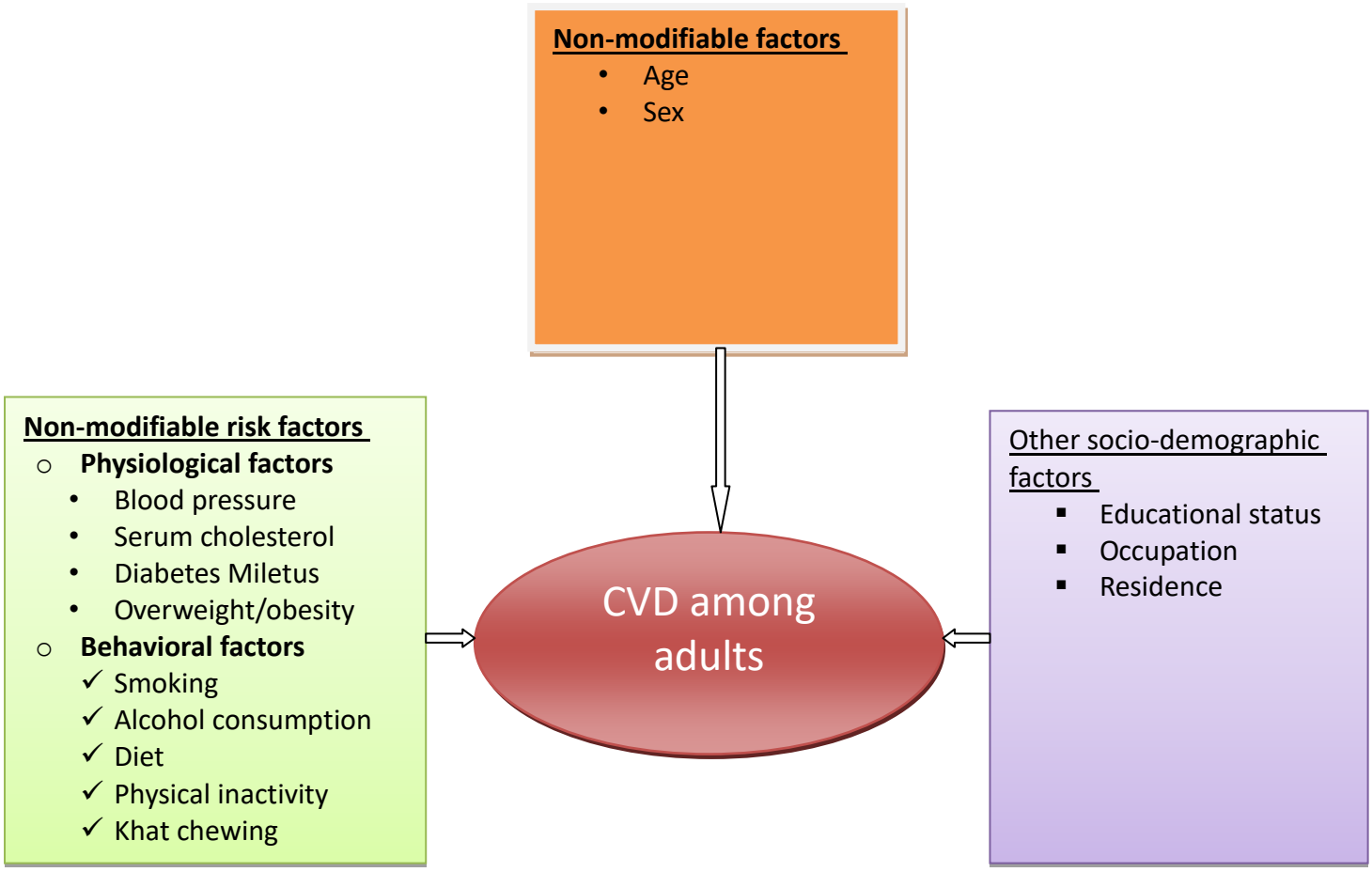

Figure 1.Conceptual frame work for CVDs and its risk factors developed from literatures.

4. Objectives

General Objective

1. To determine the prevalence and identify risk factors of cardiovascular disease among adults of both sexes at Gilgel Gibe research center in Jimma zone, southwest Ethiopia, 2017.

Specific Objectives

1. Determine the prevalence of cardiovascular disease among adults at Gilgel Gibe field research center.
2. Identify modifiable risk factors associated with cardiovascular disease among adults at Gilgel Gibe field research center.
3. Identify non-modifiable risk factors associated with cardiovascular disease among adults at Gilgel Gibe field research center.
4. Identify other socio-demographic risk factors associated with cardiovascular diseases among adults at Gilgel Gibe field research center.

5. Methods

5.1 Study Area and period

The study was conducted in Gilgel Gibe Field Research Center (GGFRC) of Jimma University (JU). The center serves as health and demographic surveillance system for the University and comprises of 8 rural and two urban kebeles (the lowest administrative unit in Ethiopia) i.e. Siba, Degoso, Kejelo, Koticha, Ayano, Deneba town, Enkure, Bore, Asendabo town and Burka). The study area comprised of about 11,000 households with a total population of 50,000. Off which, 24,500 (49%) peoples were in the age of 15 to 64 years.

Majority of the residents live with subsistence agriculture producing mainly food crops. There were one health center and 4 health posts in the center during the study period. There were two trained health extension workers in each kebele. In the urban kebeles the source of water was either shallow dug well, pipe water or protected springs whereas the major sources of water in rural kebeles were unprotected. All rural kebeles were accessible only during dry season by four-wheel drive. All the kebeles had access to mobile phone and in addition the urban kebeles had access to home phone.

This population-based cross-sectional survey was conducted from September 2008 to January 2009 at Gilgel Gibe Field Research Center (GGFRC) of Jimma University to determine the prevalence of common CNCDs and their risk factors among adults. This particular study was part of this study which focuses on the prevalence of CVD and its associated risk factors among the study subjects. Data extraction and analysis was done from February to march 2013.

5.2 Study Design

Data were extracted from a population-based survey of chronic Non-communicable Diseases and their risk factors at Gilgel Gibe Field Research Center, southwest Ethiopia, conducted from September 2008 to January 2009. Individuals' age 15 to 64 years of both sex, who were residents of the 10 kebeles of the center were studied.

5.3 Population

5.3.1 Source Population:

All 24,500 (49%) adults in the age ranges of 15-64 years of both sexes who were used as a source population in the previous study on the common CNCDs and their risk factors by the GGFR team during 2008/2009**.**

5.3.2 Study population

All randomly selected individuals' aged 15-64 years who were included in the previous study of both sexes who had complete and consistent information for this particular study Inclusion Criteria

Inclusion and exclusion criteria

5.3.2.0 Inclusion criteria

Individuals in the age range of 15-64 years living at GGFR center that had complete and consistent information based on the variable of interest for this study who were involved in to all the three stages of the previous survey were included.

5.3.2.1 Exclusion criteria

In complete and inconsistence observations which were not field by the data clerk. Data that did not had complete information on CVDs and its risk factors were excluded.

5.3.3 Sample size and sampling procedure of the previous survey

The study base was mapped, houses numbered and census carried out in August 2005. The study area comprised of about 11,000 households with a total population of 50,000 in the center. Out of the total population, nearly half of the total populations (49%) were in the age range of 15 to 64 years.

To select the study participants, the 2008 updated census list of the population and households of the ten kebeles was used as sampling frame. Taking 25% urban and 75% rural population distribution in the center, the total sample was distributed proportionally to each kebele. Then the sample was distributed to each kebele proportional to their population size. Using the age and sex stratified sampling frame obtained from the census list, individuals were selected randomly.

Sample size was determined, using recommendations in the WHO STEPS surveillance manual (36), to estimate prevalence of CNCDs and their risk factors in each stratum of age, sex and residential area (Figure 2). The sample size for STEP I and II of the survey was 5,500 and 60% (3,300) of these were sampled for STEP III. For sample selection, a list of all eligible study participants was obtained from vital registration of the area in Jimma University. Furthermore, equal sample were allotted into each sex and age strata (Table 1). Age was grouped to five strata,

in intervals of ten years. Individual study subjects were then selected using simple random sampling technique.

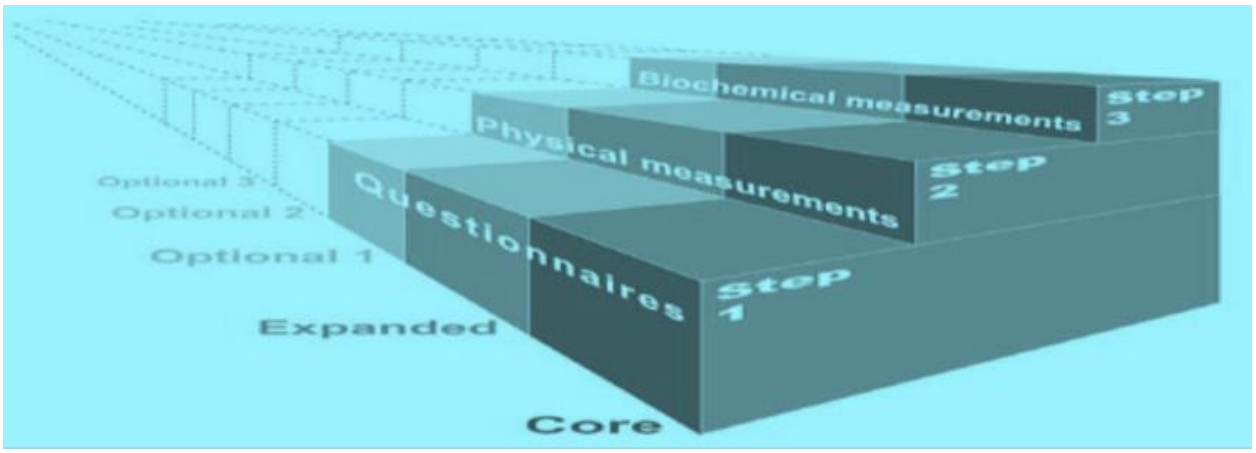

Figure 2.General concept of the STEP wise approach (35)

Individuals' aged 15 to 64 years from both sexes, who were residents of the 10 kebeles under surveillance by the research center were studied. Step one, two and three were used to assess the risk factors through interviewing, physical measurement and biochemical tests, respectively.

The population was stratified by sex, age (15-24 years, 25-34 years, 35-44 years, 45-54 years and ≥55years) (Table 1) and residential area (urban and rural) and such stratification was considered in the sample size calculation so as to be able to make analysis by those variables.

For step one (interview) and two (physical measurement), 250 individuals from each sex and each age stratum were taken giving a sample size of 2500. However, due to further stratification by residential area, the sample size was doubled to 5,000. Taking 10% non-response rate, the total sample size became 5,500. The sample was allotted to each age, sex and residential area stratum proportional to its size. Individual study participants were then selected from each stratum by stratified random sampling (Table 1).

Table 1. Age and sex strata of study population, GGFRC, 2008

Age group	Sex		Total
	Male	Female	
15-24	500	500	1000
25-34	500	500	1000
35-44	500	500	1000
45-54	500	500	1000
55-64	500	500	1000
Total	2500	2500	5000
Adding 10% for non-response			5500

For step three (biochemical testing), 3,300(60%) of the sampled individuals for step one and two were selected by simple random sampling and participated for blood sample collection as per WHO STEPS manual recommendation (35).

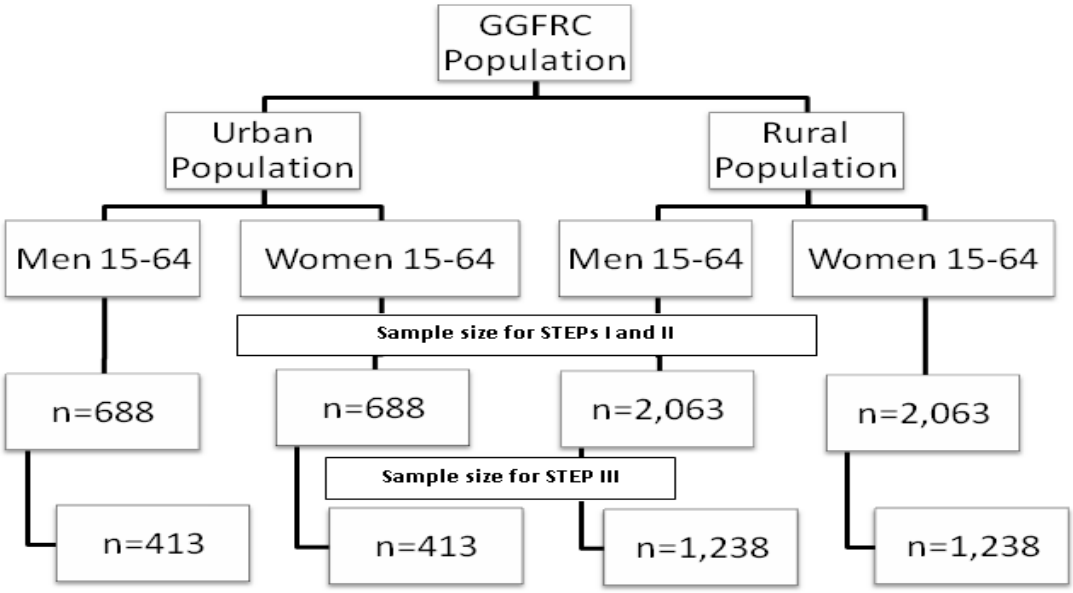

Figure 3. Schematic presentation of sampling procedure for chronic illness survey in GGFRC, Southwest Ethiopia, 2008.

The sample size for this particular study on the prevalence and determinants of CVDs among adults were derived from the previous study on CNCDs and their risk factors among adults at Gilgel Gibe field research center in 2008/2009.

After preparation of templates which included all the variables of interest for this study with formal request letter was submitted to the GGFRC team coordinator, then permission was secured and the data was accessed with a WR-CD.

A total data set of 4731 and 1861 study participants who were involved in I & II and III steps respectively, were accessed separately. Then these two data sets were merged based on the identifier i.e. family individual identification (faminv) after cleaning and editing 4731-1865=2870 study subjects did not had step III information and excluded, finally 1861 individuals were participated in all the three steps, off these 130 individuals were excluded because of missing information. Incomplete and inconsistent study subjects were removed after this individuals with complete information i.e. individuals who were involved in all the three stages (1731) were retained for final analysis. Therefore, the final sample size for this particular study was 1731 data sets that were complete information on cardiovascular disease and its associated risk factors.

5.4 Study Variables

5.4.1 Dependent Variables

Cardiovascular disease

5.4.2 Independent Variables

Non-Modifiable Risk Factors

- age
- Sex

Modifiable Risk Factors

- Physiological factors
  - High blood pressure
  - Abnormal serum cholesterol
  - Diabetes mellitus
  - Overweight/Obesity
- Behavioral factors
  - Cigarette smoking
  - Physical inactivity
  - Diet (fats and oil consumption)
  - Khat chewing
  - Alcohol consumption

Other socio-demographic Risk Factors

- Residence

- Education levels
- Occupation

5.5 Data collection tools & Measurements

The data collection tools and measurements used by the GGFR team were as follows: Data collection instruments for the study were adapted from WHO STEPS instruments (35) and translated to local languages (Amharic and Afan Oromo). The instruments were structured and contained questionnaire for Step one and recording formats for Step two and Step three. Interviewer administered structured questionnaires in English language were adapted from WHO STEPS instruments to collect data.

Socio-economic and demographic variables and questions for assessing behavioral risk factors for CNCDs including cigarette smoking, alcohol drinking, dietary habit, khat chewing, and level of physical activity. The recording formats were used to record physical measurement values of Step 2 such as blood pressure (BP), weight, height, waist and hip circumference; and values for biochemical markers of Step 3 such as fasting blood sugar level, total blood cholesterol level and blood triglycerides level.

For this current study template was prepared based on the main variables of interest and submitted to the GGFR team and accessed the data by RWR-CD after having permission from Jimma university ethical clearance committee. The following variables were collected to study the prevalence and risk factors of cardiovascular diseases among adults at GGFR center.

- ✓ Non-Modifiable Risk Factors
  - age
  - Sex
- ✓ Modifiable Risk Factors
  - Physiological factors
    - Blood pressure
    - Blood cholesterol
    - Diabetes mellitus
    - Overweight/Obesity
  - Behavioral factors

- Cigarette smoking
- Physical inactivity
- excessive Alcohol consumption
- Diet (fruit and vegetables, fats and oil consumption)
- Khat chewing

✓ Other socio-demographic Risk Factors

- Education level
- Residence
- occupation

5.6 Data Collection procedures

Data collection procedures performed by the GGFR team looks like field personnel had a minimum of high school completion and competent in Amharic and Oromifa languages. Fifteen interviewers, six physical measurement recorders and 3 supervisors were recruited for CNCDs survey. Two nurses and 2 laboratory technicians were recruited to collect blood samples.

Face to face interview was conducted at home level after the interviewers explained the purpose of the study and obtained the participant's signed consent to participate in the study. Eligible respondents were declared unavailable if they were not found on three separate visits. After completion of face to face interview, all respondents were given appointment for physical measurements. Additionally those respondents who were selected for biochemical tests were given instructions for overnight fasting (not to eat or drink after 8:00 pm) and early morning appointment given.

Whole venous blood sample was collected in the morning (8:00 am to 12:00 noon) after cleaning the cubital area by 70% alcohol and stored in 3 ml vacutainer tubes. Then the sample was placed in ice-box and transported to the JUSH laboratory where the laboratory procedures are performed.

Three blood pressure (BP) readings were taken at a minimum of three minutes interval after the participant rested for 30 minutes. BP was measured in sitting position with the arm placed at the level of the heart mostly on right upper arm in mild flexion using the WHO recommended automatic BP monitor.

Height was measured using a Stadiometers (INVICTA Plastics Limited, England, and Model 2007246) to the nearest 0.1cms while the participant stood still bare footed.

Weight was measured to the nearest 0.1 kg with a calibrated portable digital weight scale (model 770; Seca, Germany) while the participant lightly clothed and shoes off. Waist and hip circumferences were measured to the nearest 0.1cms using measuring tapes. Waist circumference was measured in centimeters at the midpoint between the bottom of the ribs and the top of the iliac crest. Hip circumference was also measured in centimeters at the largest posterior extension of the buttocks.

Fasting blood sugar level, total blood cholesterol level and blood triglycerides level were determined.

For this study on the prevalence and determinants of CVDs at GGFR center the data were extracted from the data owners of Gibe field research center in 2008/2009 after having a written permission. The data sets were extracted by two data extractors based on the variables of interest which was filled in the template.

5.7 Data Quality Assurance by the previous survey team

All data collectors were a minimum of high school completed. All study instruments were translated into local languages (Amharic and Afaan Oromo) by native speakers and then back translated to English by two other competent persons.

Calibrated Physical measurements were used. There was daily supervision in the field during data collection period at all levels by field supervisors and the investigators. Incomplete and inconsistent data found during supervision and data entry were returned to data collectors for rectification.

The physical measuring equipment was calibrated daily and standardized. Supervisors checked laboratory procedures randomly and each completed formats. Standard operating procedures were followed for all laboratory procedures.

Supervisors checked each completed format and rechecked during data entry. Data entry personnel coded and entered the data using a double entry method.

For this study to ensure and maintain the external validity of the study, adequate related literatures were reviewed; opinions from the experts and the concerned body was obtained; comments from experts invited and shared with the research advisor throughout the research process.

For this particular study incomplete, inconsistent and outlier observations were excluded from the analysis and only complete and consistent data were used.

5.8 Data processing, Analyses & interpretation

Double data entry was done by trained data clerks. Moreover, data were checked for completeness, inconsistency and outliers by looking at their distribution.

The mean of the three readings for systolic and diastolic pressures were determined and thus the mean of the three readings were accepted as BP of the individual. BMI was calculated as weight in kg divided by square of height in meter of individual (kg/m2). Waist to hip circumference ratio (WHR) was calculated by dividing the waist to hip in centimeters. Frequencies, summary values and measures of dispersion were determined when appropriate and necessary. Biochemical variables were interpreted based on standard cutoff values.

Serum total cholesterol and triglycerides were determined using Human star 80 (Gesellschaft fur Biochemical und Diagnostica, Germany) with specific reagents for each biochemical values as per the manufacturer's instructions. Incomplete and inconsistent data were excluded from the analysis. Data were properly filed and stored both in electronic copies with back up and hard copies.

This study was part of the survey for determination of magnitude of CNCDs, risk factors of CNCDs and biochemical, immunological and hematological value determination for the community at GGFRC.

For this study the data was obtained from the research team based on the variables of interest and analyzed using SPSS for Windows version 20.0. Background of the study participants was determined.

The specific variables important for this study were socio-demographic, behavioral, biophysical, biochemical (metabolic syndrome) which were associated with cardiovascular diseases to measure the prevalence and associated risk factors fort CVD. Both descriptive and analytical statistical methods (frequency distribution, cross tabulation and summery measures) were displayed based on the study variables. Bivariate logistic regression was computed to identify candidate variables for multivariable logistic regression then variables which had a $p<0.25$ were selected. To identify independent predictors of cardiac diseases backward stepwise: LR multivariable logistic regression method was used. The study variables used were (smoking, khat use, alcohol consumption, use of oils and fats, physical activity, raised blood glucose, raised blood pressure, raised total blood cholesterol, age, sex, occupation, educational level, and residence) with cardiovascular disease. A chi-squared test was used to compare groups to see whether there is significant statistical association between the dependent and independent variables. All factors with a p-value <0.25 in the bivariate logistic regression analysis was further entered into the multivariate model to control confounding effects and Odds ratios (OR) with 95% confidence intervals (CI) was calculated to identify independent predictors of CVD& Statistical significance was accepted at the 5% level ($p\leq0.05$).

Bivariate analysis was carried out and variables which were significantly associated and those who have borderline significant association with the dependent variable were candidates for the final model. Therefore, variables like sex, residence, age, khat chewing, waist-to hip ratio , blood triglyceride level, blood cholesterol, body mass index, and waist circumference) were eligible for multivariable logistic regression. Multivariate logistic regression (backward stepwise: LR) was done and finally two variables (current khat chewing and raised blood triglycirides) were identified as independent predictors of the outcome variable.

5.9 Ethical clearance

The proposal was presented to Medical Sciences Faculty research committee for assuring scientific integrity and human subjects' protection. The proposal was then submitted to the University's Research and Publication Office for final ethical clearance.

The proposal was approved by Jimma University ethical review committee. Supportive letter was obtained from the university and given to the Jimma Zonal and to the four Woredas administrations. Two written consent formats were developed and used: one for interview and

physical measurements and the second one for blood sample collection. Ethical clearance was obtained from Jimma University's Research and Publication Office. Signed informed consent was obtained from study participants before interview, physical measurements and blood sample collection.

Individuals who had elevated BP or having indication of any of the CNCDs during the survey were referred to the nearest health center or hospital for further investigation and management.

For this particular study on the prevalence and associated factors of CVD permission was secured from the Gelgel gibe survey data owners after legal request. The proposal was approved by Jimma University ethical review committee. Data was properly stored both in electronic copies with back up. Confidentiality was maintained by the principal investigator only accessing the data.

5.10 Operational Definitions and Terms

- **Participants were considered having cardiovascular disease** if they reported a previous diagnosis of heart disease, reported taking cardiac medication or symptoms of heart disease such as easily tiring on walking or tiring on sitting (30).
- **Central obesity**-Waist to Hip Ratio (WHR) greater than one for men and greater than 0.85 for women (35).
- **High cholesterol**- blood cholesterol level 5.22mmol/L or more (35).
- **Raised triglyceride**-blood triglyceride level 2.26mmol/L or more (35).
- **Non-modifiable risk factors**-factors refer to characteristics that cannot be changed by an individual (or the environment) and include age, sex, and genetic make-up. Although they cannot be the primary targets of interventions, they remain important factors since they affect and partly determine the effectiveness of many prevention and treatment approaches (35).
- **Common modifiable risk factors**-refers to characteristics of societies or individuals can change to improve health outcomes. WHO typically refers to four major ones for NCDs: poor diet, physical inactivity, tobacco use, and harmful alcohol use (35).
- **Behavioral risk factors** - represent four main risk factors: tobacco use, physical inactivity, harmful use of alcohol and unhealthy diet (35).

- **Body Mass Index**-calculated as weight in kilograms divided by height in square meters and interpreted as underweight (BMI<18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0 - 29.9 kg /m2), and obese (≥30.0kg/m^2) (35).
- **Participants were considered hypertensive** if they reported a previous diagnosis of hypertension, reported taking antihypertensive medication, or had a systolic BP (SBP) ≥ 140 mm Hg or a diastolic BP (DBP) ≥ 90 mm Hg (35).
- **Diabetes** was considered by self-report or fasting glucose (FG) ≥ 126 mg/dl (≥7.0mmol/l). Use of hypoglycemic agents was not ascertained (35).
- **Low level of total physical activity**- total physical activity MET-minutes per week <600 minutes/week **(**46**).**
- **High level of total physical activity**- total physical activity MET-minutes per week ≥1500 minutes/week (46).
- **Moderate level of total physical activity**- total physical activity MET-minutes per week≥ 600 minutes/week (46).
- **Current smoking-** reported current smoking at the time of the survey (35).
- **Current khat use**- reported consumption of khat at the time of the survey (30).
- **Alcohol consumption**- reported consumption of alcohol twelve month prior to the survey (36)

6. Result

6.1 Socio-demographic characteristics of the study subjects and cardiovascular disease

A total of 1731 study participants data were included in this study, of which 873(50.4%) and 858(49.6%) were males and females, respectively. The mean age was 41.09±14.81 years. Majority of the respondents were, from rural 1656(95.70%), 923 (53.60%) farmers, and 1436(83.30%) were not attended formal education. The prevalence of cardiovascular disease distribution among the socio-demographic characteristics were, 32(3.7%) for females, 17(4.3%) for aged ≥55 years, 5(6.7%) for urban residents, 1 (4%) for government workers, 40(2.8%) for no formal education, compared to their counterparts. Lowest prevalence was observed among individuals' aged 15-24 years 4(1.6%), males 14(1.6%) and in educational level ≥9 (1.7%). The prevalence of CVD increased (except in the age of 45-54) with age in fact it was not showed statistically significant associations (**Table 2).**

Table 2.Socio-demographic characteristics of study participants and CVD among adults of both sexes' residents of GGFRC, 2017.

Variable	CVD		COR(95%&CI)	P-value
	Yes No (%)	No No (%)		
Sex				
Female	32(3.7)	826(96.3)	**2.30(1.25,4.48)***	**0.008***
Male	14(1.6)	859(98.4)	**1**	
Age				
15-24	4(1.6)	248(98.4)	1	
25-34	7(2.1)	327(97.9)	1.33(0.38,4.58)	0.65
35-44	11(2.8)	383(97.2)	1.78(1.56,5.66)	0.33
45-54	7(2.0)	345(98.0)	1.26(0.36,4.34)	0.72
≥55	17(4.3)	382(95.7)	2.76(0.92,8.29)*	0.07*
Residence				
Urban	5(6.7)	70(93.3)	**2.81(1.08,7.34)***	**0.03***
Rural	41(2.5)	1615(97.5)	**1**	
Occupational				
farmer	26(2.8)	897(97.2)	1.565(0.47,5.23)	0.47
gov"t worker	1(4.0)	24(96.0)	2.25(0.23,22.52	0.49
merchant	1(2.9)	33(97.1)	1.64(0.17,16.22)	0.67
housewife	15(2.6)	561(97.4)	1.44(0.41,5.05)	0.57
others	3(1.8)	162(98.2)	1	0.95

Education				
No formal schooling	40(2.8)	1396(97.2)	1	
1-8	5(2.2)	224(97.8)	0.78(0.30,1.99)	0.60
>=9	1(1.7)	58(98.3)	0.60(0.08,4.45)	0.62

P*<0.25, 1-reference group

6.2 Behavioral risk factors and cardio-vascular diseases

The distribution of the various categories of risk factors is identified. Among the behavioral risk factors, the prevalence of smoking is 166(9.6%), khat chewing 760 (44%), low level of physical activity 316**(**19.1%) and alcohol consumption 65(3.8). The prevalence of CVD among these risk factors were 1.8% among smokers, 1.2% for khat chewers, 2.2% for low levels of physical activity, 6.2% for alcohol drinkers (**Table 3**).

Table 3. Behavioral risk factors and cardio-vascular disease among the study participants resident of the GGFRC, 2017.

Behavioral risk factors	CVD		COR(95%CI)	P-value
	Yes No (%)	No No (%)		
Smoking status				
Non -smokers	43(2.8)	1517(97.2)	1.56(0.48,5.09)	0.47
Smokers	3(1.8)	163(98.2)	1	
Kahat chewing				
Non chewers	37(3.8)	931(96.2)	**3.32(1.59,6.91)***	**0.001***
Kahat chewers	9(1.2)	751(98.8)	1	
Physical activities				
≥600 MET-minutes/week	36(2.7)	1305(97.3)	1	
<600 MET-minutes/week	7(2.2)	309(97.8)	0.82(0.36,1.86)	0.82
Alcohol drinking				
No	42(2.5)	1624(97.5)	**1**	
Yes	4(6.2)	61(93.8)	**2.54(0.88,7.29)***	**0.08***
Types of oils used				
cereal oil	24(2.0)	1158(98.0)	1	
vegetable oil	12(5.6)	202(94.4)	0.87(1.41,5.82)	0.400
none in particular	8(3.6)	214(96.4)	1.80(1.80,4.07)	0.265
others	2(1.8)	110(98.2)	0.88(0.21,3.76)	0.860

P*<0.25, 1-reference group, MET-metabolic equivalents (46)

6.3 Physiologic and physical risk factors and CVD distribution

The prevalence of those associated factors were for raised fasting blood glucose 47(3.70%), for overweight/obesity 26(1.50%), for higher waist- to- hip ratio 578 (33.40%), for hypertension 132(7.60%), for higher cholesterol 242(14.0%), for hypertriglyceridemia 201(11.90%) and high waist circumference 24(3.2%). The prevalence of CVD among the those factors were 7.70%, 7.70%, 5.50%, 3.60%, 3.70%, 3.80% and 2.10% among, overweight/obese, high waist circumference, hypertriglyceridemia, higher waist-to-hip ratio, higher blood cholesterol, hypertensives and raised blood glucose, respectively (Table 4).

Table 4. Physical and biochemical risk factors and CVD among adults residing at GGFRC, 2017.

Variables	CVD			
	Yes No (%)	No No (%)	COR(95%CI)	P-value
Fasting blood glucose				
Norma	34(2.5)	1324(97.5)	1	
Raised	1(2.1)	46(97.9)	0.85(0.11,6.32)	0.87
Body mass index				
underweight	21(2.5)	808(97.5)	**0.31(0.07,1.41)***	**0.13***
normal weight	21(2.4)	851(97.6)	**0.29(0.07,1.34)***	**0.11***
overweight/obese	2(7.7)	24(92.3)	1	
Waist-to-hip ratio				
Normal	25(2.2)	1124(97.8)	1	
High	21(3.6)	560(96.4)	**1.67(0.936,3.04)***	**0.08***
Blood pressure				
Normal	39(2.4)	1555(97.6)	1	
Hypertensive	5(3.8)	127(96.2)	1.57(0.61,4.05)	0.35
Blood cholesterol				
Normal	37(2.5)	1452(97.5)	1	
High	9(3.7)	233(96.3)	2.79(1.47,5.320)	0.27
Blood triglycerides				
Normal	34(2.3)	1458(97.7)	1	
Raised	11(5.5)	190(94.5)	**2.81(1.43,5.53)***	**0.01***
Waist circumference				
Not centrally obese	43(2.5)	1649(97.5)	1	
Centrally obese	3(7.7)	36(92.3)	**2.87(0.95,10.78)***	**0.06***

P*<0.25, 1-reference group, fasting blood glucose raised (≥7.0 mmol/l), body mass index, overweight/obese (≥25 kg/m2), high waist –to-hip ratio(>1 for male,>0.85 for females, high blood pressure(systolic blood pressure≥140mmhg and/or diastolic blood pressure ≥90 mmhg), high blood cholesterol(≥5.22 mmol/l),raised blood triglycerides (≥2.26mmol/l) and high waist circumference(>102cm for males and >88 for females)

6.4 Independent predictors of cardiovascular diseases

Current Khat chewers were 3.76 times more likely to had cardiovascular disease compared to non-current khat chewers (AOR=3.67, 95% CI: 1.69, 7.94). Individuals who had higher blood triglycerides (≥2.26mmol/L) were 2.42 times more likely to develop cardiovascular disease compared to normal blood triglycerides (AOR=2.42, 95% CI: 1.20, 4.88) (**Table 5**).

Table 5. Multivariable logistic regression result of independent predictors of cardiovascular diseases among adults at GGFR, 2017.

Variables	CVD		AOR(95CI)	p-value
	Yes No (%)	No No (%)		
Age				
15-24	4(1.6)	248(98.4)	1	
25-34	7(2.1)	327(97.9)	0.24(0.07,1.83)	0.06
35-44	11(2.8)	383(97.2)	0.40(0.16,1.04)	0.06
45-54	7(2.0)	345(98.0)	0.69(0.31,1.50)	0.35
≥55	17(4.3)	382(95.7)	0.42(0.16,1.08)	0.07
Sex				
Female	32(3.7)	826(96.3)	1.39(0.62,3.12)	0.42
Male	14(1.6)	859(98.4)	1	
Residence				
Urban	5(6.7)	70(93.3)	1.08(0.26,4.52)	0.92
Rural	41(2.5)	1615(97.5)	1	
Khat chewing				
Non-chewers	37(3.8)	931(96.2)	1	
Chewers	9(1.2)	751(98.8)	**3.67(1.69,7.94)***	**0.001***
Body mass index				
Underweight	21(2.5)	808(97.5)	0.31(0.07,1.44)	0.13
Normal	21(2.4)	851(97.6)	0.33(0.07,1.52)	0.15
Overweight/obese	2(7.7)	24(92.3)	1	
Alcohol drinking				
No	42(2.5)	1624(97.5)	1	
Yes	4(6.2)	61(93.8)	0.68(0.19,2.42)	0.55
Waist-to-hip ratio				
Normal	25(2.2)	1124(97.8)	1	
High	21(3.6)	560(96.4)	0.79(0.39,1.61)	0.52
Blood triglycerides				
Normal	34(2.3)	1458(97.7)	1	
High	11(5.5)	190(94.5)	**2.42(1.20,4.88)***	**0.05***
Waist circumference				
Not centrally obese	43(2.5)	1649(97.5)	1	
Centrally obese	3(7.7)	36(92.3)	0.91(0.13,6.16)	0.92

P*≤0.05, 1-reference group

‘

7. Discussion

This study assessed the prevalence of factors associated and independent predictors of cardiovascular diseases among adult population at Gilgel Gibe field research center, Gimma zone, southwest Ethiopia. The overall prevalence of cardiovascular diseases in this study was found to be 2.7% (46/1731) which is in agreement with previous study conducted in the same study setting (13) . Whereas the prevalence was lower than a study conducted in Tehran (21.8%) (21) , Yemen (24) and other parts of Ethiopia (4,36) . This might be attributed to the fact that only patients with full blown symptoms that are significant enough to affect individual's daily activities and level of functioning might report their symptoms. This might result in a significantly lower prevalence of CVD. On the other hand, there are neither sensitive nor specific questions used to determine the magnitude of cardiovascular disease.

From this study the prevalence of CVD among females (3.70%) was higher than that of males (1.60%) this could be explained by more female cases were selected for this study than males. The age wise distribution of CVD showed that the highest (4.30%) and the lowest prevalence (1.60%) of CVD were observed among ≥55 and 15-24 age groups this finding is supported by a population-based survey conducted in china to assess the prevalence and risk factors of CVD in a rural district of Beijing, reported that at different age groups, there were similar increased trends of age-specific prevalence with age growing for both either in men or women (20). The prevalence at the age group 45-54 years was not changed this could be also a proportion of cases were excluded from this age group.

The prevalence of current chat chewing in the study population was 44.0% which is found to be lowest compared to studies conducted, at southwest Ethiopia (36,37) and other parts of the world (24). The difference could be due to difference in study setting, culture and the study populations.

This prevalence was higher than the prevalence reported from Amhara region (17%) (38) and a community based study conducted in Jimma town, south west Ethiopia 30.6% (39-40). This difference could be explained in the current study the majority of the population was farmers which cultivate the plant for market and they use it because it is easily accessible to them. In addition to this, difference in study area which implies variability in terms of sociocultural value like norms and beliefs. As well as in some society khat chewing practice is believed to increase

societal relationships as people chew khat in ceremonial and work settings. In others khat is believed to be related with evil spirits and acts.

The prevalence of hypertriglyceridemia in the current study was 11.9% which is found to be lowest compared to the study conducted in Nigeria (15.0%) (3) , southwest Ethiopia (18%) (41) and National Health and Nutrition Examination Survey, 2009-2010, 24.8% (42). This difference could be explained by elevated triglyceride levels can be related to diet and genetic makeup. In addition to this, differences in study setting, study design, study period and sampling procedure while .The prevalence is similar with the study conducted in Angola (43).

The prevalence of cardiovascular disease among current khat chewers were 9(1.2%) and Khat chewers were 3.76 times more likely to had cardiovascular disease compared to non-current khat chewers (AOR=3.67, 95% CI:1.69, 7.94) this is consistent to a study conducted in Ethiopia regular chat chewing was associated with increased mean diastolic BP, which is an important determinant of CVD (44) and in areas where large amounts of khat are consumed frequently, such as Yemen, khat chewers were 5.00 times more likely to develop AMI than non khat chewers (AOR=5.00,95% CI: 1.91, 13.06) (25).

This could be explained by the amphetamine-like action of cathinone accounts for the increased nervous tension and irritability which follows the khat session together with the peripheral catecholamine-releasing effects together, these increase the oxygen demands of the heart, promote catecholamine-mediated platelet aggregation and cause coronary vasospasm, which are the potential mechanisms for AMI after amphetamine abuse and also khat use is often an entry point to smoking and increased desire to smoke and consume alcohol, as well as increased tolerance to these substances, are commonly observed among habitual khat chewers.

Prevalence of Cardiovascular disease among adults whose blood triglyceride higher were 11(5.5%) and People with raised blood triglycerides were 2.42 times more likely to develop cardiovascular diseases than people with normal blood triglycerides (AOR=2.42, 95% CI: 1.20, 4.88). This study is in agreement with the study conducted by systematic review and meta-analysis to study: individuals who had a raised blood triglysirides were 1.37 times more likely to develp cardiovascular diseases than individuals with normal blood triglysirides (AOR=1.37,95% CI:1.23, 1.53) (45). This could be explained by triglycerides directly contribute to intimal cholesterol deposition and are also involved in the activation and enhancement of several proinflammatory, proapoptotic, and procoagulant pathways. Targeting

triglycerides as a vascular risk factor is justified because of the role of triglyceride-rich lipoproteins in atherogenesis. A number of large-scale epidemiological studies have shown that elevated TG levels are independently associated with increased incidence of cardiovascular events.

Strengths and limitations

The WHO STEP survey instrument for surveillance of risk factors for chronic diseases was applied after contextualizing to the local area which is a standardized method and instrument that allows comparison across populations and over time as the strength. The limitations of this study only patients with full blown symptoms that are significant enough to affect individual's daily activities and level of functioning might report their symptoms this might result in a significantly lower prevalence of CVD in the study area. On the other hand, there are neither sensitive nor specific questions used to determine the magnitude of cardiovascular disease. Thus, the findings of this study should be interpreted within these limitations.

In conclusion, relative to other studies the prevalence of cardiovascular disease in the study area is low. In this study current Khat chewing and elevated blood triglycerides were independently associated risk factors for cardiovascular disease among adults. This study identified the major predictors of cardiovascular disease were only current khat chewing and elevated blood triglycerides, but in other studies three are well established risk factors for cardiovascular diseases, it would be better to undergo a well-designed health promotion and disease prevention activities regarding cardiovascular disease and its major risk factors in the study population. In addition, Surveillance for CVD and associated risk factors for cardiovascular disease shall be implemented nationwide to provide information for policy decisions and to guide prevention and control programs.

Finally, currently chronic non-communicable diseases and their risk factors becoming emerging public health problems in developing countries like Ethiopia, this study used a data collected from the Gilgel Gibe Field research center which was conducted to study the prevalence of common CNCDs and their risk factors among adults in 2008/2009 by using a cross-sectional study design. The aim of this latter study was to identify the prevalence and associated risk factors of CVD among adults in the study population, so any concerned body that is interested on this area, is better to undergo a study on this current hot issue by using a strong study design.

8. References

1. Puoane T, Tsolekile L, Sanders D, Parker W. Chronic non-communicable diseases: primary health care: programme areas. South African health review. 2008 (1):73-87.

2. Bloom DE, Cafiero ET, Jané-Llopis E, Abrahams-Gessel S, Bloom L, Fathima S, et al. The global economic burden of non-communicable diseases. Program on the Global Demography of Aging; 2012 Jan. www.weforum.org/EconomicsOfNCD. Accessed in 2013.

3. Sani MU, Yusuf BO, Gbadamosi M, Johnson OV, Gbadamosi A. Modifiable cardiovascular risk factors among apparently healthy adult Nigerian population-a cross sectional study. BMC Research notes. 2010 Jan 20; 3(1):11.

4. Habte B, Tesfaye D. The pattern of cardiac diseases at the cardiac clinic of Jimma university specialized hospital, south west Ethiopia. Ethiop J Health Sci. 2010; 20(2):99.

5. WHO. Global status report on non-communicable diseases 2014: World Health Organization; 2014.

6. WHO. Prevention of cardiovascular disease: pocket guidelines for assessment and management of cardiovascular risk: (WHO/ISH cardiovascular risk prediction charts for the African Region). 2007. Geneva: WHO Press Google Scholar; 2015.

7. Mathers C, Fat D, Boerma J. The global burden of disease: 2004 update: World Health Organization; 2008.

8. Kim AS & Johnston SC. Global Variation in the Relative Burden of Stroke and Ischemic Heart Disease Clinical Perspective. Circulation. 2011; 124(3):314-23

9. Mocumbi AO. Lack of focus on cardiovascular disease in sub-Saharan Africa. Cardiovascular diagnosis and therapy. 2012 Jan 26; 2(1):74-7.

10. Lepage B, Schieber AC, Lamy S. Social determinants of cardiovascular diseases. Public Health Reviews. 2011 Jul 1; 33(2):1.

11. Bosu WK. Epidemic of hypertension in Ghana: a systematic review. BMC public health. 2010 Jul 14; 10(1):418.

12. Alwan AD, Galea G, Stuckler D. Development at risk: addressing noncommunicable diseases at the United Nations high-level meeting. Bulletin of the World Health Organization. 2011 Aug; 89(8):546-546.

13. Muluneh AT, Haileamlak A, Tessema F, Alemseged F, Woldemichael K, Asefa M: et al. Population based survey of chronic non-communicable diseases at gilgel gibe field research center, southwest Ethiopia. Ethiopian journal of health sciences. 2012; 22(4):7-18.

14. World Health Organization. Chronic diseases and health promotion. STEPwise approach to surveillance (STEPS).STEPS Manual 2005. Accessed at http://www.who.int/chp/steps/ April 2013.

15. 15. Tesfaye F. Epidemiology of Cardiovascular Risk Factors in Ethiopia: The Rural-Urban Gradient. Sweden: Umea University, 2008 available at https://scholar.google.co.uk/scholar.

16. Survey. Preliminary Report. Central Statistical Agency. Addis Ababa, Ethiopia. The Ethiopia Demographic and Health Survey (EDHS), Calverton, MD 20705, USA. 2011.

17. WHO. Noncommunicable diseases country profiles 2014. www.http://apps.who.int accessed at 2014.

18. Ethiopia WHO Country Cooperation Strategy Second Generation 2008–2011; 8. WHO Regional Office for Africa, 2009. www. http://afro.who.int/index.php?

19. BeLue R, Okoror TA, Iwelunmor J, Taylor KD, Degboe AN, Agyemang C. et al. An overview of cardiovascular risk factor burden in sub-Saharan African countries: a socio-cultural perspective. Globalization and health. 2009 Sep 22; 5 (1):10.

20. He L, Tang X, Song Y, Li N, Li J, Zhang Z. et al. Prevalence of cardiovascular disease and risk factors in a rural district of Beijing, China: a population-based survey of 58,308 residents. BMC Public Health. 2012 Jan 16; 12(1):34

21. Hadaegh F, Ghanbarian A, Azizi F. Prevalence of coronary heart disease among Tehran adults: Tehran Lipid and Glucose Study. Eastern Mediterranean health journal [Internet]. 2009; 15(1):160-61.

22. Reid C, Nelson MR, Shiel L, Chew D, Connor G, DeLooze F et al. Australians at risk: management of cardiovascular risk factors in the REACH Registry. Heart, Lung and Circulation. 2008 Apr 30; 17(2):114-8.

23. Bovet P, Shamlaye C, Gabriel A, Riesen W, Paccaud F. Prevalence of cardiovascular risk factors in a middle-income country and estimated cost of a treatment strategy. BMC Public health. 2006 Jan 19; 6(1):9.

24. Al-Motarreb A, A-HM, Broadley KJ. Khat chewing, cardiovascular diseases and other internal medical problems: the current situation and directions for future research. Journal of ethnopharmacology [Internet] Elsevier Ireland Ltd. **2010**; 132(3):540-8.

25. Al-Motarreb A, Briancon S, Al-Jaber N, Al-Adhi B, Al-Jailani F, Salek MS, et al. Khat chewing is a risk factor for acute myocardial infarction: a case-control study. British journal of clinical pharmacology. **2005** May 1; 59(5):574-81.

26. 26.. Ali WM, Al Habib KF, Al-Motarreb A, Singh R, Hersi A, Al Faleh H. et al.. Acute Coronary Syndrome and Khat Herbal Amphetamine Use Clinical Perspective. Circulation. 2011 Dec 13; 124(24):2681-9.

27. Aluli NE, RP, Brady SK, Tsark JU, Jones KL, Mau M, et al. All-Cause and CVD Mortality in Native Hawaiians. NIH Public. 2011; 89(1):65-71.

28. Tesfaye F, Byass P, Wall S. Population based prevalence of high blood pressure among adults in Addis Ababa: uncovering a silent epidemic. BMC Cardiovascular Disorders. 2009 Aug 23; 9(1):39.

29. Awoke A, Awoke T, Alemu S, Megabiaw B. Prevalence and associated factors of hypertension among adults in Gondar, Northwest Ethiopia: a community based cross-sectional study. BMC Cardiovascular Disorders. 2012 Nov 28; 12(1):113.

30. Alemseged F, Haileamlak A, Tegegn A, Tessema F, Woldemichael K, Asefa M. et al. Risk factors for chronic non-communicable diseases at gilgel gibe field research center, southwest Ethiopia: population based study. Ethiopian journal of health sciences. 2012; 22(4):19-28.

31. Woldemichael K, Haileamlak A, Muluneh AT, Alemseged F, Tessema F, Asefa M. et al. Biochemical Profile at Gilgel Gibe Field Research Center, Southwest Ethiopia. Ethiopian journal of health sciences. 2012; 22(4):50-60.

32. Metcalf P, Scragg R, Davis P. Relationship of different measures of socioeconomic status with cardiovascular disease risk factors and lifestyle in a New Zealand workforce survey. The New Zealand Medical Journal (Online). 2007 Jan 26; 120(1248).

33. Kiliari N, Theodosopoulou E, Papanastasiou E, Charalambous A. Socioeconomic determinants of non-communicable-diseases among the Cypriot population: questionnaire study. JRSM short reports. 2012 Oct; 3(10):1-9.

34. Bahonar A, Sarrafzadegan N, Kelishadi R, Shirani S, Ramezani MA, Taghdisi MH. et al. Association of socioeconomic profiles with cardiovascular risk factors in Iran: the Isfahan Healthy Heart Program. International journal of public health. 2011 Feb 1; 56(1):37-44.

35. WHO. Chronic diseases and health promotion. STEPwise Approach to Surveillance (STEPS).STEPS manual available http://www.who.int/ April 2013..

36. Misganaw A, Mariam DH, Ali A, Araya T. Epidemiology of major non-communicable diseases in Ethiopia: a systematic review. Journal of Health, Population and Nutrition. 2014 Mar 1; 32(1):1.

37. Zeidan RK, Farah R, Chahine MN, Asmar R, Hosseini H, Salameh P.et al. Prevalence and correlates of coronary heart disease: first population-based study in Lebanon. Vascular health and risk management. 2016; 12:75.

38. Zeleke A, Awoke W, Gebeyehu E, Ambaw F. Khat chewing practice and its perceived health effects among communities of Dera Woreda, Amhara region, Ethiopia. Open Journal of Epidemiology. 2013 Nov 15; 2013.

39. Ayanna AM and Teklay DB. "Effect of khat chewing on blood pressure and heart rate community based study". The Ethiopian Journal of Health Development. 2002; 16(3):326-34.

40. Demographic and Health Survey 2011 Central Statistical Agency Addis Ababa. Ethiopia ICF International Calverton, Maryland, USA. 2012 Mar. https://scholar.google.co.uk.

41. Bissa S, Gobena T. Prevalence of Hypertension and Its Association with Substance Use among Adults Living in Jimma Town, South West Ethiopia. World Journal of Medicine and Medical Science 2014; 2(1).

42. Carroll MD, Kit BK, Lacher DA, Yoon SS. Total and high-density lipoprotein cholesterol in adults: National Health and Nutrition Examination Survey, 2009-2010. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 2012 Apr. https://scholar.google.co.uk/scholar.

43. Capingana DP, Magalhães P, Silva AB, Gonçalves MA, Baldo MP, Rodrigues SL. et al. Prevalence of cardiovascular risk factors and socioeconomic level among public-sector workers in Angola. BMC Public Health. 2013 Aug 7; 13(1):732.

44. Tesfaye F, Berhane Y, Bonita R, Wall S. Association of smoking and khat (Catha edulis Forsk) use with high blood pressure among adults in Addis Ababa, Ethiopia, 2006. Prev Chronic Dis. 2008; 5(3).

45. Murad MH, Hazem A, Coto-Yglesias F, Dzyubak S, Gupta S, Bancos I. et al. The association of hypertriglyceridemia with cardiovascular events and pancreatitis: a systematic review and meta-analysis. BMC endocrine disorders. 2012 Mar 31; 12(1):2.

46. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ). November 2005. Available at www.ipaq.ki.se.

47. The Federal Democratic Republic of Ethiopia Ministry of Health. health sector transformation plan 2015/16-2019/20 October 2015.

Annexes

I. Map of the study area

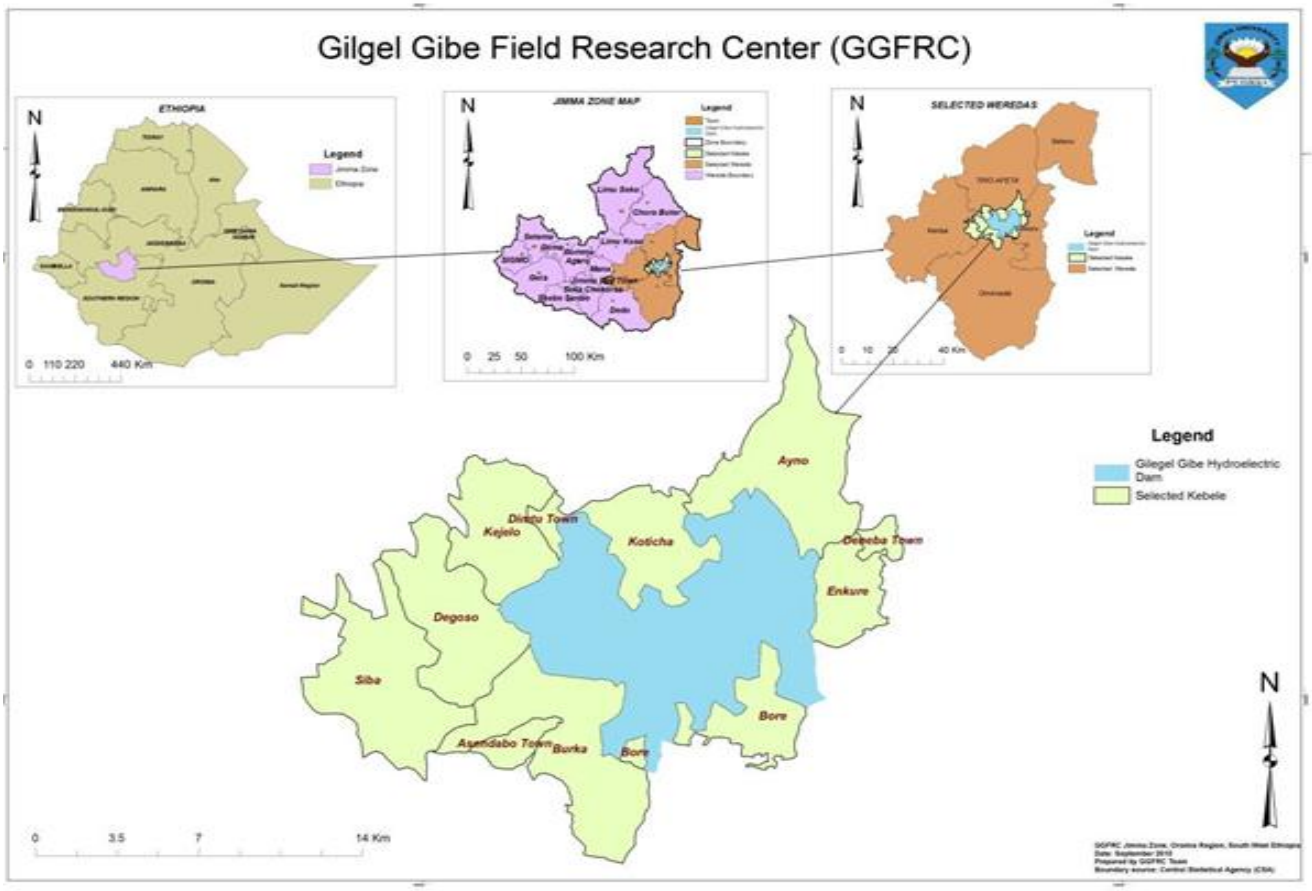

Figure 4. Maps of the study area

II. Selected Variables used for this particular survey

Step 1 Demographic Information

Question		Response
1	Sex (Record Male / Female as observed)	0. Male 1. Female
2	How old are you?	_____ 777. Don't know
		1.Oromo 2,Amhara

3	What is your ethnic group?	3.Yem 4.Gurage 5.Dawuro 6.Others 999. Refused
4	Can you read and write?	0. No → 207 1. Yes
5	Are you learning basic education in school?	0. No→ 207 1. Yes
6	What is the highest level of education you have completed?	_____ 999. Refused
7	Which of the following best describes your main work status over the past 12 months?	1.Farmer 2. Government employee 3. Non-government employee 4. merchant 5. Self-employed 6. Non-paid 7. Student 8. housewife 9. Homemaker 10. Retired 11. Unemployed 12. Others_____ 999. Refused

Step 1 Behavioral Measurements

Now I am going to ask you some questions about various health behaviors. This includes things like smoking, drinking alcohol, physical activity and khat chewing. Let's start with tobacco

	2.Tobacco Use	
8	Do you currently smoke any tobacco products, such as cigarettes, cigars or pipes?	0. No→ 306 1. Yes

	3.Alcohol Consumption	
9	Have you ever consumed an alcoholic drink such as beer, wine, spirits, fermented cider, tej and tella	0. No→ 315 1. Yes
10	During the past 12 months, how frequently have you had at least one alcoholic drink?	1.Daily 2. 5-6 days per week 3. 1-4 days per week 4. 1-3 days per month 5. Less than once a month
11	Have you consumed an alcoholic drink within the past 30 days?	0. No→ 314 1. Yes
	4. Diet	
12	What type of **oil or fat is most often** used for meal preparation in your household? *(USE SHOWCARD) (SELECT ONLY ONE)*	1.Oil grain 2. Butter 3. Vegetable oil 4. Others 5. None in particular 6. None used 777. Don't know
	5. **Physical Activity** Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person. 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. [Insert other examples if needed]. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.	
13	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?	1.Yes 0.No→ 323

14	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days_____
15	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours_____ Minutes_____
16	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?	0. No → 326 1. Yes
17	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days_____
18	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours____ Minutes_____
19	Do you walk or use a bicycle *(pedal cycle)* for at least 10 minutes continuously to get to and from places?	0. No → 329 1. Yes
20	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?	Number of days_____
21	How much time do you spend walking or bicycling for travel on a typical day?	Hours_____ Minutes_____
	Recreational activities 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]*.	
22	Do you do any vigorous-intensity sports, fitness or recreational *(leisure)* activities that cause large increases in breathing or heart rate like *[running or football]* for at least 10 minutes continuously?	0. No → 332 1. Yes
23	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational *(leisure)* activities?	Number of days_____

24	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours_____ Minutes_____
25	Do you do any moderate-intensity sports, fitness or recreational *(leisure)* activities that cause a small increase in breathing or heart rate such as brisk walking, *[cycling, swimming, volleyball]* for at least 10 minutes continuously?	0. No→335 1. Yes
26	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational *(leisure)* activities?	Number of days____
27	How much time do you spend doing moderate-intensity sports, fitness or recreational *(leisure)* activities on a typical day?	Hours_____ Minutes_____
28	The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling in car, bus, train, reading, playing cards or watching television, but do not include time spent sleeping. How much time do you usually spend sitting or reclining on a typical day?	Hours_____ Minutes___
6. Khat chewing		
29	Do you currently chew khat?	1. No→345 2. Yes
7. **Alcohol Consumption**		
30	Have you consumed an alcoholic drink such as beer, wine, spirits, fermented cider or in the past 12 months [add other local Examples]?	Yes 1 No 2
8. History of Raised Blood Pressure		
31	Have you ever had your blood pressure measured by a doctor or other health worker?	Yes 1 No 2

32	Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?	Yes 1 No 2
33	Have you been told in the past 12 months?	Yes 1 No 2
34	Drugs (medication) that you have taken in the past two weeks	Yes 1 No 2
35	Advice to reduce salt intake	Yes 1 No 2
36	Advice or treatment to lose weight	Yes 1 No 2
37	Advice or treatment to stop smoking	Yes 1 No 2
38	Advice to start or do more exercise	Yes 1 No 2
	9.History of Diabetes	
39	Have you ever had your blood sugar measured by a doctor or other health worker?	Yes 1 No 2
40	Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?	Yes 1 No 2
41	Have you been told in the past 12 months?	Yes 1 No 2
42	Insulin	Yes 1 No 2
43	Drugs (medication) that you have taken in the past two weeks	Yes 1 No 2
44	Special prescribed diet	Yes 1 No 2
45	Advice or treatment to lose weight	Yes 1

		No 2
46	Advice or treatment to stop smoking	Yes 1 No 2
47	Advice to start or do more exercise	Yes 1 No 2
10. History of cardiovascular diseases		
48	Have you ever been told by a doctor or other health worker that you have cardiovascular disease?	Yes 1 No 2
49	Have you been told in the past 12 months?	Yes 1 No 2
50	Drugs (medication) that you have taken in the past two weeks	Yes 1 No 2
Step 2 Physical Measurements		
1. Height and Weight		
51	Device IDs for height and weight	Height_____ Weight_____
52	Height	In Centimeter(cm) ____
53	Weight	In Kilogram (Kg) _____
54	**For women:** Are you pregnant?	0. Yes→ 351 1. No
55	Device ID for waist	_____
56	Waist circumference	In Centimeter(cm) ____
57	Hip circumference	In Centimeter(cm) ____
Biochemical Measurements		
2. **Blood Glucose**		
58	During the past 12 hours have you had anything to eat or drink, other than water?	Yes 1 No 2
59	Time of day blood specimen taken (24 hour clock)	⌊_⌊_⌋ : ⌊_⌊_⌋ Hours :minutes hrs mins

60	Fasting blood glucose	mmol/l ⌊_⌊_⌋ ⌊_⌊_⌋
61	Today, have you taken insulin or other drugs (medication) that have been prescribed by a doctor or Other health worker for raised blood glucose?	Yes 1 No 2
3. Blood Lipids		
62	Total cholesterol	mmol/l ⌊_⌊_⌋ ⌊_⌊_⌋
63	During the past two weeks, have you been treated for raised cholesterol with drugs (medication) prescribed by a doctor or other health worker?	mmol/l ⌊_⌊_⌋ ⌊_⌊_⌋
4.Triglycerides		
64	Triglycerides	mmol/l ⌊_⌊_⌋ ⌊_⌊_⌋