Cardiovascular risk factors with special focus on diet in southern Ethiopia:

a community-based cross-sectional study

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Thesis for the Degree of Philosophiae Doctor (PhD)
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To

The glory of God, the Almighty,

Who has been my refuge and strength

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Summary

Background: Evidence from different studies indicates that Africa is experiencing a shift in dietary structure, and an increase in the burden of related non-communicable diseases, such as cardiovascular diseases The contributing factors for the change in dietary patterns are socioeconomic development, urbanization accompanied by advances in technology, and a sedentary lifestyle. Ethiopia has exhibited considerable economic growth during the last few decades. The rate of urbanization is relatively rapid, and the level of physical inactivity has also increased. Overweight and obesity are on the rise. However, in Ethiopia, there is minor knowledge about changes in dietary patterns, or the prevalence of cardiovascular risk factors like for instance hypertension. Therefore, the studies in this thesis attempted to answer the question of whether there is a transition to a new dietary pattern and if this has any relation to the prevalence of major modifiable cardiovascular (CVD) risk factors in Ethiopia.

Objectives: The general objective of this thesis was to obtain more information about dietary patterns, and other CVD risk factors in Wolaita, southern Ethiopia.

Methods: A community-based cross-sectional study was conducted among 2483 adult residents aged 25-64 years, selected using a three-stage random sampling technique in southern Ethiopia. Data, collected using structured questionnaires; anthropometric, dietary, blood pressure, and biochemical measurements, were analyzed in this study. We generated the weighted prevalence using finite population corrections for the clusters. Dietary patterns were identified using factor analysis by employing *orthogonal transformation* (*varimax rotation)* to identify uncorrelated factors. We used a logistic regression model to assess factors associated with hypertension,

Poisson regression for the number of major modifiable cardiovascular disease risk factors, and multiple linear regressions for dietary patterns.

Results: We identified three dietary patterns in this study; *the western, the traditional, and the healthy.* These dietary patterns explained 51% of the variance in food consumption in the study area. There was a co-existence of *western-style* and *healthy dietary patterns* in the urban environment of the study area, while the *traditional dietary pattern was found* in the rural environment. The urban environment and major modifiable cardiovascular risk factors, consisting of obesity, hypertension, blood glucose, and total cholesterol levels, were significantly associated with the occurrence of the *western dietary pattern*. The prevalence of having one or more major modifiable cardiovascular risk factors was 75.8%, and hypertension was 31.3%. Socio-demographic and dietary factors comprising an urban residence, older age, male sex, being a farmer, and sugar-sweetened food consumption played an important role in the increased number of major modifiable cardiovascular risk factors, including hypertension. The combination of physical inactivity with low HDL-C was the largest co-occurrence of major modifiable cardiovascular risk factors, followed by physical inactivity with hypertension.

Conclusions: The co-existence of *western, traditional, and healthy dietary patterns*, indicates the transition to new diets, here called a nutrition transition in the study area. The magnitude of having one or more major modifiable cardiovascular risk factors, including hypertension in the study population, indicates a relationship between these factors and diet changes. In general, there seems to be a need to focus on nutrition-related non-communicable diseases, and strengthen the prevention of several modifiable cardiovascular risk factors.

List of original papers

The following papers serve as the basis for this thesis, and they will be referenced in the text by their corresponding Roman numerals:

Paper I: Kumma WP, Lindtjørn B, Loha E. Prevalence of hypertension, and related factors among adults in Wolaita, southern Ethiopia: A community-based cross-sectional study. PLoS ONE 2021; 16(12):e0260403. doi: 10.1371/journal.pone.0260403.

Paper II: Kumma WP, Lindtjorn B, Loha E. Modifiable cardiovascular disease risk factors among adults in southern Ethiopia: a community-based cross-sectional study. *BMJ Open* 2022; 12:e057930. doi: 10.1136/bmjopen-2021-057930.

Paper III: Kumma WP, Loha E. Dietary patterns and their association with cardiovascular risk factors in Ethiopia: a community-based cross-sectional study. *Frontiers in Nutrition:* submitted on October 19, 2022. Manuscript ID: 1074296.

Abbreviations/Acronyms

AIC: Akaike Information Criterion

AOR: Adjusted Odds Ratio

BMI: Body Mass Index

CI: Confidence Interval

COR: Crude Odds Ratio

COVID: Coronavirus Disease

CVD: Cardiovascular Diseases

DALY: Disability Adjusted Life Years

DBP: Diastolic Blood Pressure

HDL-C: High-Density Lipoprotein Cholesterol

IDF: International Diabetes Federation

IRR: Incidence Rate Ratio

LDL-C: Low-Density Lipoprotein Cholesterol

LMICs: Low-and Middle-Income Countries

MET: Metabolic equivalents

NCD: None Communicable Diseases

PEN: Package of Essential Non-communicable disease

SBP: systolic Blood Pressure

TC: Total Cholesterol

TG: Triglycerides

WHO: World Health Organization

Contents

Chapter I: Introduction

1.1. What is this thesis about?

Evidence from different studies indicates that Africa is experiencing a shift in dietary structure, and an increase in the burden of related non-communicable diseases (NCDs) [1-4]. As the literature suggests this shift is relatively occurring at a rapid pace [1]. The contributing factors to the change in dietary patterns and related NCDs are socioeconomic development, and urbanization accompanied by advances in technology and a sedentary lifestyle [5, 6].

Ethiopia exhibited considerable economic growth during the last few decades [7, 8]. Its economy was one of the fastest-growing economies in Africa. The proportion of people living below the national poverty line reduced from 30% in 2011 to 24% in 2016 [8]. The rate of urbanization in Ethiopia compared to the historical trends in the developed world or other developing countries, has been relatively rapid [9]. According to evidence from various studies in Ethiopia, the level of physical inactivity is now high [10-12]. That might be due to the growing socio-economic development, access to technology, and new ways of transportation [13-15].

Experiences of other countries which passed through similar stages, imply the risk of having a shift to unhealthy dietary patterns and related NCDs in Ethiopia [1-4]. One important disease entity is cardiovascular disease (CVD). ‘Cardiovascular risk factors’ are a short expression used for ‘risk factors that may be related to the development of CVDs’. The literature tells about several cardiovascular risk factors of importance. In this study, we describe these as ‘modifiable’ risk factors, as they can be modified by changes in lifestyle and ways of living. Examples are tobacco smoking and physical activity. Other examples are given later in this introduction.

Therefore, the studies in this thesis attempt to answer the question of whether there is a transition to a new dietary pattern and if the diet is related to the prevalence of modifiable CVD risk factors, including hypertension, in Ethiopia. To answer these research questions we have assessed the dietary patterns in the rural and urban populations; the prevalence and related factors of hypertension, and major modifiable CVD risk factors among adults in Wolaita, southern Ethiopia.

1.2. Overview of nutrition transition

The nutrition transition is a shift from traditional diets characterized by higher consumption of cereals to the western dietary pattern which is rich in fat, processed meat, refined carbohydrates, and sugar-sweetened beverages and foods [13, 16]. Historically, it started with the industrial revolution in western nations [17]. The process of nutrition transition in western countries was gradual compared to other countries that attained dietary sufficiency at the national level [18-21].

Globally, low-and middle-income countries (LMICs) seem to be undergoing a nutritional transition because of economic growth, urbanization, and adaptation to modern lifestyles [14, 22]. The nutritional transition in the LMICs began with the production and import of oilseeds and vegetable oils having a higher proportion of dietary energy [15]. Formerly, these countries were known for having a monotonous traditional dietary pattern with a high prevalence of under nutrition and communicable diseases. However, the trend is shifting to a western dietary pattern with a double burden of both under nutrition, hunger, and communicable diseases and over-nutrition with NCDs [21, 23, 24].

Similarly, several nations in Africa are undergoing a nutrition transition, with a situation where under-and over-nutrition exists within the same family [1, 23]. The number of undernourished

people, especially energy and several micronutrient deficiencies rose [25]. Concurrently, the number of overweight people and those with associated nutrition-related diseases increased [4-6, 26]. Changes in dietary patterns are occurring at a relatively faster rate and in earlier stages of economic and social development [1, 23].

Ethiopia was frequently attacked by drought and famine during the past decades [27, 28]. The total population living under the poverty line in 1994/95 was around 49.5%. After the application of various poverty reduction measures, the level of poverty has been decreasing [7]. During the last decades, Ethiopia demonstrated growth in its economy [29]. Succeeding economic growth the rate of urbanization is progressively increasing [7, 29-31]. Evidence indicates the coexistence of economic growth and urbanization results in lifestyle changes including changes in dietary patterns, which in turn leads to increased obesity and nutrition-related NCDs [3, 17, 32, 33].

1.2.1. Dietary patterns

Diet is an important modifiable risk factor associated with NCDs [34]. Individual nutrients and foods, however, cannot be considered in isolation, due to the complex interactions among nutrients [35, 36]. Dietary pattern is an essential factor for the health of individuals and populations, which is also a key factor in the pattern of energy and nutrient intake [37]. Changes in dietary patterns are not limited to the satisfaction of basal physiologic needs, but are also affected by social and cultural factors, including eating behavior [38, 39]. The discrepancy in increased energy intake and reduced expenditure results in energy imbalance, and when this is coupled with the reduction in physical activity becomes the underlying cause of overweight and obesity [40].

Dietary patterns that contain above the recommended quantity of energy-dense food items had an association with an increased burden of CVDs [32, 34]. Globally, CVD remains the leading cause of mortality among middle-aged adults; and in high-income countries, it is the main cause of death next to cancer [32, 41]. The dietary patterns in high-income countries are characterized by a high quantity of added sugars, fats, refined carbohydrates, and animal-source foods, which are termed a Western diet [13, 32, 37].

Low-and middle-income countries (LMICs) are not immune to this problem. They are facing a double burden of diseases; both illnesses resulting from under and over-nutrition [13]. The incidence of NCDs such as CVDs and type-2 diabetes are increasing due to changing lifestyles, urbanization, and increasing life expectancy [34, 42, 43]. The dietary patterns in the LMICs, especially those with emerging economies are changing from traditional dietary patterns with a high intake of fruits, vegetables, cereals, tubers, and legumes to western diets characterized by a high intake of energy-dense food items such as animal food products [44-46].

Diets are determined by several factors, including individual and environmental factors. Urbanization independently or in combination with other factors is associated with changes in dietary patterns [47, 48]. The urban food consumption pattern is generally more diversified; contains more animal products and sugar [40, 47, 48]. A systematic review of data from forty countries in sub-Saharan Africa indicated variation in the dietary patterns between rural and urban areas [2]. Factors including hypertension, blood cholesterol level, smoking, and physical activity were also related to dietary patterns [34, 37, 49, 50]. In Ethiopia, there is minor evidence of dietary patterns and related factors among the adult populations.

1.2.2. Socio-demographic determinants

Socio-economic development and urbanization accompanied by a sedentary lifestyle are the main factors of nutritional transition in the LMICs [5, 15, 16, 17]. Urbanization independently or in combination with other factors is associated with changes in dietary patterns [51-53]. The urban food consumption pattern is generally more diversified; contains more animal products and added sugar that resembles the western dietary pattern [40, 52, 53]. A systematic review of data from forty countries and other studies in sub-Saharan Africa indicated variation in the dietary patterns between urban and rural areas [2, 3, 52].

An additional contributing factor to change in dietary patterns is economic development. The dietary intake pattern varied significantly between people with higher and lower wealth status [6, 14, 22]. A change in the frequency and type of consumption is activated by an increase in per-capita income [51, 52]. The experiences of several countries in the world show an association between growth in the economy and a shift in the dietary pattern that led to obesity and related diseases. In Chile, following the economic development, the population adopted the western dietary pattern which has resulted in an increased burden of obesity [14]. Studies from four countries in Africa have also shown a rapid shift in dietary patterns, that is largely influenced by economic development [1].

Physical inactivity combined with urbanization and dietary changes is an important factor in instigating overweight or obesity [13, 51]. In LMICs, changes in physical activity are linked to different factors, including advancements in technology. Globally, industries and service sectors are replacing the labor-intensive occupations that demand high energy expenditure [13]. Similarly, household activities are becoming less energy-demanding due to the improvements in

technology. Changes in transportation, leisure, and office work have also triggered a sedentary lifestyle, and urban residents are the main victim of these changes [15].

Another factor that contributes to nutrition transition is under-nutrition during childhood accompanied by urbanization and dietary change later in life. Studies from LMICs have shown that adult overweight or obesity is more common in areas where pregnant women experienced maternal malnutrition, which led to fetal growth retardation, and childhood stunting [13, 23, 53-55]. Various studies in Africa recorded a double burden of underweight and overweight with a prevalence of overweight or obesity higher in the adult women population [2, 4, 23, 51, 56]. The growing prevalence of overweight or obesity among the adult population could also be due to a lower intake of fruits and vegetables, and physical inactivity [5, 26, 57].

1.3. The burden of non-communicable diseases

Globally, NCDs are accountable for 72.3% of all deaths in 2016 [58, 59]. These diseases unacceptably develop among people in LMICs where 78% of deaths due to NCDs occur [60]. CVDs are responsible for the majority of NCDs deaths followed by cancer [61]. They are the consequence of a combination of genetic, physiological, environmental, and behavioral factors. The main modifiable risk factors include the harmful consumption of alcohol, tobacco use, unhealthy diets, physical inactivity, high blood pressure, elevated blood glucose, raised blood lipids, and obesity [59, 62, 63]. Even though the diseases are related to older age, people of all age groups are susceptible to the risk factors causing NCDs [59].

The global prevalence of the risk factors of NCDs remains high, except for declines reported for some risk factors [60]. In sub-Saharan Africa, the burden of NCDs has been rising over the last two decades. By 2030, it is estimated to exceed the aggregate prevalence of communicable,

maternal, neonatal, and nutritional diseases [59, 62]. A study from Nigeria showed a high prevalence of some of the risk factors of NCDs such as 35.3% hypertension, 47.1% dyslipidemia, 41.3% smoking, 72.5% alcohol consumption, and 47.1% physical inactivity [64]. Similarly, a WHO STEPwise survey in Tanzania reported a high prevalence of major risk factors of NCDs including 15.9% current smoking, 29.3% harmful alcohol consumption, 97.2% less than 5 servings of fruit and/or vegetable consumption per day, 26% overweight/ obesity, 26% hypercholesterolemia, 33.8% hypertriglyceridemia, and 25.9% hypertension [65].

In Ethiopia, NCDs were responsible for 39% of the total deaths due to all causes, as reported by the World Health Organization (WHO) in 2018 [60]. Various studies show an increasing burden of NCDs. For instance, in southern Ethiopia, out of the total health facility visits, 29.7% were due to NCDs [66]. A community-based study from northern Ethiopia documented a high prevalence of specific NCDs among the general population, with for instance 32.2% heart disease, 31.9% hypertension, and 27.7% asthma [67]. Another community-based study from northern Ethiopia revealed a high prevalence of NCDs metabolic risk factors among the adult populations [68]. The WHO NCDs country profiles recorded a high prevalence of certain major modifiable CVD risk factors among adult populations in Ethiopia such as 14% physical inactivity, 24% raised blood pressure, and 4% obesity [60].

1.4. Cardiovascular disease

Globally, CVD is a major public health challenge [61, 69-72]. The magnitude of CVD accountable to modifiable risk factors such as high blood glucose, high systolic blood pressure, high low-density lipoprotein cholesterol, and obesity is rising [71]. Certain evidence also indicates increased burden and severity of CVD due to the additive and synergistic effect of the

presence of multiple modifiable CVD risk factors [73-75]. The burden of CVD cases almost doubled, and the number of deaths, excluding the high-income countries consistently increased from 1990 to 2019 [69]. About 523 million people suffered, and 18.6 million died from CVD in 2019 [69, 71]. The magnitude of deaths due to CVD is estimated to be one-third of deaths due to all causes [71]. The burden of CVD in LMICs is on the rise, and these countries carry almost 80% of global CVD deaths [43, 61, 70, 76, 77]. In Africa, CVD becomes an emerging public health problem, mostly due to lifestyle changes such as lack of physical activities, increased rural-urban migration, and high-calorie intake [78-80].

According to the American Heart Association, the major modifiable CVD risk factors are smoking, dyslipidemia, high blood pressure, physical inactivity, obesity and being overweight, and diabetes [81]. Modifiable CVD risk factors in an individual may occur either in single or multiple numbers. Some studies reported different levels of modifiable CVD risk factors with a prevalence varying from 17.2% to 73% [82-84]. Few studies in Africa reported the presence of multiple modifiable CVD risk factors. A study conducted in semi-urban communities in southwestern Nigeria documented the presence of 15.5% of three, and 8.4% of four or more modifiable CVD risk factors [85]. Some of the factors that showed association with having multiple modifiable CVD risk factors were age, sex, residence, education, and socio-economic status [82-85].

There is minor information on the presence of multiple modifiable CVD risk factors in Ethiopia. However, there are few reports on the prevalence of contracting multiple metabolic syndrome components, and CVD risk factors [86-88]. For instance, a community-based survey on the presence of multiple metabolic syndromes in eastern Ethiopia showed a 9.5% prevalence of having three factors of metabolic syndrome components [86]. On the other hand, a national

NCD STEPS survey demonstrated a prevalence of 3.2% diabetes, 5.2% hypercholesterolemia, 21.0% hypertriglyceridemia, 14.1% high LDL-C, and 68.7% low HDL-C [87]. Following, we will discuss a list of major modifiable CVD risk factors, including smoking, and hypertension.

1.4.1. Smoking

Smoking continues to be a global public health challenge with a prevalence of 20% among individuals aged 15 years and older in 2016 [60, 88]. It is one of the prominent global risk factors for infirmity and fatality from the main NCDs. Globally, one in three men currently smokes, and the reduction of smoking among men is lower compared to women [60], but this may differ between countries. Similarly, the rate of smoking was highest in Europe, while it was the lowest in Africa, despite its rapid increase [61]. The LMICs experienced a slower tobacco smoking reduction [60, 61]. A multi-center study reported a reduced prevalence rate of current smoking from 22.9% in 2003 to 17% in 2014 in Kenya [89]. Another study from Ghana reported a 3.8% self-reported prevalence of current smoking among individuals aged 14 years and older [90].

In Ethiopia, there are several studies conducted among different segments of the population. A multi-center study reported an increased prevalence of current smoking from 8.5% in 2005 to 11.7% in 2011 [89]. According to the WHO, the prevalence of current tobacco smoking among people aged 15 years and above in 2016 was 4% [60]. Similarly, aggregated data from the demographic and health surveys of 2011 and 2016 showed a 3.2% of overall prevalence of current tobacco smoking [91]. Surprisingly, a study conducted among adolescents in eastern Ethiopia documented a high prevalence (21.1%) of current cigarette smoking [92]. A systematic review of 13 studies conducted among Ethiopian universities showed a 12.6% pooled prevalence

of current cigarette smoking among students [93]. These indicate that smoking poses a serious public health challenge in Ethiopia.

1.4.2. Dyslipidemia

Dyslipidemia is a lipoprotein disorder that promotes the development of atherosclerotic CVDs such as coronary heart disease and stroke [94, 95]. It is characterized by the presence of one or more of the following lipid abnormalities: total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) [95, 96]. Globally, atherosclerotic CVD is the leading cause of death and is increasing in LMICs [97]. A study from rural Ghana reported a prevalence of 4.02% elevated TC, 2.12% elevated TG, 5.55% elevated LDL-C, and 60.30% low HDL-C [98]. A systematic review of 177 studies from Africa reported a pooled prevalence of 25.5% elevated TC, 37.4% low HDL-C, 28.6% elevated LDL-C, and 17.0% elevated triglycerides in the general population [96]. There are varying levels of dyslipidemia across the world [99-101].

Evidence from the Ethiopian NCDs STEPS survey showed a prevalence of 5.2% hypercholesterolemia, 21.0% hypertriglyceridemia, 14.1% high LDL-C, and 68.7% low HDL-C [87]. Another study conducted in northern Ethiopia reported a 66.7% overall prevalence of dyslipidemia with 49.5% high LDL-C, 40.2% elevated TG, 30.8% elevated TC, and 16.5% low HDL-C [102]. On the other hand, an institutional-based cross-sectional study from Addis Ababa, Ethiopia reported a 67.8% overall prevalence of dyslipidemia, and the prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL-C, and low HDL-C was 25.4%, 33.4%, 21.5%, and 50.7% respectively [103]. Risk factors associated with dyslipidemia in Ethiopia

include age, socioeconomic status, waist-hip ratio, alcohol consumption, low vegetable intake, physical inactivity, obesity, and blood glucose [87-103].

1.4.3 Hypertension

The burden of NCDs in developing nations is increasing as a result of expanding urbanization, a growing economy, and shifting lifestyles [23, 104]. Hypertension, as a significant contributor to the burden of NCDs, is a global public health challenge [61, 105]. Hypertension is a risk factor for other CVDs, such as the development of ischemic heart disease and stroke, but is at the same time often handled as a disease on its own. The global burden of hypertension is projected to be 1.56 billion in 2025; two-thirds of this will be occurring in developing countries [105]. Hypertension disproportionately affects populations in low- and middle-income countries [106].

Hypertension is defined as systolic blood pressure greater or equal to 140 mmHg and/or diastolic blood pressure greater or equal to 90 mmHg or a self-reported case for medication [107]. Hypertension was believed to be rare in Africa, but it is currently perceived as one of the most important causes of CVDs contributing to about 40% of the cases in the continent [106, 108]. According to the WHO report on NCDs in 2014, hypertension among adults was highest in the African region with a prevalence of 30% [109]. It is a widespread problem with great economic impact because of its effect on productive subpopulations [110].

Studies around the world report different levels of prevalence of hypertension and factors associated with blood pressure. A study conducted on the prevalence of hypertension among Indian adults reported an overall prevalence of 30% [111]. A study from Ghana showed a 13% prevalence of hypertension [112], and in Kenya, 24% of the population was hypertensive [113]. Factors reported as having associations with hypertension comprise older age, being male, being

married, being overweight, added sugar intake, alcohol drinking, and fruit consumption [111-115].

Evidence from the national NCDs STEPS survey of Ethiopia showed a 15% overall prevalence of hypertension [87]. Community-based cross-sectional surveys from other areas in Ethiopia reported prevalence rates ranging from 28% to 35% [116, 117]. In some places in southern Ethiopia, the prevalence of hypertension ranged from 22% to 35% [118, 119]. Identified risk factors of hypertension from studies in Ethiopia include older age, male sex, urban residence, higher formal education, physical inactivity, overweight or obesity, total cholesterol, raised fasting glucose, poor vegetable diet, and alcohol drinking [87, 116-119].

1.4.4. Physical inactivity

Physical inactivity is considered the fourth most important risk factor for global death [89, 90]. It is suggested to be responsible for 21.5% of ischemic heart disease, 11% of ischemic stroke, and 16% of colon cancer [91]. Worldwide, 28% of adults aged 18 years and older in 2016 were physically inactive [60, 92]. The prevalence in high-income countries is more than double the prevalence in low-income countries. Furthermore, the global prevalence of physical inactivity was not reduced during the past two decades [60]. Globally, women, the elderly, wealthier, and urban people are more affected by the problem [60, 90]. Various independent studies across the world have reported the level of physical inactivity. A study from Shenzhen, China reported a 67.3% level of inactivity among adults aged 40 years and older [93]. Similarly, a population-based survey conducted in Uganda reported 18.8% sedentary, and 37.6% physically inactive lifestyles among adults [120]. On the other hand, a nationwide STEPwise survey in Kenya recorded a 7.7% prevalence of physical inactivity among adults aged between 18-69 years [121].

The level of physical inactivity in Ethiopia is similar to that of other low-income countries. A national NCD survey in 2015 reported a 5.8% prevalence of inactivity among people aged 15-69 years [122]. Independent studies from various parts of the country reported different levels of physical inactivity. A community-based cross-sectional study from urban southern Ethiopia reported a prevalence of 25.7% among adults aged 18-64 years [123]. Another study from a similar setup in the country recorded 45.1% of physical inactivity among adults aged 25-64 years [124].

1.4.5. Unhealthy diet

Around the world, unhealthy diet is suggested to account for 11 millions of all deaths among adults in 2017 [125]. Poor diet is the leading risk factor in 2015 contributing to 12.2% of the total Disability Adjusted Life Years (DALYs) for men and 9% for women [126]. In many countries around the world, diets high in sodium, low intake of whole grains, and low consumption of fruits are leading dietary risk factors for deaths, and development of DALYs [125, 126]. Intake of a diet high in sodium was moderately higher in countries such as the high-income Asia Pacific, Southeast Asia, and eastern sub-Saharan Africa, where many are LMICs [126]. The majority of deaths associated with dietary risk factors were caused by CVDs followed by cancers and type II diabetes [125, 126]. Globally, there is progress in the consumption of healthy diet items; however, the consumption of unhealthy diets was worsened. High-income countries were better compared to low-income countries in terms of the consumption of healthy diets [127].

Similar to other low-income nations in the world, the contribution of dietary risk factors to the burden of NCDs in Ethiopia has been suggested to be significant [128]. In Ethiopia, poor diet is likely to be responsible for one-fourth of all NCD deaths and accounts for 44% of all CVD-related deaths in the country. Diets low in fruit and vegetable intake and raised consumption of

sodium were the leading dietary-related risk factors [128]. Evidence from the 2011 Welfare Monitoring Survey in Ethiopia reported varying dietary consumption patterns among regions and groups of the society. Further, cereals were reported as the most commonly used dietary items, whereas fish, eggs, and fruits were the least consumed food items [129]. Various studies reported low levels of household dietary diversity in the country [129-131].

1.4.6. Harmful alcohol consumption

Around the world, harmful alcohol intake was the seventh leading risk factor in terms of deaths. Moreover, it was the leading cause of death globally among people aged 15-49 years in 2016 [132]. The three main causes of death attributable to the harmful consumption of alcohol were tuberculosis, road injuries, and self-harm. The biggest percentage of deaths related to tuberculosis occurred in low-income nations [132, 133]. According to the WHO, globally, 5.3% of deaths from all causes, and 5.1 % of the burden of disease and injury were due to the harmful consumption of alcohol [134]. The prevalence of current alcohol use differs across various socio-demographic index locations with the largest consumption in high-income nations [132, 133]. The prevalence widely differs between males and females, being higher among males [135-138].

The prevalence of alcohol use disorders in Ethiopia among populations aged 15 and older in 2016 was 2.5% [139]. Many studies across the country reported a high level of current alcohol drinking with the prevalence highest among men [140-145]. A national NCDs STEPS survey in 2015 reported 40.7% current alcohol drinking, and 12.4% heavy episodic drinking [142]. Further, a systematic review and meta-analysis conducted on the epidemiology of alcohol utilization in Ethiopia documented a 23.9% pooled prevalence of current alcohol intake [141].

Another systematic review and meta-analysis conducted among school adolescents recorded a similar level of current alcohol intake [140].

1.4.7. Overweight and obesity

Globally, overweight and obesity are major public health problems affecting more than 1.9 billion adults aged 18 and older [146]. It is increasing at an alarming rate and is associated with the development of NCDs such as hypertension, type 2 diabetes, and stroke [147]. Obesity is known to be a nutritional disorder in high-income countries [148]. However, it is becoming an emerging public health problem in LMICs, in addition to the existence of the persistently high prevalence of undernutrition [23].

During the past few years, several countries in Africa experienced sustained economic growth; even though currently the economy is declining because of the Coronavirus disease (COVID-19) pandemic [13, 149, 150]. The economic development in Africa is accompanied by rapid urbanization, and lifestyle changes [151]. With the increasing urbanization and adaptation to the modern lifestyle, Africa is facing a growing overweight and obesity problem [6, 126].

Evidence from several studies in sub-Saharan African countries shows the growing burden of overweight and obesity [152-155]. For instance: a population-based survey in peri-urban and rural eastern Uganda reported a 17.8 % prevalence of overweight; and a 7 % prevalence of obesity [156]. Similarly, a population-based cross-sectional study carried out in rural and urban Malawi reported a 27.4% prevalence of overweight/ obesity [157]. Another study conducted in the Kinondoni municipal district, Dar es Salaam, Tanzania reported a 19.2% prevalence of obesity among adults [158]. These studies reported older age, urban residence, high

socioeconomic status, female sex, and light-intensity activities as independent predictors of overweight/ obesity [156-158].

Ethiopia is also facing a growing burden of overweight/ obesity. According to the Ethiopian Demographic and Health Survey 2016, the prevalence of overweight/ obesity among women aged 15-49 years increased from 3% in 2000 to 8% in 2016 [159]. Community-based studies from various parts of the country have reported prevalence rates ranging from 8.6% to 28.2% [160-162]. The risk factors reported by these studies include urban residence, older age, physical inactivity, alcohol intake, and consumption of sweets, meat, and egg.

1.4.8. Diabetes

Globally, the prevalence of CVD, and diabetes mellitus is increasing [61, 163]. These diseases are no longer associated with affluent nations, and are increasing in LMICs [163, 164]. The LMICs carry almost three-quarters of all NCD deaths and the majority of premature deaths [61]. In Africa, it is becoming an emerging public health problem, most likely due to lifestyle changes, lack of physical activities, increased rural-urban migration, and high-calorie intake [78].

According to the International Diabetes Federation (IDF), the global prevalence of diabetes in the age group 20 to 79 was estimated to be 8.3% in 2019, and the prevalence is expected to rise to 9.2% by 2030. Similarly, in Africa, the prevalence of diabetes in 2019 was estimated to be 4.7%, and is projected to be 5.1% in 2030 [165, 166]. The prevalence of diabetes has been reported to vary amongst people and age groups of the same population [165-168]. In Africa, more than half of people with diabetes live in cities, even though the population in the continent is predominantly rural [166].

Studies around the world report different levels of prevalence of diabetes. In Punjab, India, the prevalence of diabetes was 9.4% among the urban and 7.6% among the rural populations in 2018, and age, marital status, hypertension, obesity, and family history of diabetes were found to be significantly associated with this disease [169]. Similarly, in Iran, the prevalence of diabetes in the urban area was shown to be 9.2%, while it was 7.5% in the rural area [170]. This study reported hypercholesterolemia, hypertriglyceridemia, hypertension, obesity, and central obesity among urban residents compared to rural ones. A population-based survey conducted in Uganda showed a 2.7% prevalence of diabetes among urban residents, and 1.0% among rural residents [171]. Factors associated with diabetes were age, sex, household floor finish as a proxy for poverty, and abdominal obesity.

Studies in Ethiopia reported varying levels of diabetes prevalence (0.5% - 14.9%) [87, 172, 173]. Evidence from the national NCDs STEPS survey showed a prevalence of 3.2% [87]. In southern Ethiopia, the prevalence of diabetes varies from 1.9%-12.4% [174-176]. Some of the reported risk factors were advancing age, lack of physical exercise, obesity, alcohol consumption, smoking, raised blood pressure, high waist circumference, and educational status [87, 173-176].

1.5. Existing strategies for non-communicable disease prevention

Various LMICs across the world are transitioning through demographic, epidemiologic, and nutritional changes [43, 53, 177]. These transitions in the sub-Saharan African context are incomplete because of interruptions due to for instance the Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome (HIV/AIDS) epidemic, its co-morbidities, and the impact of war in several countries [53, 178]. However, Africa with its growing population size and urbanization is facing significant challenges due to the double burden of communicable and NCDs [179]. By 2030, NCDs are estimated to be the leading cause of death in Africa surfacing

the combined deaths attributable to communicable diseases, maternal, neonatal, and nutritional causes [62]. Meanwhile, the continent has limited resources to battle the threat posed by the growing burden of NCDs [77, 180]. Therefore, the identification of cost-effective and population-wide interventions for the prevention and management of NCDs in the African context is crucial.

The WHO has formulated a package of essential non-communicable (PEN) disease interventions to combat the most important NCDs at the primary healthcare level in low-resource settings [181]. The prioritized NCDs are CVDs, diabetes, chronic respiratory diseases, and cancer. The essential intervention package consists of early detection and diagnosis supported by affordable technologies, the application of pharmacological and non-pharmacological approaches to the treatment of the risk factors, and the use of cost-effective medications for the prevention and treatment of major NCDs. The interventions are designed to be implemented in a stepwise approach using the following procedure: Engagement of stakeholders, assessment of current NCDs status, development of a service delivery package for primary health care, capacity building, monitoring and evaluation, and review and plan for scale-up. Various countries across the world implemented the WHO PEN program and their experiences demonstrate that targeting combinations of CVD risk factors for prevention, such as treatment of hypertension, diabetes, and hyperlipidemia reduces CVDs such as heart attack, and stroke among people having these conditions [182-185]. Healthy behaviors such as halting smoking, lowering the use of salt, reducing high cholesterol diets, and regular exercising were reported to reduce the risk of CVDs [182-185].

1.5.1. Non-communicable disease prevention strategies in Ethiopia

The population of Ethiopia projected for 2021 was 117,876,226, 77.83% were rural and the remaining 22.17% were urban. The population growth rate of Ethiopia in 2021 was 2.53% with 4.6% growth in urban [186, 187]. The health extension program in Ethiopia started in 2004 targeting rural households. It consisted of 17 basic and essential promotive, preventive, and high-impact curative health service packages that did not include prevention and control of NCDs [188]. It was designed to offer technical services and brought changes to maternal and child health, communicable diseases, and hygiene and sanitation [189, 190]. On the other hand, the urban health extension program started in 2009 with 15 packages that included the prevention and control of NCDs, mental health, and violence and injury prevention. However, client satisfaction with the urban NCDs control that focused on the screening service was low [191, 192].

The health extension program in preventing NCDs in Ethiopia has so far not been successful [192-194]. In the primary healthcare setting, there is no detection, treatment, and control of NCDs. There is also insufficient healthcare financing, low political commitment and leadership, and inadequate stakeholder engagement in the control of NCDs. The health extension workers lack essential skills; and at the primary health care level, essential medicines and basic diagnostic equipment for the diagnosis and treatment of NCDs are not available [193, 194].

In response to this challenge, the Ministry of Health recently prepared a policy framework and designed a strategy to prevent, and control NCDs using the health extension program at the primary healthcare level [195]. The program has expanded its service packages to include curative care and NCDs. It offers prevention and control of NCDs, NTDs, mental health services,

institutional hygiene and sanitation, HIV testing and counseling, as well as additional maternal health services. However, the successful implementation of the policy and strategy is crucial.

1.6. Context of the study

This thesis was carried out in Wolaita Zone, which is located in southern Ethiopia. Wolaita Zone is a rapidly growing population area with an estimated population of 2,91,704 in 2022. The proportion of the 25-64 years population in the zone was about 30.5%. Ninety-eight percent of the Wolaita people are Christians by religion, of which 71% are evangelical Christians followed by Orthodox (21%) [196-1998]. Wolaita was one of the famine-affected and vulnerable areas in Ethiopia during 1983-1986 [27, 28]. The livelihood of the urban population in Wolaita is based on employment, trade, or daily labor, while the livelihood of the rural population is based on crop production and animal husbandry [199]. Access to food in rural areas depends on subsistence farming and is influenced by farm size, rainfall patterns, and crop production culture [199, 200]. The major crop production in the study area includes maize, haricot bean, taro, cassava, sweet potato, *enset (Ensete ventricosum)*, banana, avocado, mango, and coffee [201]. Livestock production is predominantly cattle, which is an important economic sector of the Wolaita people [202]. The zone has significant educational challenges, especially with the coverage of preparatory high schools [203]. Migration from Wolaita within the zone or elsewhere in the country is high. Some of the driving factors for migration are poverty, drought, scarcity of land, and unemployment [204, 205].

As evidence from the literature indicates, the health service coverage in Wolaita has so far been low. The distribution of health posts and health centers in the towns and newly established administrative districts have been scarce, and there is no tertiary-level health service delivery in the area [203]. The diagnosis, treatment, and control of NCDs in the neighboring area of

Wolaita are very low [194]. In the study area, there is no detection, treatment, and control of NCDs. Like other settings in the country, the health extension program was designed to offer technical services on maternal and child health, communicable diseases, and hygiene and sanitation [189], and brought improvements [190]. In the past, the detection, treatment, and control of NCDs were not included in the health extension service package. However, recently it has been an effort made to realize universal health coverage through primary health care. The prevention and control of NCDs have now been addressed within the health extension program policy [195]. However, the health extension workers have no training in the detection, treatment, and control of NCDs; and at the primary health care level, essential medicines and basic diagnostic equipment for the diagnosis and treatment of NCDs are not available. Most hypertension and diabetes cases are not identified, and there is no dedicated unit for NCDs. Furthermore, there are limited numbers of stakeholders, and their involvement has so far been insufficient.

1.7. The rationale for this thesis

The nutrition transition is a shift in diets accompanied by physical inactivity and is commonly referred to as the shift from *traditional* toward *western dietary patterns* [13, 16, 206]. It coincides with modernization, urbanization, economic development, and increased wealth [56, 207]. Globally, about 11 million deaths in 2017 were attributable to unhealthy diets. [125]. CVD was the leading cause of death related to dietary factors, followed by diabetes and cancer [125, 126].

Ethiopia has been going through substantial economic growth during the last few decades [7, 8]. The rate of urbanization in Ethiopia compared to the historical trends in the developed world or

other developing countries was relatively rapid [7, 9]. Overweight and obesity are on the rise [159]. Like any other low-income country around the world, nutritional risk factors play a substantial role in the burden of NCDs [128]. However, in Ethiopia, there is minor information about the dietary patterns, and the prevalence of major modifiable CVD risk factors including hypertension among adult people (See Supplementary Files 1 and 2. Knowledge gap). Hence the studies in the present thesis assessed the dietary patterns, and the prevalence of related major modifiable CVD risk factors including hypertension in Wolaita, southern Ethiopia. The evidence produced from this thesis might provide baseline data for future interventions, and might be useful for the promotion of a healthy lifestyle and diet. The information obtained might be useful for the prevention of nutrition-related NCDs in Ethiopia.

1.8. Conceptual framework

Nutrition transition refers to the change from *traditional* to *western diets*, which are characterized by diets high in fats, sugars, meat, and refined carbohydrates with little fiber, along with sedentary lifestyles [13, 16, 206]. The majority of low- and middle-income countries are rapidly transitioning from *traditional diets* to *western-style diets* [206]. There is evidence that indicates the association of *western dietary patterns* with nutrition-related CVD risk factors [3, 17, 32, 33]. Factors contributing to the change in diet include modernization, urbanization, and economic development. The conceptual framework for this thesis was developed through a literature search performed using MEDLINE (PubMed) InfoBase and manual searches [1, 4, 6, 22, 23, 51, 208].

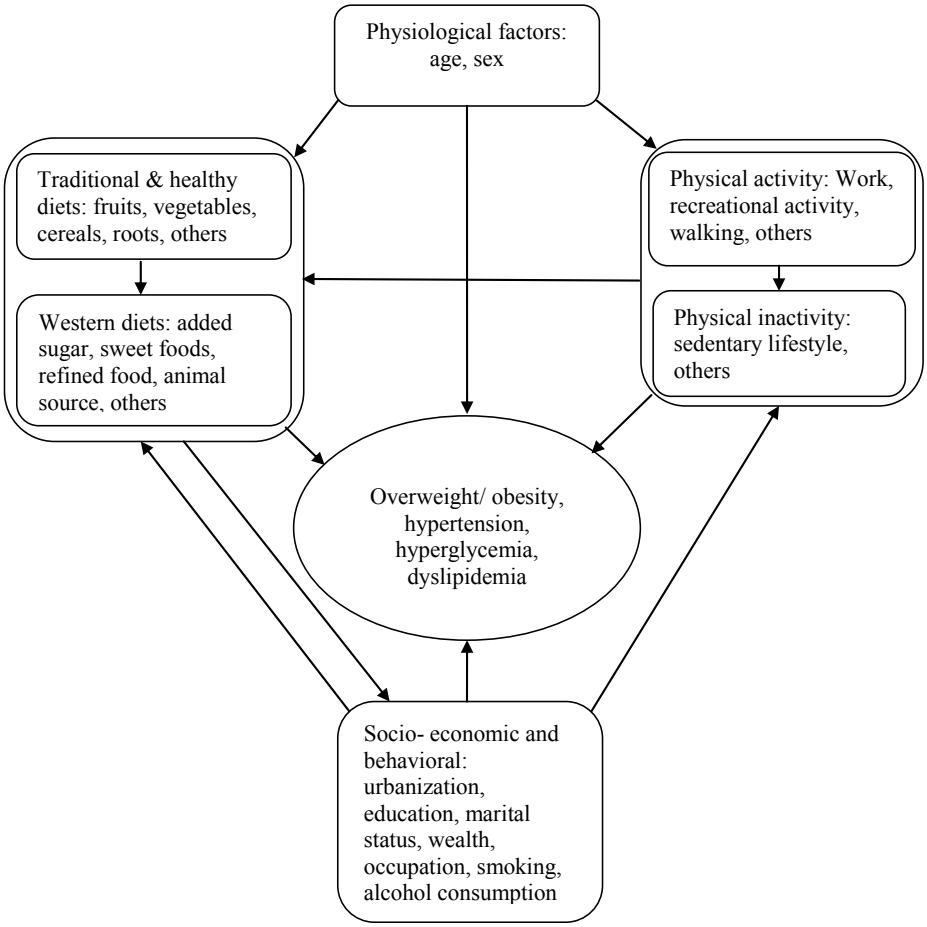

Figure 1. A conceptual framework that illustrates the development of cardio-metabolic risk factors, and their relation to other cardiovascular risk factors such as physiological, socioeconomic, and lifestyle factors

Chapter II: Objectives

2.1. General objective

The general objective of this thesis was to obtain more information about dietary patterns, and other CVD risk factors in Wolaita, southern Ethiopia.

2.2. Specific objectives

1. To assess the prevalence of hypertension, prehypertension, and related factors among adult populations of Wolaita, southern Ethiopia (Paper-I)'
2. To assess the prevalence and factors associated with the number of modifiable CVDs risk factors among adult people in Wolaita, southern Ethiopia (Paper-II).
3. To identify the dietary patterns, and their association with cardiovascular risk factors among adult people in Wolaita, southern Ethiopia (Paper-III).

Chapter III: Methods

3.1. Study setting and period

We carried out this study in Wolaita, southern Ethiopia from May 2018 to February 2019 (Fig II). Administratively, the zone is divided into 22 districts. The study was conducted in Wolaita Sodo town and rural Ofa among adults aged between 25-64 years. Wolaita Sodo is the largest town in the zone with an estimated population of 204, 121, and Ofa is one of the rural districts in the zone with a population of about 142,636 in 2022 [198]. Wolaita Sodo is the capital and rapidly growing urban area of Wolaita Zone [209], and Ofa is a rural district with a traditional lifestyle which is located 33 km to the west of Wolaita Sodo town (Fig II).

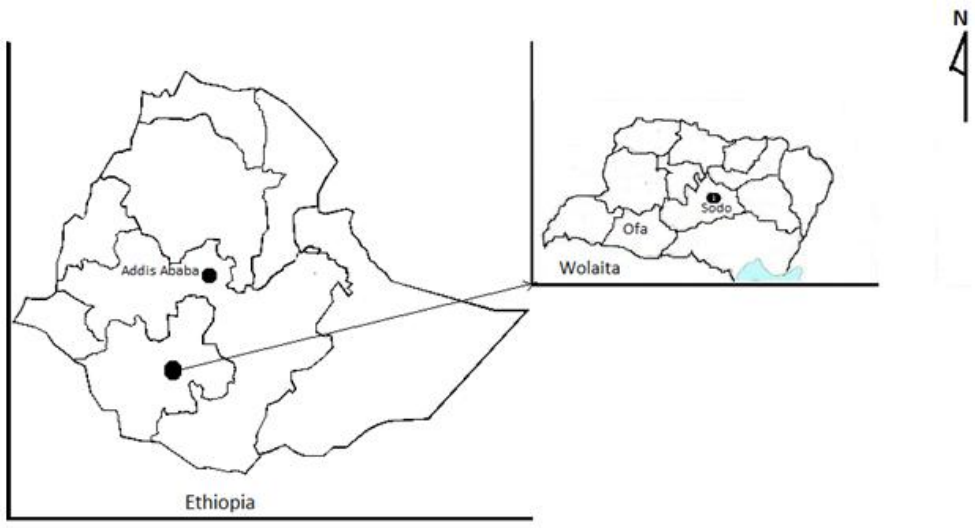

Figure II. Map of Ethiopia and the study area in Wolaita Zone, southern Ethiopia

Geographically, Wolaita lies between $6^0$4′N - $7^0$1′N latitude and $37^0$4′E - $38^0$2′E longitude. The altitude varies between 900 meters and 2600 meters above sea level [198, 199]. It occupies a total area of 4537.5 square kilometers. Generally, the zone is divided into three agro-ecological

areas: Highland, midland, and low land. The mean annual rainfall varies between 803 mm in the lowlands and 1189 mm in the highland. The main rainy season approximately starts in June and ranges to August followed by a small rainy season that lasts from late February to early April. The mean temperature is estimated to be 21.86^{o}C [198, 199].

3.2. Study design, and sample size determination

This was a community-based cross-sectional study undertaken among the adult population aged 25-64 years in Wolaita, southern Ethiopia. The sample size for this study was computed using Epi Info version 7 StatCalc software. This project is a large study, titled CVD risk factors with special focus on diet in southern Ethiopia, and the number of participants was 2486. We considered assumptions from the study entitled prevalence of high blood pressure, hyperglycemia, dyslipidemia, metabolic syndrome and their determinants in Ethiopia: evidence from the national NCDs STEPS survey, 2015 to compute the sample size in one of the studies in our project [87]. Accordingly, with a 14.9% prevalence of hypertension in rural, 19.7% prevalence of hypertension in urban, 95% confidence level, 80% power, one for the ratio of unexposed and exposed groups, and 10% non-response rate the total sample size became 2233. In general, to confirm the adequacy of the sample size for each specific objective, we carried out a posthoc power estimation using OpenEpi version 3.03 software with 95% CI and addressed this in the methodological discussion indicating adequate sample size with the power of the study > 90%.

3.3. Participants

The study was undertaken among the adult populations aged 25-64 years in Wolaita, southern Ethiopia. Two thousand four hundred eighty-three people participated in the study, and all

invited to the study participated, except 3 people who were not available during three visits. One thousand two hundred forty-three people from Wolaita Sodo town and 1240 from rural areas in the Ofa district participated in the study. The study participants were permanent residents in the study sites and were chosen using a three-stage random sampling.

The study *kebeles* (villages: the smallest administrative division in Ethiopia), stratified in the urban and rural, were selected using a simple random sampling technique from the list of enumerated *kebeles* in each stratum. We selected eleven from the 54 urban, and ten from the 52 rural *kebeles* (Fig III). Then, we applied a simple random sampling technique to select the study households by generating sample household numbers using a random integer generator from a list given to us by the community health workers [211]. The allocation of the *kebeles* in the urban and rural study sites; and households in the study *kebeles* was based upon a sample proportional to size (Fig III). We used a simple random sampling method to select the study participants from the sampled households. A lottery method was employed using one colored and the other plain match sticks; the eligible household members would pick from a vessel, and one who picked the colored matchstick was considered the study participant.

Every household was visited at least twice during the data collection time, one for the interview including 24-hour dietary intake assessment and anthropometric measurements, and the other for blood sample collection. After conducting interviews and taking anthropometric measurements during the first visit, the study participants were instructed to be fasting overnight and were appointed for blood sample collection the next day.

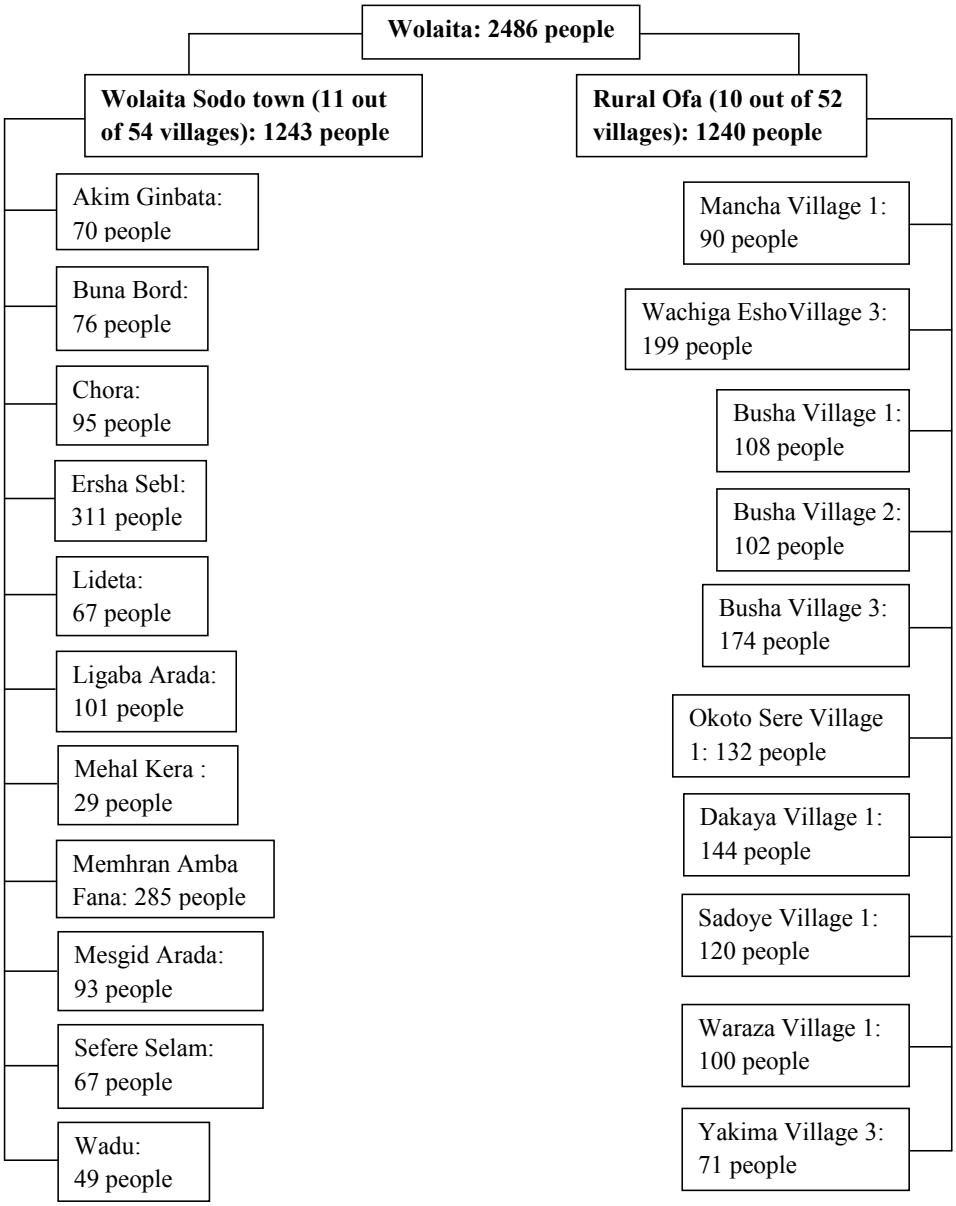

Figure III. Flow chart of the study subjects selection from villages in Wolaita Sodo town and rural Ofa, Wolaita, Southern Ethiopia 2018.

3.4. Assessment of variables

A total of 2483 adult household members randomly selected for the survey were interviewed by trained data collectors, using a structured questionnaire about the socio-demographics such as age, education, wealth, diet, and other lifestyle factors. Additionally, we measured the previous 24-hour dietary intake, anthropometric, blood pressure, and biomedical parameters of the study participants. The data collection process was undertaken within the participants' homes, and people in the study obtained information about the data collection such as dates of the interview and overnight fasting from the supervisor and coordinator of the data collection before the data were collected. The blood samples were collected in the morning before eating breakfast. A series of questions about the potential risk factors and related variables were adapted from the WHO protocol for chronic NCDs (WHO STEPS survey) [212]. We adapted a quantitative 24-hour dietary recall technique to serve as the data collection instrument for the previous day's 24-hour dietary intake assessment [213, 214] (See Table 1). The questionnaire was first designed in English (See Appendices 1. English questionnaire) and then translated into Amharic (See Appendices 2. Amharic questionnaire) and Wolaitato (See Appendices 3. Wolaitato questionnaire) languages; and these were retranslated into English by an independent professional to ensure the accuracy of the translation.

Data collection was conducted using six field data collectors, five laboratory technologists, a field supervisor, a coordinator, and two data clerks after providing training for one week. The training consisted purpose of the survey, ethical conduct, and data collection techniques such as 24-hour dietary intake assessment, interviewing skills, calibration of data collection instruments, and anthropometry. The training also addressed the standard laboratory operating procedures and analysis, format completion, and storage of samples. Following this, we conducted a pretest on

5% of our sample size among the population which was not selected for the survey. Subsequently, the inputs obtained from the pretest were incorporated into our data collection tool. The principal investigator, field supervisor, and coordinator provided supportive supervision, daily throughout the data collection time. Incomplete and inconsistent data were returned to data collectors for corrections.

Table 1. Variables in the study of nutrition and cardiovascular factors in Wolaita, southern Ethiopia, showing three papers and their objectives.

Papers	**Objectives**	**Variables**	
		Dependent	**Independent**
Prevalence of hypertension, and related factors	To assess the prevalence of hypertension, prehypertension, and related factors among adult populations of Wolaita, southern Ethiopia.	Hypertension	Age, sex, residence, educational status, marital status, vegetable consumption, physical activity, sugar-sweetened food intake, obesity, alcohol drinking, total cholesterol, and fasting blood sugar
Modifiable CVD risk factors	To assess the prevalence, magnitude, and factors associated with the number of major modifiable CVD risk factors.	The number of major modifiable CVD risk factors	Age, gender, residence, marital status, education status, occupation, wealth index, fruit consumption, vegetable consumption, sugar-sweetened beverage intake, and sugar-sweetened food intake
Dietary patterns and their association with CVD risk factors	To identify the dietary patterns, and associated factors.	Dietary patterns	Age, gender, residence, education, wealth index, physical activity, obesity, hypertension, total cholesterol, blood sugar, and triglyceride

3.5. Measurements

Self-reported daily fruit and vegetable consumption were assessed using food frequency questions adapted from the WHO STEPwise approach to surveillance. For example, one serving of fruit is one medium-sized piece of fruit such as an apple, banana, or orange or half a cup of chopped, cooked, or canned fruit, or a half-cup of juice from a fruit that is not artificially flavored. On the other hand, one serving of vegetables is one cup of raw, leafy green vegetables,

one-half cup of other vegetables, cooked or chopped raw, or one-half cup of vegetable juice. A low serving of fruits or vegetables is < five servings of fruits or vegetables per day [212].

A participant's physical activity was assessed by asking about activities during work, for instance carrying or lifting heavy loads. In addition, they were asked about their travel to and from places; e.g. walking and bicycling, and they were also asked about sports, fitness, and recreational activities (e.g. running, football, swimming). The recall period for the assessment of the activities was one week. It was assessed based on the self-reported performance of moderate-intensity and vigorous-intensity activities, walking; time spent in minutes to carry out each activity, and MET (Metabolic equivalents) value of the respective activity. MET-minutes/week of the specific activity was the product of the number of days in a week used to accomplish a given activity, the time spent in minutes in a day, and the respective MET value of the particular activity. Finally, a combination of MET minutes per week of walking, moderate-intensity, and vigorous-intensity activities was considered as the total MET minutes/per week [212, 215].

BMI was calculated as weight (kg) divided by height squared (m^2). Weight was measured to the nearest 0.1 kg using a portable digital weight scale (Seca digital scale, 22089 Hamburg, Germany). The study subjects were weighed standing with light clothes on the scale with their shoes off. Before every measurement, the scale was tested for zero adjustments. Height was measured using a portable stadiometer (Seca, 22089 Hamburg, Germany), which consisted of a simple triangular headboard. For height measurement, the study subjects took off their shoes, stood straight, and held their head erect. The external auditory and the lower borders of the eyes were kept in one horizontal plane. The buttocks, shoulder blades, and heels touched the scale while the legs with their knees stayed together, and arms hung by their sides. Height was measured to the nearest 0.1 cm. People with conditions not suitable for anthropometric

measurements such as pregnant women and two people who were not suitable for height measurements such as participants who were unable to stand on the stadiometer were excluded from the study.

WHO STEPS data collection instrument was adapted for the measurements of biochemical markers such as total cholesterol, fasting blood sugar level, and triglyceride values [212]. Whole venous blood samples from all participants were collected in the morning within the participants' homes after instructing overnight fasting, and cleaning the skin with a 70% alcohol swab. Then the samples were stored in 3 ml vacutainer tubes holding ethylenediaminetetraacetic acid (EDTA). The test tubes with the samples were placed in the icebox and transported to Wolaita Sodo University Hospital Laboratory for analysis of lipid profiles. Serum total cholesterol, high-density lipoprotein cholesterol, and triglycerides were determined using BS-200 Chemistry Analyzer with specific reagents for each biochemical value as per the manufacturer's instructions. The laboratory technicians performed the laboratory work within 12 hours of the blood sample collection at the Wolaita Sodo University Hospital Laboratory. The fasting blood sugar level was determined on-site using a glucose meter (SensoCard®).

Blood pressure was measured using a digital sphygmomanometer apparatus named Riester richampion®N, Germany (www.riester.de). Blood pressure was measured three times, while the study subject was in a sitting position with the right upper arm placed at the level of the heart, and after the subject had 10 minutes of rest [216]. The average of the last two measurements was considered to compute systolic and diastolic blood pressure [217].

To measure the dietary intakes at a population level, we employed single-day dietary histories on different individuals, the study population was selected randomly, and all the days of the week

were represented in the sample, and this was in line with the recommendation given by the principles of nutritional assessment [213]. Since the previous day's history is a recent memory, the interviewers asked the study participants to tell all the foods and beverages they consumed with their specific information such as preparation. We interviewed by helping the participants with probing to recall all foods and beverages consumed during the previous day (from sunrise to sunrise) before the survey. The study participants were requested to provide specific information on foods and drinks including their product names and preparation techniques. We prepared a finite list of foods and beverages such as cereals, pulses, dairy products, vegetables, fruits, tubers, roots, meat and meat products, poultry, fish, egg, fats and oils, sugars, salt, coffee, and tea that helped to recall the previous day food and beverage consumption and ticked off the mentioned items. In the end, the interview was finalized with the study participants confirming that all the foods and beverages they consumed during the previous day had been mentioned.

3.6. Definitions of variables

The variables of this study originated from different categories including age, sex, residence, educational status, wealth index of socio-demographic background, and fruit, vegetable, sugar-sweetened beverage, sugar-sweetened food consumption, and nutritional status from nutrition-related categories. In addition, we have included variables with biochemical characteristics such as blood glucose, total cholesterol, and triglyceride levels; and dietary patterns derived from factor analysis. The variables used in this study were defined based on standard definitions as indicated in Tables 2 and 3.

Table 2. Definitions of independent variables

Terms	Definition	Paper
Age	The age of the adult study participants in years at the time of the interview.	Paper I, II, III
Sex or gender	A set of the biological attributes of the study participants and assessed as male or female.	Paper I, II, III
Residence	An individual will be enumerated as a usual resident of the specific study area (urban or rural) if he or she continuously lived in that geographic area for at least six months right before the commencement of the study [218].	Paper I, II, III
Ethnicity	The study participants' ethnicity was assessed based on the status that is indigenous to the study area or others otherwise.	Paper I
Educational status	The educational attainment of the study participants was categorized from the lowest to highest as primary and below, high school, and college.	Paper I, II, III
Marital status	The study participants' marital status was assessed as married or single at the time of the interview.	Paper I, II
Occupation	This variable is assessed as being categorized as employed, merchant, farmer, housewife, retired, student, and others.	Paper I, II
Wealth index	Constructed using the ownership of household assets using a principal component analysis. In each study setting, 11 components with factor loadings of > 0.4 were identified and retained. The wealth index values were calculated by summing up the scores of 11 components in each study setting, and the socioeconomic categories were generated by splitting the wealth index values into three equal classes.	Paper I, II, III
Nutritional status	BMI values of < 18.5 kg/m^2: underweight, 18.5-24.9 kg/m^2: normal, 25-29.9 kg/m^2: overweight and ≥ 30 kg/m^2: obese were used to classify the nutritional status of adults [219, 220].	Paper I, III
Hyperglycemia	Persons with FBS level 7.0 mmol/l or above) and/ or self-reported for medication [166, 221].	Paper I, III
Hypertension	Having a systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, and/or using medication for lowering blood pressure [107].	Paper III
Elevated total cholesterol level	Total cholesterol level 5.2 mmol/l (200 mg/dl) or more [222].	Paper I, III
Low HDL-C	A measure of HDL-C concentration in blood with < 1.0 mmol/l in men and < 1.3 mmol/l in women [222].	
Raised TG	A blood TG concentration of 1.7 mmol/l or more [222].	Paper I, III
Physical activity	Is the accomplishment of vigorous or moderate physical activity ≥ 600 METs-minutes/week [212, 215].	Paper I, III
Alcohol drinking	Defined based on the self-reported consumption of a standard alcoholic drink such as 285 ml of beer, 120 ml of wine, and 30 ml of spirits of five or more for men or four or more for women in a single drinking occasion within the past 30 days [212].	Paper I, II
Current smokers:	Self-reported current (daily) use of smoked tobacco or smokeless tobacco products [212].	Paper I
Fruit consumption	Assessed based on the self-reported responses of the study participants' intake of fruits daily or not.	Paper I, II
Vegetable consumption	Assessed based on the self-reported responses of the study participants' intake of vegetables daily or not.	Paper I, II
Sugar-sweetened beverage intake	Determined based on the self-reported responses of the study participants' intake of sugar-sweetened beverages at least once a month.	Paper I, II
Sugar-sweetened food intake	Determined based on the self-reported responses of the study participants' intake of sugar-sweetened foods at least once a month.	Paper I, II

Table 3. Definitions of dependent variables

Paper	Outcome variable	Definition
Paper I	Hypertension	Defined as systolic blood pressure 140 mmHg or more and/or diastolic blood pressure 90 mmHg or more and/ or self-reported case for medication [107].
Paper-II	The number of modifiable CVD risk factors	According to the AHA, major modifiable CVD risk factors are smoking, elevated TC, high LDL-C, low HDL-C, and TG, high blood pressure, physical inactivity, obesity, being overweight, and diabetes [81]. However, based on our data the major modifiable CVD risk factors included smoking, elevated TC, low HDL-C, raised TG, high systolic blood pressure, high diastolic blood pressure, physical inactivity, obesity, and hyperglycemia. Therefore, the outcome variable was generated by adding the above nine variables considered components of major modifiable CVD risk factors.
Paper III	Dietary patterns	The dietary patterns were named after the food items or groups with the highest loadings in factor analysis, and related literature. The *Western dietary pattern* consisted of meat/organ meat, biscuits/sweets, chicken stew, pasta-macaroni recipes, butter, white wheat bread, egg recipe, and shiro-wet food items or groups [13, 32, 37]. A *traditional dietary pattern* is characterized by the consumption of tubers, whole-grain maize products, coffee leaves and herbal beverage, legumes, and sweet potatoes [44-46]. A *healthy dietary pattern* was defined based upon the presence of green leafy vegetables, green pepper, and whole-grain maize products food items or groups.

3.7. Wealth index analysis

The wealth index was constructed using 40 variables for rural and 28 variables for urban areas related to the ownership of household assets using a principal component analysis (PCA) [223, 224]. During the analysis, in each study setting eleven components with factor loading ≥ 0.4 (house lighting, ceiling type, bedroom, cooking place, ox, electricity, radio, mobile, chair, table, and mattress for a rural area, and floor type, wall type, ceiling type, bedroom, house ownership, toilet, television, mobile, table, mattress, and injera stove for an urban area) were identified and retained. The wealth index values were calculated by summing up the scores of eleven components in each study setting. Finally, the three socioeconomic categories were generated by splitting the wealth index values into three equal classes (See Tables 4 & 5).

Table 4. Rural household assets used in wealth index construction

Variables (N = 1240)	Assigned values	Present or favorable		Factor loadings
		Frequency	Percent	
Source of light	Improved = 1, Unimproved = 0	756	61.0	0.54
Type of ceiling	Improved = 1, Unimproved = 0	633	51.1	0.45
Number of bedrooms	Improved = 1, Unimproved = 0	841	67.8	0.42
Place of cooking	Improved = 1, Unimproved = 0	697	56.2	0.45
Owning ox	Present = 1, Absent = 0	803	64.8	0.43
Access to electricity	Present = 1, Absent = 0	657	53.0	0.50
Owning radio	Present = 1, Absent = 0	329	26.5	0.51
Having a mobile phone	Present = 1, Absent = 0	500	40.3	0.52
Owning chair	Present = 1, Absent = 0	1080	87.1	0.52
Owning table	Present = 1, Absent = 0	1129	91.1	0.51
Owning bed mattress	Present = 1, Absent = 0	568	45.8	0.63

Table 5. Urban household assets used in wealth index construction

Variables (N = 1243)	Assigned values	Present or favorable		Factor loadings
		Frequency	Percent	
Type of floor material	Improved = 1, Unimproved = 0	1107	89.1	0.59
Type of wall material	Improved = 1, Unimproved = 0	624	50.2	0.46
Type of ceiling material	Improved = 1, Unimproved = 0	1128	90.8	0.53
Number of bedrooms	Improved = 1, Unimproved = 0	642	51.7	0.42
Type of toilet facility	Present = 1, Absent = 0	1143	92.0	0.40
Owning a house	Present = 1, Absent = 0	704	56.6	0.43
Owning television	Present = 1, Absent = 0	1129	90.8	0.56
Having mobile phone	Present = 1, Absent = 0	1173	94.4	0.46
Owning table	Present = 1, Absent = 0	1222	98.3	0.42
Owning bed mattress	Present = 1, Absent = 0	1188	95.6	0.46
Owning injera (bread) stove	Present = 1, Absent = 0	876	70.5	0.49

Description of assigned values of household assets included in wealth index construction

Type of floor material: Unimproved sources (0): a house with earth, sand, or dung floor.

Improved sources (1): a house with plastic, wood, bamboo, polished wood, ceramic tiles, cement, or carpet floor.

Type of wall material: Unimproved sources (0): a house with earth, or local wood wall.

Improved sources (0): a house with plastic, local brick, cement, or cement brick wall.

Source of light: Unimproved sources (0): a house with fire, lantern, and beer can with gas/candle, or battery. Improved sources (1): a house with a generator, biogas, or solar lamp.

Type of ceiling: Unimproved sources (0): a house with no or thatched ceiling. Improved sources (1): a house with plastic, cloth, corrugated iron sheet, wood, local brick, or cement brick ceiling.

The number of bedrooms: Unimproved sources (0): a house with no or one bedroom. Improved sources (1): a house with two, three, or more bedrooms.

Place of cooking: Unimproved sources (0): cooking inside a house using firewood and other biomass fuel. Improved sources (1): a house with a separate kitchen for cooking.

Type of toilet facility: Unimproved sources (0): a house with no facility, pour-flush not piped to a septic tank, sewer system, pit latrine without a slab, or hanging latrine. Improved sources (0): a house with flush/ pour flushed to a septic tank or piped sewer system, ventilated improved pit (VIP) latrine, pit latrine with slab, or composting toilet.

3.8. Assessment of dietary patterns

Generally, dietary patterns are identified by using foods or nutrients, or a combination of both, and foods or food groups are often used as nutrients are composite food scores [225]. Since the aim of this study was the identification of dietary patterns and associated factors, we used the previous day's 24-hour dietary intake to assess the dietary patterns. Therefore, the dietary patterns were determined using factor analysis based on the intake of 24 food items or groups [225, 226]. Some of the food items were categorized into groups depending on their similarities such as legumes, tubers, green leafy vegetables, and pasta and macaroni recipes. Food items or groups with factor loadings ≥ 0.3 or ≤ -0.3 were considered as significantly contributing to the pattern. The number of factors that were retained in the analysis was determined based on the *eigenvalue* > 1.0, evaluation of the *scree plot*, and the plausibility of the factors. We used

orthogonal transformation (*varimax rotation)* to identify uncorrelated factors and facilitate interpretability. Therefore, factor analysis and subsequent vari*max rotation* were used to determine the dietary patterns.

Positively loaded food items or groups contributed to a given dietary pattern, whereas negatively loaded foods have an opposite relation with a particular dietary pattern. A high factor score demonstrates a high intake of foods comprising a particular food pattern, whereas low scores demonstrate a low intake. Dietary patterns were named after the food items or groups with the highest loadings of those dietary patterns. Factor scores for each dietary pattern and participant were estimated by summing the consumption of each food item or group weighted by their factor loadings. Subsequently, the *tertiles* of the dietary patterns scores were generated by classifying the scores into three categories: first *tertile* (lowest), second *tertile* (middle), and third *tertile* (highest) to show the frequencies in relation to other variables in the descriptive tables.

3.9. Statistical analysis

Data were entered into the Epi-Data version 3.1 (EpiData Association, Odense, Denmark) and excel-template using the double-entry system and cleaned for inconsistency. The data were analyzed using STATA version 15 software (StataCorp LLC College Station Texas, USA). Descriptive summaries were analyzed to determine the frequency and proportion of categorical variables. All the independent variables satisfied the assumption for the *multicollinearity* test with the Variance Inflation Factor (VIF) less than 10 or tolerance greater than 0.1.

The outcome variable of the first specific objective (paper I) was hypertension. The prevalence of pre-hypertension and hypertension was computed based on the European Society of Hypertension (ESH) Guideline [107]. To generate a weight for the three-stage cluster sampling,

first, we computed finite population corrections for the two stages independently. Then to get our survey weight, we multiplied and inverted the two finite population corrections. We determined the weighted prevalence, after declaring the data set as a three-stage survey, using the primary sampling unit identifier, the weight of the cluster, finite population correction of the first stage sampling, secondary sampling unit identifier, and finite population correction of the second stage sampling.

Factors associated with hypertension were analyzed using logistic regression. Binary categorical explanatory variables were coded in the same way as the outcome variable. Variables with P values less than 0.20 in the bivariable analysis, and those with socio-demographic and public health importance were selected for multivariable analysis. The number of cases that represent observation in the rarer of the two binary levels of the outcome variable was considered to fix the number of candidate variables that entered into the final multivariable logistic regression model. Accordingly, twelve variables were selected for multivariable analysis to control overfitting. The multivariable logistic regression analysis was started after declaring the data set as survey data to account for the effect of clustering on the estimated standard errors. The adjusted odds ratio (AOR) with 95% CI, and a P value less than 0.05 were used to ascertain the significance of the association.

The outcome variable of the second specific objective (paper II) was the number of modifiable CVD risk factors, a count variable that comprises values from zero to seven. The weighting of the data was done using finite population corrections for *kebele*/ cluster and also household selections. Finally, we generated the weighted prevalence after declaring the data as survey data and incorporating the computed sampling weights. The event was analyzed using Poisson regression to assess its association with explanatory variables [227]. We have checked the

assumptions for the requirements of Poisson regression. Accordingly, the independence of observations was checked using the *multicollinearity* test, and all observations were found independent of each other. The outcome variable also satisfied the assumption of the equality of the mean and variance. Further, we conducted an interaction analysis of modifiable variables by stratifying socio-demographic characteristics with the number of modifiable CVD risk factors. There was no sufficient evidence for the presence of interaction. Therefore, the model without the interaction term is presented. Variables with P values < 0.2 in the bivariable analysis were considered a candidate for the multivariable Poisson regression analysis. The test statistics for the *Deviance and Pearson goodness of fit tests* of the simple Poisson regression model were insignificant indicating our final model was a good-fitting model. To identify the best fitting model, we computed the *Akaike Information Criterion* (AIC) after carrying out the simple and multilevel analysis with *estat ic* command. Accordingly, we found a smaller AIC for the multilevel model; therefore, we selected a multilevel model for the final regression analysis. The 95% CI of the adjusted incidence rate ratios that did not include one declared the presence of an association.

Dietary patterns were the outcome variables of the third specific objective (paper III) that were identified using factor analysis. The prevalence and frequencies of tertiles of dietary patterns were calculated. The covariates used in this analysis include residence, education, physical activity, obesity, hypertension, hyperglycemia, total cholesterol, and triglyceride levels. The associations between covariates and dietary patterns were assessed using bivariable and multivariable linear regression models building a separate model for each of the identified dietary patterns. The data analysis was started after declaring the data set as a three-stage cluster survey to account for the effect of clustering on the estimated standard errors. The assumption of

normality of the continuous variables was checked objectively using *sktest* (*skewness-kurtosis* test) and subjectively using histograms. Based upon this the natural logarithmic transformation was made for the outcome variables to satisfy the assumption. The result demonstrated the normal distribution of the residuals. Variables with the P values < 0.2 in the bivariable analysis were considered a candidate for multivariable linear regression analysis. The adjusted regression coefficient with its 95% CI is presented, and the absence of 0 within the 95% CI declared the presence of association.

Chapter IV: Results

4.1. Paper-I: Hypertension

This study was aimed at determining the prevalence of hypertension, prehypertension, and related factors among 2483 adult study participants. We determined the weighted prevalence of hypertension and pre-hypertension using finite population corrections for *kebele* (village) and households. The weighted prevalence was generated following survey data declaration and incorporating the computed sampling weights. We used logistic regression to analyze associated factors, and this has been executed after the data set has been classified as survey data.

The study area's overall weighted prevalence of hypertension and prehypertension was 31.3 % [95% CI: 27.7%-35.1%] and 46.4 % [95% CI: 42.9%-50.0%], respectively. The weighted prevalence of hypertension in the urban was 37.2% [95% CI: 28.3%-47.0%] while it was 28.7% [95% CI: 25.8%-31.8%] in the rural. The weighted prevalence of hypertension among those who did not know about their condition before the study was 29.8% [95% CI: 26.5% -33.38%]. In contrast, the weighted prevalence of self-reported hypertension was 2.2% [95% CI: 1.2%-3.8%].

Obesity [AOR = 2.5; 95% CI: 1.4-4.5], sugar-sweetened foods intake [AOR = 1.6; 95% CI: 1.3-2.1], male sex [AOR = 1.4; 95% CI: 1.1-1.7], raised total cholesterol [AOR = 1.2; 95% Ci: 1.1-1.3], increased fasting blood sugar [AOR = 1.1; 95 % CI: 1.01-1.2], and increasing age [AOR = 1.03; 95% CI: 1.01-1.04] showed statistically significant association with hypertension.

4.2. Paper-II: Modifiable cardiovascular disease risk factors

We aimed at assessing the prevalence, magnitude, and factors associated with the number of major modifiable CVD risk factors among adults. We conducted a community-based survey in southern Ethiopia using a three-stage random sampling technique among 2483 adult populations.

The prevalence and magnitude of the number of major modifiable CVD risk factors were computed employing weighting of the data and declaring survey data analysis. We used a multilevel Poisson regression to analyze the association of covariates with the number of modifiable CVD risk factors.

Among the adult participants in the study, the weighted prevalence of physical inactivity was 44.1% [95% CI: 33.6%-55.3%]. A small proportion of adults (0.8% [95% CI: 0.3%-2.1%]) used a smokeless or smoked tobacco product. In general, 3.7% [95% CI: 2.9%-4.8%] of the study participants had hyperglycemia. We observed hypertriglyceridemia in 15.5% [95% CI: 13.3%-18.0%], and hypercholesterolemia in 5.0% (95% CI: 3.9%-6.4%) of the study population. Other major modifiable CVD risk factors identified in the study area include obesity with a weighted prevalence of 2.8% [95% CI: 1.5-5.1], low high-density lipoprotein cholesterol (HDL-C) 31.3% [95% CI: 20.9-44.0], high systolic blood pressure (SBP) 22.2% [95% CI: 19.2-25.6], and high diastolic blood pressure (DBP) 22.4% [95% CI: 19.4-25.8].

Overall, 24.2% of the 470 study participants did not have the major modifiable CVD risk factors. Totally, there were 2013, 1201, and 576 participants who had one, two, or three major modifiable CVD risk factors with a weighted prevalence of 75.8% [95% CI: 67.6-82.5], 42.3% [95% CI: 34.6-50.3], and 19.4% [95% CI: 14.9-24.7] respectively. In contrast to the rural area, where the weighted prevalence of having one or more major modifiable CVD risk factors was 67.4% [95% CI: 59.5-74.4], similar figures for the urban area were 94.8% [95% CI: 92.8-96.2]. The weighted prevalence of having two or more major modifiable CVD risk factors in the urban was 64.3% [95% CI: 57.9-70.2], while it was 32.4% [95% CI: 26.0-39.6] in the rural. There were typically 28 distinct combinations of major modifiable CVD risk factors co-occurrences. The combination of physical inactivity with low HDL-C was found in 19.7% (488) of the study

participants, followed by physical inactivity with hypertension in 17.8% (443) and high blood pressure with low HDL-C in 12.1% (301).

The number of major modifiable CVD risk factors was positively associated with urban residence [IRR = 1.53; 95% CI: 1.29-1.81], male gender [IRR = 1.13; 95% CI: 1.05-1.23], sugar-sweetened foods intake [IRR=1.14; 95% CI: 1.05-1.24], and older age [IRR = 1.01; 95% CI: 1.009-1.02]; while being a farmer [IRR = 0.80; 95% CI: 0.70-0.92] was negatively associated.

4.3. Paper III: Dietary patterns

The objective of this paper was to identify the dietary patterns, and their association with cardiovascular risk factors among adult people in Wolaita, southern Ethiopia. The dietary patterns were determined using factor analysis. Multiple linear regression models were used to analyze the associations between dietary patterns, and CVD risk factors.

Three dietary patterns that account for 51% of the overall variation in food intake were identified. The first pattern, which is similar to the *western dietary pattern* and consists of foods from animal sources with added sugars and refined carbohydrates, explained 21.5% of the total variation in food intake. The highest factor loading food items or food groups including meat/organ meat, biscuits/sweets, chicken stew, pasta-macaroni recipes, butter, white wheat bread, egg recipe, and Shiro-*wet* positively influenced the *western dietary pattern*, but whole grain maize products had a negative impact. The second pattern exhibited a substantial consumption of plant-based food sources that is consistent with a *traditional dietary pattern* and accounts for 18.1% of the overall variance. The highest positive factor loadings in this pattern are recorded in tubers, whole-grain maize products, coffee leaves and herbs beverages, legumes, and sweet potatoes. The *traditional dietary pattern* was characterized by the intake of tubers,

whole-grain maize products, coffee leaves and herbs beverages, legumes, and sweet potatoes. The third pattern, known as the *healthy dietary pattern*, is defined by the consumption of green leafy vegetables, green peppers, and whole-grain maize products. This pattern explained 11.4% of the overall variance.

The *western dietary pattern* was positively associated with urban residence [β = 0.6; 95% CI: 0.3-0.8], obesity [β = 1.2; 95% CI: 0.9-1.5], hypertension [β = 1.0; 95% CI: 0.7-1.3], blood glucose [β = 0.15; 95% CI: 0.11-0.18], and total cholesterol levels [β = 0.15; 95% CI: 0.07-0.23]. The *traditional dietary pattern* had a positive relationship with physical activity [β = 0.4; 95% CI: 0.2-0.6], and obesity [β = 1.1; 95% CI: 0.5-1.6], while it had a negative relation with hypertension [β = -1.2; 95% CI: -1.4, -0.9], and urban residence [β = -0.9; 95% CI: -1.6, -0.2]. The *healthy dietary pattern* was negatively related to obesity [β = -0.48; 95% CI: -0.94, -0.02], and hypertension [β = -0.7; 95% CI: -0.9, -0.4], while it was positively related to urban residence [β = 0.8; 95% CI: 0.5-1.0].

Chapter V: Discussion

5.1. Methodological discussion

5.1.1. Study design

We used a cross-sectional study design to answer the questions raised in this study and address the specific objectives stated in this thesis. A cross-sectional study design has the advantage of determining the prevalence of the intended outcome, at a given point in time, within the population under investigation. The collection of data in one specific time point enables the researchers to maximize the completeness of key data points and privileges control of the information acquisition process, since there are not any long-term considerations involved with this specific approach. Since the overall population is studied at one point, it requires having a large sample size to produce reliable data, and improve precision. Therefore, we considered this important aspect of the study design while computing the sample size. Non-response, particularly affects cross-sectional studies, especially in a situation where the characteristics of non-responders vary from the responders. Therefore, to control bias concerning non-participation, we made diligent efforts to increase participation. For instance, we created clarity on the objective of the study in the information to potential participants, the examinations were made at the participants' houses, and we performed repeated visits at their houses if they were not present at our first visit. The cross-sectional design does not provide information about temporal relationships between examined variables [228-230]. We are aware that the temporality of the association between the outcome variables and the independent variables remains in question, but still, findings from this study bring forward new information that might be useful in the understanding of diet and other factors. We considered this while interpreting the results.

5.1.2. Sample size

We used Epi Info version 7 StatCalc to compute the sample size for each specific objective [Paper I, II, and III] of this study. The response rate in this study was very high, as 2483 people participated, out of a population of 2486. The reason for the high response was, as previously mentioned, likely to be the provision of information including the objective of the study and schedules before the data collection, and repeated visits to the homes in their absence. To verify the adequacy of the sample size for each specific objective, we carried out a posthoc power calculation for prevalence, and mean differences using OpenEpi version 3.03 software. We determined a statistical power for paper one using a 95% confidence level, 1243 study participants from the urban with a 37.2% prevalence of hypertension, and 1240 study participants from the rural with a 28.7% prevalence of hypertension. Accordingly, the statistical power of paper one became 99.4%, which indicates the adequacy of the sample size. Accordingly, the statistical power of paper one became 99.4%, which indicates the adequacy of the sample size. Similarly, we analyzed the power of the study for paper two considering a 95% confidence level, with 1243 participants with 64.3% having ≥ 2 modifiable CVD risk factors, and 1240 rural participants with 32.4% having ≥ 2 modifiable CVD risk factors. Consequently, the power resulted in 100%, which confirms the availability of an adequate sample size for paper II. For paper III, we have compared power for two means to evaluate the adequacy of the sample sizes to assess the dietary patterns (*western, traditional and healthy*), and associated factors among adult people considering residence as the main independent variable. Subsequently, the power for the three outcome variables in the study was > 90%, indicating a sufficient sample size for the specific objective III (See Supplementary File 3. Posthoc power).

5.1.3. Internal validity

Validity and precision are essential components of epidemiological study. Validity refers to conditions where the parameters of the study are measured with little systematic error and classified into internal and external validity. Internal validity represents the trustworthiness of the measurement of the group of people in the study and is affected by selection bias, information bias, and confounding [230, 231]. Epidemiologic studies are also affected by a lack of precision which is caused due to sampling or random error (chance) [232].

5.1.4. Selection bias

In cross-sectional studies, selection bias occurs due to the application of inappropriate sample selection procedures and factors that affect participation in the study. It results due to the use of non-random methods and non-participation in the study. It can either differentially or non-differentially affect the study by underestimating or overestimating the true effect [230, 231, 233-235].

We followed similar procedures to select our study participants for the three papers included in this thesis. We employed a three-stage sampling technique to select the primary and secondary units of our study and used a simple random sampling technique to select the study villages and participants. We generated survey weight to determine the prevalence in papers one and two. To control the effect of clustering, which results because of the sampling procedure, we used survey data analysis for the final multivariable analysis in papers I and III. In paper two, we applied multilevel analysis for the final regression analysis. The rate of participation in this study was high. On the other hand, the distribution of non-participants among the study groups was random. Therefore, bias related to sample selection in this study might be minimal.

5.1.5. Measurement Bias

Information bias arises from the improper measurement of the study parameters. It can be created when information is gathered differently from various study groups [230, 231, 233-235]. In this thesis, information bias can be originated due to interviewer bias that occurs during the interview, biomedical sample collection, operation of laboratory procedures, and reading of data collection instruments and results. It can also be created due to interviewee bias as a result of social desirability reasons, recall problems, and the physiologic condition of the participants. Furthermore, information bias can be caused as a result of the failure of data collection equipment, and the use of unreliable tools such as questionnaires, guidelines, laboratory instruments, and procedures.

In this thesis, to minimize information bias, we conducted various data quality control activities. To avert interviewer-related bias [Paper I-III]; we trained the data collectors and their immediate supervisors together for the reduction of any bias related to different data collection. This is a feasible method in a population where some individuals might be illiterate and others are not used to writing at all. Further, a pretest was conducted to acquaint the data collection team with the data collection instruments. We also conducted retraining based on the identified gaps during the pretest. During the actual data collection period, we performed regular supervision to monitor the process. For bias linked to the interviewee [Paper I-III], we used memory aids and applied standardized procedures to control conditions that alter the subjects' statuses. Regarding the mechanism of managing instrument bias, we used standard and calibrated laboratory machines and other data collection tools such as Seca digital weighing scale, digital sphygmomanometer, and glucose meter. The questionnaires of this thesis were developed by adapting standardized questions from the WHO protocol for chronic NCDs (WHO STEPS survey), and a 24-hour

dietary recall assessment tool [212, 214]. In addition, questionnaires were enriched by incorporating inputs gained from the pretest. Moreover, we developed appropriate operational definitions for independent and outcome variables using reliable guidelines (See Tables 2 and 3).

On the other hand, we expect a social desirability bias for self-reported responses related to behavioral questions such as smoking, and harmful alcohol consumption, since the population in the study area is predominantly religious. However, we have taken measures of reducing social desirability bias by ensuring confidentiality and employing anonymized data collection and analysis of participants in the survey. We have also adapted standardized questions to self-reported behavioral questions including physical activity and fruit and vegetable consumption. In addition, we limited the recall times to shorter durations, and made the purpose of our research project clear to the study participants (Paper I-III). We also admit the possibility of having recall bias, particularly while measuring age. Ethiopians often do not know their exact age. We recorded the age parameter based on the birth date estimation using the study participants' recall memory. In addition, we used memory aids to estimate the age of participants such as the occurrence of popular public events around the participants' birth date to control this recall bias.

Meanwhile, in paper II, we recognize the absence of other important modifiable CVD risk factors such as low LDL-C, and insufficient consumption of fruit and vegetable as the components of major modifiable CVD risk factors. This might underestimate the magnitude of major modifiable CVD risk factors. However, insufficient intake of fruit and vegetable were not taken into account as part of our outcome variable as we defined the major modifiable CVD risk factors based on the American Heart Association [81]. There might be a misclassification in our study related to the blood glucose and lipid profile (Paper I-III). Although the study participants were told to be fasting before the blood test, we cannot be confident that this was the situation

for everyone. We tried to reduce this weakness of the study by giving the participants the required information before the examination day.

In paper III, information on dietary intake was obtained for all interviewed individuals using a 24-hour recall method and this has been used in low-income settings for many years. A single-day experience may not guarantee an understanding of the usual dietary pattern; however, we employed this method on different individuals at a population level, where the study population was selected randomly, and all the days of the week were represented in the sample. This was in line with the recommendation given by the principles of nutritional assessment [213]. The method has been debated whether it can serve as a substitute for the weighted food records to assess the absolute nutrient intake [236, 237]. Nevertheless, in this study, the amount of food and type of nutrient intake was not required as we aimed at identifying the dietary patterns. In this paper, the causality between the diets and the risk factors cannot be interpreted, but still, findings from this study bring forward new information that might be useful in the understanding of diet and other factors.

5.1.6. Confounding and effect modification

Confounding is an error in the estimation of effect measure between the potential independent variables and the outcome that occurs when there is variation between the comparison groups other than the factor of interest (independent variable) [230, 231, 233-235]. It is caused by the existence of a third factor that is associated with the independent variable and the outcome but is not intermediate in the causal pathway. The magnitude of confounding is assessed using the level of variation between the crude and adjusted estimates, and the absence of difference between the two estimates indicates the observed effect was not confounded by the potential confounding

variable [230]. The issue of confounding can be addressed at the stage of design, and implementation, while its effect can be controlled during analysis using an appropriate statistical technique [234, 235]. In this thesis, the effect of confounding was controlled by using multivariable analysis [Paper I-III]; however, variables that were not assessed remain potential confounders. For instance, the consumption of salt was not considered in the analysis of the first paper.

Further, we carried out an interaction analysis of modifiable variables such as obesity, blood glucose, and total cholesterol levels with hypertension by stratifying them into socio-demographic characteristics such as age, gender, and residence for the first paper. We found no evidence for the presence of interaction. Similarly, we conducted an interaction analysis of sugar-sweetened food intake with the number of modifiable CVD risk factors by stratifying it into socio-demographic variables in paper II and found no interaction.

5.1.7. Random error (chance)

In epidemiologic studies, inferences about the entire population can be drawn using the sample. Random error is also called sampling error or chance that occurs as the result of variability in samples and affects the reliability of the investigation [230, 231, 234, 235]. The existence of a statistically significant association cannot be in itself proof of causation. The observed association could be the result of chance. A statistically significant test can be ascertained using a p-value with a cutoff point < 0.05 and more efficiently using a 95% confidence interval that does not consist of the null hypothesis value. The involvement of a large (adequate) sample size in a study could reduce the likelihood of chance. In this thesis, we enrolled large study participants and used efficient statistical techniques to control random error such as the application of a simple random sampling technique to select study villages and participants. In all papers (I-III), we considered

the clustering effect in our final regression analysis that arises from the multistage selection of the study participants. For paper one, we used logistic regression with survey data analysis, while we used Poisson regression with multilevel analysis for the second paper. We used linear regression with the survey data analysis for the third paper. Multiple statistical tests and comparisons may cause erroneous results, due to chance alone. In the present studies, numerous tests have been performed, and this must be considered when evaluating the results

5.1.8. External validity and transferability

External validity or generalizability is the practice of extrapolating the findings of the study to a population outside that population [230, 231, 234, 235]. The external validity of the study may be affected by circumstances such as a smaller sample size, lower enrollment rate or higher non-participation level, and lack of internal validity. Internal validity is the primary concern of a study. A study without internal validity is worthless and disseminates fallacious evidence to the external population.

In light of the above perspective, our study consisted large study population with adequate power [Papers I-III]. Further, the rate of non-participation in this thesis was very low that also strengthens the external validity of our study. Moreover, as discussed in the previous section, the level of systematic error in this thesis may not be large. The judgment of causality was made using the strength of association and consistency of our findings in comparison with other studies. Furthermore, explanations of the mechanism of action were given to factors that showed associations with the outcome variables to ensure the plausibility of our findings with the existing knowledge [Paper I-III]. On the other hand, we selected rural Ofa and urban Wolaita Sodo to represent the *traditional* and *western* dietary practices in the study area [238]. Wolaita Sodo is one of the largest cities in Ethiopia, relatively registering better economic growth with

rapid urbanization, and changing lifestyles [209]. In contrast, villages selected from Ofa characterize typical rural scenarios with a traditional or cultural way of living. We believe that the above evidence described in this thesis makes it likely that the results are valid for the mentioned areas and in similar areas in Ethiopia. It is difficult to know how valid the results are for other populations.

5.1.9. Neutrality and interest

Neutrality in research refers to the ability to do research, analyze data, and publish findings without bias or consideration of the investigator's opinions, experiences, or positions. It is unethical to allow personal values to affect how study findings are interpreted. The findings of this research project were not influenced by the interests of the authors, and the investigators remained impartial while conducting the research project.

This research project was funded by the South Ethiopia Network of Universities in Public Health, which in turn is funded by the Norwegian Program for Capacity Development in Higher Education and Research for Development. Wolaita Sodo University has also provided logistics and technical support. The funders had no role in the study design, data collection, analysis, decision to publish, or preparation of the manuscript. No author received a salary from the funders of this research project. The principal investigator is the academic staff of Wolaita Sodo University, Ethiopia. Therefore, Wolaita Sodo University, southern Ethiopia paid the salary of the principal investigator. However, the university had no role in the study design, data collection, analysis, decision to publish, or preparation of the manuscript.

5.1.10. Ethical considerations

Ethical clearance was obtained from the Institutional Review Board at Hawassa University (IRB/005/10) and the Regional Committee for Medical Research Ethics Northern Norway, REK North (2017/2248/REK Nord) (Appendix IV and V). A support letter was obtained from Wolaita Sodo University and submitted to the concerned zonal and district offices. Written informed consent was obtained from all the study subjects; after introducing the purpose of the research using information sheets. Participation was based on voluntary consent. The identities of the study participants were kept confidential, except participants with FBS levels of 7.0 mmol/l (126 mg/dl) or above, high blood pressure, and other serious ailments who were linked to the nearest health service facilities.

5.2. Discussion of the main findings

This thesis was aimed at assessing the dietary patterns, and the prevalence of major modifiable CVD risk factors including hypertension in Wolaita, southern Ethiopia. As the evidence demonstrates, the presence of a *western dietary pattern* and the highest burden of related cardio-metabolic risk factors indicate the transition to new diets [1-3, 13, 16]. In our study, we observed the co-existence of *western* and *healthy dietary patterns* in the urban environment of the study area, while the rural population relied on the *traditional dietary pattern*. All dietary patterns were associated with one or more cardiovascular risk factors, but the *western dietary pattern* was associated with most of these. The urban environment and major modifiable CVD risk factors consisting of obesity, hypertension, blood glucose, and total cholesterol levels were significantly associated with the occurrence of the *western dietary pattern*. Food items or groups including meat/organ meat, biscuits/sweets, chicken stew, pasta-macaroni recipes, butter, white wheat

bread, egg recipe, and shiro-wet positively contributed to the *western dietary pattern*. In the study area, as indicated in papers I and II, the prevalence of having one or more major modifiable CVD risk factors, and hypertension was high. Socio-demographic and dietary factors comprising an urban residence, older age, male sex, being a farmer, and sugar-sweetened food consumption played an important role in the increased number of major modifiable CVD risk factors including hypertension. The combination of physical inactivity with low HDL-C was the largest co-occurrence of major modifiable CVD risk factors, followed by physical inactivity with hypertension.

We detected a more significant association of *western, and healthy dietary patterns* with the urban part of the population, compared to the rural population. The observed positive relationship between the *western dietary pattern* and the urban environment is in agreement with the findings reported elsewhere in the LMICs [49, 239, 240]. This might be due to lifestyle changes related to the rapidly growing urbanization in the study area [209, 241]. However, this study also indicated the presence of a *healthy dietary pattern* in the urban environment. The co-occurrence of *western and healthy dietary patterns* in the urban environment of the study might indicate the transition to new diets [16, 242]. Further, we found an association between urban residence, and the number of major modifiable CVD risk factors as indicated in paper II, and this is consistent with the findings of other studies [83, 84, 243-245]. The higher prevalence of having one or more major modifiable CVD risk factors observed in the study area might be instigated by the changing lifestyle including dietary patterns. In contrast, we recorded a significant relationship between the *traditional dietary pattern* and the rural part of our study population, which was also accompanied by a higher level of physical activity. This is consistent with the findings of other studies [49, 246]. This might be due to the way of life in a rural area.

Moreover, moderate or vigorous activities like farming in rural areas may account for the observed positive relationship between physical activity and *traditional dietary pattern*.

Consumption of the *western dietary pattern* was also significantly related to obesity. The finding regarding the link between *western dietary pattern*, and obesity was supported by various studies which might indicate the introduction of transition to new diets among people in the study area [34, 44, 239, 247]. Compliance with the western diet is associated with higher energy intake, which accounts for weight gain and increased risk of obesity [248, 249]. Meanwhile, a *healthy dietary pattern* appears to be inversely associated with obesity, which is supported by the findings of other studies [44, 250]. The direct and inverse relationship demonstrated between obesity and *western*, as well as *healthy dietary patterns* respectively in the urban area of the research in this thesis might exhibit a circumstance during the transition to new diets. With a further look at the positive association between the *traditional dietary pattern* and obesity, we noted that the proportion of obesity was not higher for the third tertile (23%), but it was for the second tertile (51%), both compared to the first tertile (26%) showing this association was not straight forward. Multiple testing might play a role here, increasing the risk of 'chance' findings. This finding might also be due to the limitation of a single 24-hour dietary assessment not representing long-term dietary habits. However, it is shown in the literature that usual dietary intake in a population can be measured using a single-day dietary assessment, provided that the study participants are selected randomly, and all days of the week are represented in the sample [213]. However, there exists some evidence from Asian countries that indicate a positive relationship between *traditional dietary pattern* and obesity [251-253]. We suggest further investigation to ascertain this relationship in the context of our study area. On the other hand, obesity, as has been described in the first paper, was also associated with the occurrence of

hypertension. This is comparable with the findings from other studies [114, 116, 155, 156]. There is an established link between obesity and hypertension. The accumulation of excess fatty tissue instigates a cascade of events that may give rise to increased blood pressure [254, 255].

Hypertension was positively associated with the *western dietary pattern* [34], and it was negatively associated with the *traditional and healthy dietary patterns* [50, 256]. There has been little understanding of the mechanisms involved related to hypertension. The mechanisms linked to the etiology of arterial hypertension brought on by the western diet are complex and include several factors. High salt intake is one of the best-known risk factors for hypertension [257], but several different antioxidants are also associated with the development of high blood pressure [258]. Apart from this, the observed relationship between hypertension, and the *western dietary pattern* might be the consequence of the transition to new diets among people in the study area [4, 259].

Furthermore, we found a positive linear association between blood glucose levels and a *western dietary pattern*. Similar findings were reported elsewhere [34, 46, 251]. As a pro-inflammatory diet, the western diet can trigger inflammatory markers and cytokines and increase oxidative stress, which in combination lead to cell and Deoxyribonucleic Acid (DNA) damage, reducing insulin receptors, and lowering insulin production [260]. There was also a positive association between blood sugar levels and hypertension as shown in paper one. A study elsewhere in Ethiopia reported a similar finding [117]. This might be partially explained by the sharing of common risk factors [261, 262]. Similarly, total cholesterol levels increased with adherence to the *western dietary pattern*. Increases in plasma cholesterol may occur if the sources of cholesterol are consumed along with saturated and trans fats, as is the case with the *western dietary pattern* [263]. Other community-based studies have also revealed similar results [34, 264,

265]. Likewise, elevated total cholesterol levels were significantly associated with a higher prevalence of hypertension as indicated in the first paper [87]. This might be due to increased deposition and accumulation of lipids in the blood vessels.

The higher prevalence of having one or more major modifiable CVD risk factors, including hypertension documented in the second paper might be the consequence of the transition to new diets. It was related to socio-demographic and dietary factors consisting of an urban residence, older age, male sex, being a farmer, and sugar-sweetened food consumption. Being male was positively associated with the number of major modifiable CVD risk factors, which is comparable with the findings from other LMICs [84, 114, 117, 243, 266]. A similar relationship was also observed with hypertension as has been shown in the first paper. However, there are also findings from other studies which relate females to the number of major modifiable CVD risk factors [242, 267]. Therefore, additional investigation in ascertaining the relationship between the number of major modifiable CVD risk factors and gender may be needed. Additionally, the number of major modifiable CVD risk factors in paper two, and hypertension independently as demonstrated in paper one was associated with older age. This is in line with the findings reported by other community-based studies [116, 117, 244, 268, 269]. The observed association could be explained by a combination of genetic, and lifestyle factors. Furthermore, the number of major modifiable CVD risk factors and hypertension (papers I and II) increased with the consumption of sugar-sweetened food [115]. This might be due to a positive energy balance leading to developing any related risk factors of CVD [270]. On the other hand, being a farmer had a negative association with the number of major modifiable CVD risk factors. Farmers in Ethiopia are smallholder farmers relying on their physical labor for producing crops, and hence more energy expenditure [271].

Healthy lifestyles such as relying on the consumption of *healthy, and traditional dietary patterns* in combination with physical exercise as shown in this thesis may prevent the occurrence of the nutrition transition and related CVD risk factors [183-185]. Experiences from various Asian countries demonstrated that targeting combinations of CVD risk factors for prevention, such as treatment of hypertension, diabetes, and hyperlipidemia reduces CVDs such as heart attack, and stroke among people having these conditions [182-185]. In our study, physical inactivity, hypertension, and hyperlipidemia were found common and more prevalent in urban. In the study area, there is no detection, treatment, and control of NCDs. In addition, there are no essential medicines, and medical equipment in the primary health care facilities for the detection, treatment, and control of NCDs, and the health extension workers are not trained in the diagnosis and treatment of NCDs. In the past, the health system in Ethiopia has primarily been designed to treat and control communicable diseases. It has not been intended to detect, treat, and control NCDs. But recently in an effort made to realize universal health coverage through primary health care, the prevention, and control of NCDs were addressed within the health extension program policy [195]. Therefore, detection, treatment, and control of hypertension, and hyperglycemia might be an important strategy to prevent NCDs, especially CVD, targeting the urban population in the study area and similar settings in Ethiopia.

Chapter VI: Conclusions and recommendations

6.1. Conclusions

1. The prevalence of hypertension and prehypertension, in the study population of 2486, was 31.3% and 46.4%, respectively. Obesity, sugar-sweetened food consumption, being male, elevated total cholesterol, raised blood sugar, and advancing age was positively associated with hypertension.
2. The percentage of participants having ≥1, >2 and ≥3 major modifiable cardiovascular risk factors were 75.8%, 42.3 and 19.4%, respectively. Only 18 people were smoking. Physical inactivity and low high-density lipids were most often co-occurring, followed by physical inactivity and hypertension. Urban residence, being a male, sugar-sweetened food consumption, and older age had a positive association with several other cardiovascular risk factors.
3. The coexistence of *western, traditional, and healthy dietary patterns* in the present study indicates the transition to a new dietary pattern in the study area. All dietary patterns were associated with one or more cardiovascular risk factors, but the western dietary pattern was associated with most of these, while the traditional diet showed fewer such associations.

6.2. Recommendations

It is difficult to give recommendations based on one study only, and also the cross-sectional design creates limitations for how the results from the present study can be used. However, here are some suggested recommendations, open for discussion:

6.2.1. Operational

- A *healthy and traditional dietary pattern* might be promoted to prevent *the western dietary pattern* to develop. Consumption of sugar-sweetened food and high-cholesterol diets should be reduced, and this information should be disseminated both at local and national levels in Ethiopia.
- Farming-related moderate or vigorous activities might be promoted and maintained in rural areas while it is suggested to promote regular physical exercise in urban areas.
- The local, and federal governments should train the primary health care workers on the detection, treatment, and control of hypertension, and ensure the availability of essential medicines and medical equipment at the primary health care units.
- It seems also essential to develop periodic screening programs for hypertension, and primary intervention strategies such as the prevention of obesity both at local and national levels in Ethiopia.

6.2.2. For policy

- The government should give priority to working with NCDs in Ethiopia, not only infectious diseases and reproduction. They need to make relevant policies to work with the scientific people, public health, producers, and consumer groups in directing the production, marketing, and consumption of food toward more healthy diets and life-style.

6.2.3. For research

- For more certain conclusions and recommendations, future epidemiological studies should have a longitudinal design with repeated measurements of the diet and other lifestyle factors. It would also be of interest to study the development of different CVDs, but this must be done with caution due to the ethical considerations needed. Intervention studies might be useful, targeting specific risk factors, to reduce the prevalence of CVDs in the country.

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Original articles

Paper I

PLOS ONE

RESEARCH ARTICLE

Prevalence of hypertension, and related factors among adults in Wolaita, southern Ethiopia: A community-based cross-sectional study

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Abstract

Introduction

Hypertension is a global public health challenge. There is a lack of evidence on the preva-lence of hypertension, prehypertension, and related factors among adult populations of Wolaita, southern Ethiopia.

Aim

To assess the prevalence of hypertension, prehypertension, and related factors among adult populations of Wolaita, southern Ethiopia.

Methods

A community-based cross-sectional study was conducted on 2483 adult residents, selected using a two-stage random sampling technique. The quantitative data collected from struc-tured questionnaires; anthropometric and biochemical measurements were entered into EpiData version 3.1 using double-entry systems. We determined the weighted prevalence of hypertension and pre-hypertension for the two-stage survey. The multivariate logistic regression analysis was used to assess factors associated with hypertension and carried out after declaring the data set as survey data to account for the effect of clustering. An adjusted coefficient with 95% CI was used to ascertain the significance of the association.

Results

The weighted prevalence of hypertension and prehypertension in the Wolaita area was 31.3% (27.7%-35.1%) and 46.4% (42.9%-50.0%) respectively. The weighted prevalence of hypertension of those who were not aware of their hypertension until the time of the survey was 29.8%% (26.5%-33.3%). Where the weighted prevalence of self-reported cases of hypertension was 2.2% (1.2%-3.8%). Obesity, sugar-sweetened food consumption, male

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sex, elevated total cholesterol, raised fasting blood sugar, and advancing age were posi-tively associated with hypertension.

Conclusion

The prevalence of hypertension among adults in Wolaita was high. A small proportion of the affected people are aware of their high blood pressure. This study reported a high preva-lence of pre-hypertension; which indicates a high percentage of people at risk of hyperten-sion. It is essential to develop periodic screening programs, and primary intervention strategies such as the prevention of obesity, and reduction of sugar-sweetened food consumption.

Introduction

The burden of non-communicable diseases (NCDs) in developing nations is increasing as a result of expanding urbanization, a growing economy, and shifting lifestyles [1, 2]. Hyperten-sion, as a significant contributor to the burden of non-communicable diseases, is a global pub-lic health challenge [3, 4]. The global burden of hypertension is projected to be 1.56 billion in 2025; two-thirds of this will be occurring in developing countries [3]. Hypertension dispropor-tionately affects populations in low- and middle-income countries [5].

Hypertension, defined as a systolic blood pressure greater or equal to 140 mmHg and/or diastolic blood pressure greater or equal to 90 mmHg or a self-reported case for medication [6]. Hypertension was believed to be rare in Africa, but it is currently perceived as one of the most important causes of cardiovascular diseases contributing to about 40% of the cases in the continent [5, 7]. According to the World Health Organization (WHO) report on NCDs 2014, hypertension among adults was highest in the African region with a prevalence of 30% [8]. It is a widespread problem with great economic impact because of its effect on productive subpop-ulations [9].

Studies around the world reported different levels of prevalence of hypertension and factors associated with blood pressure. A study conducted on the prevalence of hypertension among Indian adults reported an overall prevalence of 30% [10]. A study from Ghana showed a 13% prevalence of hypertension [11], and in Kenya, 24% of the population was hypertensive [12]. Factors reported as having associations with hypertension comprise older age, being male, being married, overweight, added sugar intake, alcohol drinking, and fruit consumption [10– 14].

Evidence from the national NCDs STEPS survey of Ethiopia showed a 15% overall prevalence of hypertension [15]. Community-based cross-sectional surveys from other areas in Ethiopia reported prevalence rates ranging from 28% to 35% [16, 17]. In some places of southern Ethiopia, the prevalence of hypertension ranged from 22% to 35% [18, 19]. Identified risk factors of hypertension from studies in Ethiopia include older age, male sex, urban residence, higher formal education, physical inactivity, overweight or obesity, total cholesterol, raised fasting glucose, poor vegetable diet, and alcohol drinking [15–19]. In the study area, there is a lack of evidence on the prevalence and factors associ-ated with hypertension (See S1 File). Therefore, this study aimed at determining the prev-alence of hypertension, prehypertension, and related factors among adult populations of Wolaita, southern Ethiopia.

Materials and methods

Study design and setting

A community-based cross-sectional study was conducted from May 2018 to February 2019 in Wolaita Sodo town and Ofa rural areas, Wolaita Zone, southern Ethiopia. According to the projection based upon the 2007 population census, the population of Wolaita Zone in 2019 is about 2,042,593 people. Out of which, the proportion of the 25–64 years population is about 30.5%. We surveyed urban Wolaita Sodo and rural Ofa to assess variation in the prevalence of hypertension between urban and rural settings. Wolaita Sodo is the largest town in the zone with an estimated population of 165,596, and Ofa, one of the distant districts in the zone with a population of about 141,339 [20].

Study subjects and sample size determination

The source population consists of people residing in the selected administrative areas of Wolaita Sodo town and Ofa rural district. The study population was permanent residents of randomly selected households aged between 25 to 64 years.

We calculated the sample size using Epi Info 7 StatCalc for two population proportions. Initially, the overall sample size (2486) was calculated to measure differences in dietary intake and nutrition transition among rural and urban populations as a general objective. Since our pri-mary exposure variable is residence; the sample size was calculated based upon the prevalence of hypertension in urban and rural populations. The following assumptions from the study entitled prevalence of high blood pressure, hyperglycemia, dyslipidemia, metabolic syndrome and their determinants in Ethiopia: evidence from the national NCDs STEPS survey, 2015 were considered to calculate the sample size for this study [15]: 14.9% prevalence of hyperten-sion in rural, 19.7% prevalence of hypertension in urban, 95% confidence level, 80% power, one for the ratio of unexposed and exposed groups, 10% non-response rate, and the total sam-ple size became 2233. Therefore, the above sample size used in this study was sufficient to assess the prevalence of hypertension, prehypertension, and related factors among adult popu-lations of Wolaita, southern Ethiopia.

Sampling techniques and procedures

Data were collected in a two-stage cluster survey, with the villages from the urban and rural study sites being selected at the first stage, and a random sample of households within each vil-lage selected at the second stage. Initially, eleven out of 54 villages with urban characteristics of Wolaita Sodo town were selected using a simple random sampling technique. Similarly, ten out of 52 villages with rural characteristics of Ofa district were selected using a simple random sampling technique (Fig 1).

The distribution of samples in urban and rural areas was equal. Hence, 1243 people were selected from each study area. The estimated sample size was proportionally allocated to the selected villages based on their population size (Fig 1). The secondary unit of the study was the household and was selected using a simple random sampling technique from the list of enu-merated households. To ensure the independence of observation, one eligible adult from each household was selected using simple random sampling. Each household was visited twice dur-ing the data collection time, one for the interview and anthropometric measurements, and the other for blood sample collection. After conducting interviews and taking anthropometric measurements during the first visit, the study participants were instructed overnight fasting and were appointed for blood sample collection for the next day.

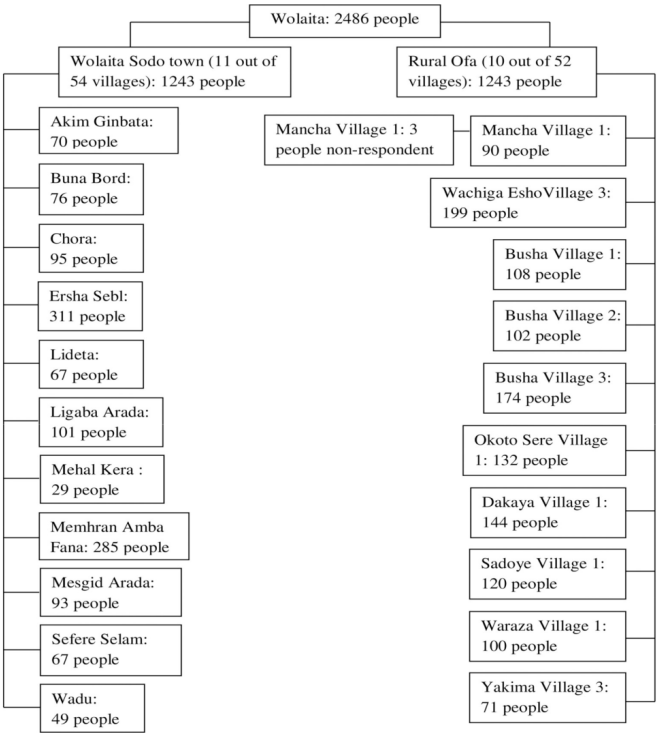

Fig 1. Flow chart of the study subjects selection from villages in Wolaita Sodo town and rural Ofa, Wolaita, southern Ethiopia 2018.

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Data collection procedures and techniques

Data for this study were collected using structured questionnaires, laboratory investigations, and anthropometric measurements. A series of questions about the potential risk factors and related variables were adapted from the World Health Organization (WHO) protocol for chronic non-communicable diseases (WHO STEPS survey) [21]. The English version (See S1 Questionnaire) of the questionnaire was translated into Amharic (See S2 Questionnaire), and Wolaita (See S3 Questionnaire) languages; and these were retranslated into English by an inde-pendent professional to ensure the accuracy of the translation.

Six field data collectors, five laboratory technicians, one field supervisor, one field coordina-tor, and two data clerks were recruited and given one week of training on data collection instruments. The training consisted of the purpose of the study, the contents of the question-naire, interviewing skills, anthropometric measurements, laboratory procedures and analysis, format completion, and storage of samples.

Self-reported daily fruit and vegetable intakes were assessed using food frequency questions adapted from the WHO STEPwise approach to surveillance [21]. Physical activity was assessed based on the self-reported performance of moderate-intensity and vigorous-intensity activi-ties, walking; time spent in minutes to carry out each activity, and MET (Metabolic equiva-lents) value of the respective activity. MET-minutes/week for a particular activity was computed by multiplying the number of days per week taken to perform each activity, with the time spent in minutes per day to perform the activity and the respective MET value of the activity [21, 22]. Finally, a combination of MET-minutes per week of walking, moderate-inten-sity, and vigorous-intensity activities was considered as the total MET-minutes/week [21, 22]. The recall period for the physical activity assessment was one week [21].

BMI was calculated as weight (kg) divided by height squared (m^2). Weight was measured to the nearest 0.1 kg using a portable digital weight scale (Seca electronic scale, 22089 Hamburg, Germany). The study subjects were weighted standing with light clothes on the scale with their shoes off. Before every measurement, the scale was tested for zero adjustments. Height was measured using a portable stadiometer (Seca, 22089 Hamburg, Germany), which consisted of a simple triangular headboard. For height measurement, the study subjects took off their shoes, stood straight, and held their head erect. The external auditory and the lower borders of the eyes were kept in one horizontal plane. The buttocks, shoulder blades, and heels touched the scale while legs with their knees stayed together and arms hanged by their sides. Height was measured to the nearest 0.1 cm. People with conditions not suitable for anthropometric measurements such as pregnant women and two people who were not suitable for height mea-surement such as participants who were unable to stand on the stadiometer were excluded from the study.

WHO STEPS data collection instrument was adapted for measurements of blood pressure (BP), and biochemical markers such as total cholesterol, fasting blood sugar level, and triglyc-eride values [21]. Whole venous blood samples were collected from participants in the morn-ing after overnight fasting; and the application of 70% alcohol. Then the samples were stored in 3 ml vacutainer tubes holding ethylenediaminetetraacetic acid (EDTA). The test tubes with the samples were placed in the icebox and transported to Wolaita Sodo University (WSU) Hospital Laboratory for analysis of lipid profiles. Serum total cholesterol, HDL (High-Density Lipoprotein cholesterol), and triglycerides were determined using BS-200 Chemistry Analyzer with specific reagents for each biochemical value as per the manufacturer's instructions. The laboratory technicians performed the laboratory work within 12 hours of the blood sample col-lection at the WSU Hospital Laboratory. The fasting blood sugar level was determined on-site using a glucose meter (SensoCard[1]).

Blood pressure was measured using a digital sphygmomanometer (Riester, Germany). Blood pressure was measured three times, while the study subject was in a sitting position with the right upper arm placed at the level of the heart and after the subject had 10 minutes rest [23]. The average of the two measurements was considered to compute systolic and diastolic blood pressure [24]. There was a ten-minute interval between two blood pressure measurements.

Operational definitions

Hypertension. Defined according to the 2018 European Society of Cardiology (ESC) and the European Society of Hypertension (ESH) Guidelines for the management of arterial hyper-tension (systolic blood pressure 140 mmHg or more and/or diastolic blood pressure 90 mmHg or more) and/ or self-reported for medication [6]. We classified hypertension based on the sev-enth report of the Joint National Committee, and the American College of Cardiology [25, 26].

Accordingly, systolic or diastolic blood pressure measurement < 120/80 mmHg is normal, 120-139/80-89 mmHg is pre-hypertension or elevated blood pressure, 140-159/90-99 mmHg is stage 1 hypertension, and ≥ 160/100 mmHg is stage 2 hypertension [25, 26].

Hyperglycemia. Defined based upon the American Diabetes Association definition (persons with FBS level 7.0 mmol/l or above) and/ or self-reported for medication based on the prescription made by health personnel working in a licensed health institution [27].

Nutritional status. BMI values of < 18.5 kg/m^2: underweight, 18.5–24.9 kg/m^2: normal, 25–29.9 kg/m^2: overweight and ≥ 30 kg/m^2: obese were used to classify the nutritional status of adults [28, 29].

High total cholesterol level. Total cholesterol level 5.2 mmol/l (200 mg/dl) or more [30].

Alcohol drinking. Defined based on the self-reported consumption of a standard alcoholic drink such as 285 ml of beer, 120 ml of wine, and 30 ml of spirits of five or more for men or four or more for women in a single drinking occasion within the past 30 days [21].

Current smokers. Self-reported current use of smoked tobacco or smokeless tobacco products.

Khat chewing. Defined based on the self-reported current chewing of khat.

Low level of physical activity. If the study subject performed vigorous or moderate physi-cal activity less than 600 METs-minutes/week [21, 22].

Data quality management

Data collectors and immediate supervisors were trained for one week on the data collection instrument, key variables, and their measurements. A pre-test was conducted on 5% of the total sample size, with a population having the same socio-economic characteristics as the study population. The data collection team was offered retraining based on the problems identified and experiences gained during the pre-test. Laboratory technicians received training on standard operating procedures of blood sample collections. The principal investigator and field supervisors provided supportive supervision, daily throughout the data collection time. Incomplete and inconsistent data were returned to data collectors for corrections.

Data entry and analysis

Data were entered into the Epi-Data version 3.1 (EpiData Association, Odense, Denmark) using the double-entry system and cleaned for inconsistency. The data were analyzed using STATA ver-sion 15 software (StataCorp LLC College Station Texas, U.S.A.). The wealth index was con-structed using 40 variables for rural and 28 variables for urban areas related to the ownership of household assets using a principal component analysis. During the analysis, in each study setting eleven components with factor loading > 0.4 (house lighting, ceiling type, bedroom, cooking place, ox, electricity, radio, mobile, chair, table and mattress for a rural area, and floor type, wall type, ceiling type, bedroom, house ownership, toilet, television, mobile, table, mattress, and injera stove for an urban area) were identified and retained. The wealth index values were calculated by summing up the scores of eleven components in each study setting. Finally, the three socioeco-nomic categories were generated by splitting the wealth index values into three equal classes. Descriptive summaries were analyzed to determine the frequency and proportion of categorical variables. All the independent variables satisfied the assumption for the multicollinearity test with the Variance Inflation Factor (VIF) less than 10 or tolerance greater than 0.1.

Prevalence of pre-hypertension and hypertension was computed based on the European Society of Hypertension (ESH) Guideline [6]. To generate a weight for the two-stage cluster sampling, first, we computed finite population corrections for the two stages independently. Then to get our survey weight, we multiplied and inverted the two finite population

corrections. We determined the weighted prevalence, after declaring the data set as a two-stage survey, using the primary sampling unit identifier, the weight of the cluster, finite population correction of the first stage sampling, secondary sampling unit identifier, and finite population correction of the second stage sampling.

Factors associated with hypertension were analyzed using logistic regression. Binary categorical explanatory variables were coded in the same way as that of the outcome variable. Variables with P values less than 0.20 in the bivariate analysis, and those with socio-demographic and public health importance were selected for multivariate analysis. The number of cases that represent observation in the rarer of the two binary levels of the outcome variable was considered to fix the number of candidate variables that entered into the final multivariate logistic regression model. Accordingly, twelve variables were selected for multivariate analysis to control overfitting. The multivariate logistic regression analysis was started after declaring the data set as survey data to account for the effect of clustering in the estimated standard errors. AOR with 95% CI, and P value less than 0.05 were used to ascertain the significance of the association.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board at Hawassa University (IRB/005/10) and the Regional Ethical Committee of Western Norway (2017/2248/REK nord). A support letter was obtained from Wolaita Sodo University and submitted to the concerned zonal and district offices. Written informed consent was obtained from all the study subjects; after introducing the purpose of the research using information sheets. Participation was based on voluntary. The identities of the study participants were kept confidential. Persons with FBS level 7.0 mmol/l (126 mg/dl) or above, high blood pressure, and other serious ailments were linked to the nearest health service facilities.

Results

Socio-demographic profiles of the participants

A total of 2483 respondents participated in the study with a response rate of 99.9%. The study participants were from two districts, namely Wolaita Sodo town (1243 (50.1%)) and Ofa rural district (1240 (49.9%)). The male to female ratio of the participants was 1.1. One thousand four hundred twenty-one (57.2%) study participants were between 25 and 39 years of age, with the median age of 35 ranging from 25–64 years. Of the total study participants, 676 (27.2%) were educated at the level of college or more. Most of the participants (2322 (93.5%)) were married or in relation (See Table 1).

Prevalence of prehypertension and hypertension

The overall weighted prevalence of hypertension and prehypertension in the Wolaita area was 31.3% (27.7%-35.1%) and 46.4% (42.9%-50.0%) respectively. The weighted prevalence of hypertension of those who were not aware of their hypertension until the time of the survey was 29.8%% (26.5%-33.3%). Where the weighted prevalence of self-reported cases of hyperten-sion was 2.2% (1.2%-3.8%). The weighted prevalence of hypertension in urban was 37.2% (28.3%-47.0%), while 28.7% (25.8%-31.8%) in the rural (See Table 1).

A remarkably higher weighted prevalence of hypertension was noted among participants with obesity (55.7% (45.3%-65.6%)) compared to the people with the normal nutritional status (29.6% (26.4%-33.0%)). The weighted prevalence of hypertension among participants who consumed sugar-sweetened food was 33.8% (29.5%-38.3%), while it was 23.6% (19.4%-28.4%) among people who did not consume sugar-sweetened food (See Table 2).

Table 1. Distribution of socio-demographic and economic characteristics by hypertension among adults aged 25–64 years in Wolaita, southern Ethiopia 2018 (n = 2483).

Variables	Categories (n)	Prehypertension		Hypertension	
		Number of cases	Weighted prevalence % (95% CI)	Number of cases	Weighted prevalence % (95% CI)
Age	25–39 years (1421)	747	51.5 (46.7, 56.3)	366	25.9 (21.9, 30.4)
	40–64 years (1062)	408	39.7 (35.6, 44.1)	452	38.5 (33.3, 44.0)
Sex	Female (1170)	552	46.5 (42.1, 50.8)	340	28.8 (24.4, 33.6)
	Male (1313)	603	46.4 (42.3, 50.6)	478	33.4 (29.3, 37.9)
Residence	Rural (1240)	575	46.3 (42.9, 50.0)	356	28.7 (25.8, 31.8)
	Urban (1243)	580	46.7 (38.3, 55.2)	462	37.2 (28.3, 47.0)
Educational status	Primary & below (1410)	611	44.6 (41.0, 48.2)	445	29.9 (26.5, 33.6)
	High school (397)	203	50.2 (45.0, 55.5)	130	32.3 (27.1, 37.8)
	College+ (676)	341	50.1 (40.7, 60.0)	243	35.6 (26.7, 45.5)
Ethnicity	Wolaita (2372)	1124	47.0 (43.5, 50.5)	757	30.6 (27.3, 34.1)
	Others (111)	31	27.6 (17.9, 40.0)	61	55.5 (42.6, 67.7)
Marital status	Single (161)	86	55.2 (48.6, 61.6)	43	25.8 (20.5, 31.8)
	Married/ in relation (2322)	1069	45.9 (42.1, 50.0)	775	31.7 (28.0, 35.6)
Occupation	Employee (637)	318	49.8 (39.1, 60.4)	236	37.3 (27.3, 48.5)
	Merchant (332)	164	49.4 (43.8, 55.1)	102	29.4 (24.5, 34.9)
	Farmer (740)	337	46.1 (41.6, 50.8)	213	27.7 (24.7, 31.0)
	Housewife (509)	219	42.9 (37.3, 48.7)	160	31.0 (24.9, 37.8)
	Retiree (133)	50	37.2 (29.6, 45.6)	63	48.0 (40.7, 55.4)
	Students (74)	43	55.7 (43.6, 67.2)	17	24.8 (15.0, 38.2)
	Others (58)	24	47.4 (33.7, 61.4)	27	39.4 (24.4, 56.6)
Wealth index	Poor (784)	321	42.4 (37.1, 47.8)	288	34.4 (27.8, 41.7)
	Medium (793)	364	46.8 (42.4, 51.2)	263	30.5 (25.8, 35.6)
	Rich (906)	470	49.8 (44.0, 55.5)	267	29.3 (25.4, 33.4)

Weighted prevalence: weighted for sampling.

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Factors associated with hypertension

Participants who developed obesity were significantly associated with hypertension [AOR = 2.5; 95% CI: 1.4–4.5] as compared to their counterparts. Similarly, there was a greater chance of developing hypertension among participants who consumed sweet food at least once a month [AOR = 1.6; 95% CI: 1.3–2.1] as compared to those who did not. Likewise, male participants had a greater chance of getting hypertension [AOR = 1.4; 95% CI: 1.1–1.7] com-pared to the female participants.

Moreover, hypertension increased with the increasing total cholesterol level [AOR = 1.2; 95% CI: 1.1–1.3] after adjusting the other factors. Hypertension was also increased with the increased blood sugar level [AOR = 1.1; 95% CI: 1.01–1.2] after adjusting the other factors. We observed a higher chance of developing hypertension with the advancing age [AOR = 1.03; 95% CI: 1.01–1.04] (Table 3).

Discussion

The prevalence of hypertension among adults in Wolaita was high, with a weighted prevalence of 31.3%. A small proportion of the affected people are aware of their high blood pressure. This study reported a high prevalence of prehypertension; which indicates a high percentage of people at risk of hypertension. Obesity, sugar-sweetened food consumption, male sex,

Table 2. Behavioral and anthropometric characteristics by hypertension among adults aged 25–64 years in Wolaita, southern Ethiopia 2018 (n = 2483).

Variables	Categories (n)	Prehypertension		Hypertension	
		Number of cases	Weighted prevalence % (95% CI)	Number of cases	Weighted prevalence % (95% CI)
Physical activity	Low (1311)	626	46.5 (40.9, 52.2)	451	34.5 (28.9, 40.5)
	Moderate/high (1172)	529	46.4 (43.2, 49.6)	367	28.8 (25.3, 32.5)
Fruit consumption	Not daily (60)	22	36.3 (23.2, 51.8)	21	33.0 (21.5, 47.0)
	Daily (2423)	1133	46.6 (43.0, 50.2)	797	31.3 (27.7, 35.1)
Vegetable consumption	Not daily (131)	46	38.0 (24.3, 54.0)	59	42.8 (30.6, 56.0)
	Daily (2352)	1109	46.8 (43.1, 50.5)	759	30.8 (27.3, 34.6)
Sugar sweetened beverage intake	No (1743)	833	47.9 (44.4, 51.4)	543	29.7 (26.3, 33.4)
	Yes (740)	322	42.0 (35.0, 49.3)	275	36.1 (29.8, 42.8)
Sugar-sweetened food intake	No (545)	289	53.4 (48.4, 58.3)	153	23.6 (19.4, 28.4)
	Yes (1938)	866	44.2 (40.2, 48.3)	685	33.8 (29.5, 38.3)
Smoking	No (2466)	1150	46.6 (43.0, 50.2)	812	31.4 (27.8, 35.2)
	Yes (18)	5	29.2 (11.9, 55.8)	6	24.8 (12.8, 42.5)
Alcohol drinking	No (2435)	1142	46.7 (43.1, 50.4)	790	31.0 (27.5, 34.7)
	Yes (48)	13	29.3 (15.8, 47.9)	28	50.4 (29.0, 71.7)
BMI	Underweight (411)	170	41.2 (35.4, 47.3)	117	27.9 (23.1, 33.2)
	Normal (1548)	741	48.4 (45.4, 51.4)	477	29.6 (26.4, 33.0)
	Overweight (415)	208	48.6 (36.7, 60.7)	163	41.2 (28.6, 55.1)
	Obese (109)	36	31.6 (23.2, 41.3)	61	55.7 (45.3, 65.6)
Hyperglycemia	No (2373)	1122	47.1 (43.5, 50.7)	757	30.6 (27.0, 34.3)
	Yes (110)	33	29.5 (19.3, 42.2)	61	50.6 (39.9, 61.3)

Weighted prevalence: weighted for sampling.

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elevated total cholesterol, raised fasting blood sugar, and advancing age were positively associ-ated with hypertension.

The overall prevalence of hypertension reported in this study is in agreement with the find-ings reported from other studies [11, 13], while it is higher than the results indicated elsewhere in Ethiopia [14, 17], and other countries in Africa [12, 31]. The observed difference might be because of the socio-demographic and cultural variations among the study populations. The present study reported a higher prevalence of prehypertension compared to similar studies conducted in other African countries [11, 31]. It also reported a higher proportion of people who were not aware of their hypertension until the time of the survey compared to another study conducted in northwest Ethiopia [17]. This shows the presence of a high proportion of people that are at high risk of hypertension.

Participants who developed obesity were more likely to develop hypertension as compared to their counterparts. This is comparable with the findings from other studies [13, 16]. There is an established link between obesity and hypertension. The accumulation of excess fatty tissue instigates a cascade of events that give rise to increased blood pressure [32, 33]. Similarly, sugar-sweetened food consumption was also positively associated with hypertension, which is consistent with the finding from another study [14]. Excessive energy consumption might result in overweight and obesity and be linked to hypertension [34]. Furthermore, sex as a non-modifiable factor showed a positive association with hypertension, as has been found in another study [13, 17]. In this study, hypertension was more prevalent among male partici-pants as compared to females.

Table 3. A multivariate logistic regression using survey data analysis of factors with hypertension among the adult population aged 25–64 years in Wolaita, south-ern Ethiopia.

Variables (n = 2483)	Categories	Hypertension		Crude OR (95% CI)	Adjusted OR (95% CI)
		No N (%)	Yes N (%)		
Age				1.03 (1.02, 1.05)	1.03 (1.01, 1.04)
Sex	Female	830 (70.9)	340 (29.1)	1.0	1.0
	Male	835 (63.6)	478 (36.4)	1.4 (1.1, 1.7)	1.4 (1.1, 1.7)
Residence	Rural	884 (71.3)	356 (28.7)	1.0	1.0
	Urban	781 (62.8)	462 (37.2)	1.5 (0.9, 2.4)	1.2 (0.8, 1.9)
Educational status	Primary & below	965 (68.4)	445 (31.6)	1.0	1.0
	High school	267 (67.2)	130 (32.8)	1.1 (0.8, 1.4)	1.0 (0.7, 1.3)
	College+	433 (64.0)	243 (36.0)	1.2 (0.8, 1.9)	0.9 (0.7, 1.2)
Marital status	Single	118 (73.3)	43 (26.7)	1.0	1.0
	Married/ in relation	1547 (66.6)	775 (33.4)	1.4 (1.0, 1.9)	1.0 (0.7, 1.4)
Vegetable consumption	Not daily	72 (55.0)	59 (45.0)	1.0	1.0
	Daily	1593 (67.7)	759 (32.3)	0.6 (0.3, 0.9)	0.6 (0.4, 1.1)
Physical activity	Low	860 (65.6)	451 (34.4)	1.0	1.0
	Normal	805 (68.7)	367 (31.3)	0.9 (0.6, 1.2)	1.0 (0.7, 1.4)
Sugar sweetened food intake	No	412 (75.6)	133 (25.4)	1.0	1.0
	Yes	1253 (64.7)	685 (35.4)	1.7 (1.4, 2.1)	1.6 (1.3, 2.1)
Obesity	No	1617 (68.1)	757 (31.9)	1.0	1.0
	Yes	48 (44.0)	61 (56.0)	2.7 (1.7, 4.2)	2.5 (1.4, 4.5)
Alcohol drinking	No	1645 (67.6)	790 (32.4)	1.0	1.0
	Yes	20 (41.7)	28 (58.3)	2.9 (1.3, 6.7)	2.1 (0.9, 4.9)
Total cholesterol	Mmol/ l			1.3 (1.2, 1.4)	1.2 (1.1, 1.3)
Blood sugar	Mmol/ l			1.1 (1.1, 1.2)	1.1 (1.01, 1.2)

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Moreover, hypertension increased with elevated total cholesterol levels. This is in line with the finding reported by another community-based study [15]. This might be due to increased deposition and accumulation of lipids in the blood vessels. Similarly, there was a positive asso-ciation between fasting blood sugar level and hypertension. A study elsewhere reported a simi-lar finding [17]. This might be partially explained by the sharing of common risk factors [35, 36]. Advancing age was associated with hypertension as has been found in other studies [16–18]. The decreasing energy expenditure with advancing age may lead to the accumulation of adipose tissue and this may give rise to the development of obesity and high blood pressure [32, 37].

Strengths and limitations

The magnitude of confounding was assessed using the level of variation between the crude and adjusted estimates. The absence of difference between the two estimates indicates the observed exposure-outcome effect was not confounded by the potential confounding variable. The study, being a cross-sectional survey, lacks a temporal relationship. Since Wolaita is a predom-inantly religious society, we expect a social desirability bias for responses related to behavioral questions such as smoking, alcohol, and khat chewing. In this study, the distribution of sex across the age groups was not as expected. Age was measured based on the birth date estima-tion using the study participants' recall memory, which was supported by main public events that occurred around the participants' birth date.

Conclusion

The prevalence of hypertension among adults in Wolaita was high. A small proportion of the affected people are aware of their high blood pressure. This study reported a high prevalence of prehypertension; which indicates a high percentage of people at risk of hypertension. Obe-sity, sugar-sweetened food consumption, male sex, elevated total cholesterol level, raised fast-ing blood sugar level, and advancing age were positively associated with hypertension. We identified modifiable risk factors with public health importance that includes obesity, sugar-sweetened food consumption, elevated total cholesterol, and raised fasting blood sugar level. The findings of this study can be used for immediate public health practice. Therefore, it is essential to develop periodic screening programs, and primary intervention strategies such as the prevention of obesity, and reduction of sugar-sweetened food consumption as has been shown in this study.

Supporting information

S1 File. Knowledge gap on factors associated with systolic and diastolic blood pressures and comparison of mean systolic and diastolic blood pressures considering residence as a primary exposure variable in Ethiopia.
(RAR)

S1 Questionnaire. English questionnaire and consent.
(RAR)

S2 Questionnaire. Amharic questionnaire and consent.
(RAR)

S3 Questionnaire. Wolaita language questionnaire version and consent.
(RAR)

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Paper II

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Modifiable cardiovascular disease risk factors among adults in southern Ethiopia: a community--based cross--sectional study

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ABSTRACT

Objective To assess the prevalence, magnitude and factors associated with the number of major modifiable cardiovascular disease (CVD) risk factors.

Design Community-based cross-sectional study. **Setting** General population in urban and rural Wolaita, southern Ethiopia.

Participants A total of 2483 adults aged 25–64 years were selected using the three--stage random sampling. **Outcome measures** Prevalence of major modifiable CVD risk factors, co--occurrences and the number of modifiable CVD risk factors.

Results The major modifiable CVD risk factors documented in the Wolaita area were smoking with a weighted prevalence of 0.8%, hypercholesterolaemia 5.0%, hypertriglyceridaemia 15.5%, low high--density lipoprotein cholesterol (HDL--C) 31.3%, high systolic blood pressure 22.2%, high diastolic blood pressure 22.4%, physical inactivity 44.1%, obesity 2.8% and hyperglycaemia 3.7%. The numbers of participants having ≥1, ≥2 and ≥3 major modifiable CVD risk factors in the study area were 2013, 1201 and 576 with a weighted prevalence of 75.8%, 42.3% and 19.4%, respectively. In general, there were 28 different combinations of major modifiable CVD risk factor co--occurrences. The combination of physical inactivity with low HDL--C was found in 19.7% of the study participants, followed by physical inactivity with hypertension of 17.8%. Urban residence, male gender, sugar--sweetened food consumption and older age had a positive association with the number of major modifiable CVD risk factors, while being a farmer had a negative association.

Conclusions The prevalence and magnitude of major modifiable CVD risk factors in the study area were high. The components of the most prevalent combinations of major modifiable CVD risk factors should be targeted. Therefore, public health measures against major modifiable CVD risk factors such as promotion of physical exercise and reduction of sugar--sweetened food consumption have to be taken, targeting the vulnerable groups such as urban residents and older age.

Strengths and limitations of this study

- This is the first community--based study in Ethiopia assessing the prevalence, magnitude and factors associated with the number of major modifiable cardiovascular disease (CVD) risk factors.
- The findings have a policy implication in directing the need to focus on non--communicable disease treatment and control.
- The findings are important for public health prac-tices in preventing CVDs from the study area and similar settings in the country.
- Lack of temporal relations because of the cross-- sectional study design.
- Social desirability bias due to the self--reported as-sessment of behavioural variables.

INTRODUCTION

Globally, cardiovascular diseases (CVDs) continue to be the major public health challenge.[1–5] The magnitude of CVD accountable to modifiable risk factors such as high blood glucose, high systolic blood pressure (SBP), high low--density lipoprotein choles-terol (LDL--C) and obesity is rising.[3] Certain evidence also indicates increased burden and severity of CVD due to the additive and synergistic effect of the presence of multiple modifiable CVD risk factors.[6–8] The burden of CVD cases almost doubled, and the number of deaths, excluding high--income countries consistently increased from 1990 to 2019.[1] About 523 million people suffered, and 18.6 million died from CVD in 2019.[1 3] The magnitude of deaths due to CVD is estimated to be one--third of deaths due to all causes.[3] The burden of CVD in low--income and middle--income countries (LMICs) is on the rise, and these countries carry almost 80% of global CVD deaths.[2 5 9–11] In Africa, CVD becomes an emerging public health problem, mostly due to lifestyle changes, lack of phys-ical activities, increased rural–urban migration and high--calorie intake.[12–14]

According to the American Heart Association, the major modifiable CVD risk factors are smoking, dyslipidaemia, high blood

pressure, physical inactivity, obesity and being overweight and diabetes.[15] Modifiable CVD risk factors in an individual may occur either in single or multiple numbers. Some studies reported different levels of modifiable CVD risk factors with a prevalence varying from 17.2% to 73.0%.[16–18] Few studies in Africa reported the presence of multiple modifiable CVD risk factors. A study conducted in semiurban communities in southwestern Nigeria documented the presence of 15.5% of three, and 8.4% of four or more modifiable CVD risk factors.[19] Some of the factors that showed association with having multiple modifiable CVD risk factors are age, sex, residence, alti-tude, education and socioeconomic status.[16–19]

There is no report on the presence of multiple modi-fiable CVD risk factors in Ethiopia. However, there are few reports on the prevalence of contracting multiple metabolic syndrome components and CVD risk factors (see online supplemental file 1).[20–22] For instance, a community--based survey on the presence of multiple metabolic syndromes in eastern Ethiopia showed a 9.5% prevalence of having three factors of metabolic syndrome components.[20] On the other hand, a national non--communicable disease (NCD) STEPS survey demon-strated a prevalence of 3.2% diabetes, 5.2% hypercho-lesterolaemia, 21.0% hypertriglyceridaemia, 14.1% high LDL--C and 68.7% low high--density lipoprotein choles-terol (HDL-C).[21]

We assessed the prevalence, magnitude and factors associated with the number of major modifiable CVD risk factors among the adult population in Wolaita, southern Ethiopia. In Ethiopia, there is no evidence on the preva-lence, magnitude and factors associated with the number of major modifiable CVD risk factors. Therefore, this study aimed at assessing the prevalence, magnitude and factors associated with the number of major modifiable CVD risk factors among adults within the context of Wolaita, southern Ethiopia.

MATERIALS AND METHODS

Study setting

Wolaita Zone is a rapidly growing population area with an estimated population of 2 042 593 in 2019. Adminis-tratively, Wolaita is divided into 22 districts. The zone has significant educational challenges, especially with the coverage of preparatory high school.[23] As evidence from the literature indicates, the health service coverage in the area was low. The distribution of health posts and health centres in the towns and newly established administrative districts was scarce, and there was no tertiary--level health service delivery in the area.[23] In the study area, there was no detection, treatment and control of NCDs. The health extension programme in Ethiopia was designed to offer technical services on maternal and child health, communicable diseases, and hygiene and sanitation[24] and brought improvements.[25] However, the detection, treatment and control of NCDs were not included within the health extension service package. The health extension workers had no training in the detection, treatment and control of NCDs, and at the primary healthcare level, essential medicines and basic diagnostic equipment for the diagnosis and treat-ment of NCDs were not available. Most hypertension and diabetes cases were not identified before, and there was no dedicated unit for NCDs.

Study design, participants and sampling procedure

This was a cross--sectional study undertaken in the community among the adult population aged 25–64 years in Wolaita, southern Ethiopia, from May 2018 to February 2019. It involved 1243 people from Wolaita Sodo town and 1240 from rural areas in Ofa district. Wolaita Sodo is the capital and rapidly growing urban area of Wolaita Zone,[26] and Ofa is a rural district with a traditional life-style which is located 33 km to the west of Wolaita Sodo town. The study participants were permanent residents in the study sites. We used three--stage random sampling to select the study participants. The study kebeles (villages, the smallest administrative division in Ethiopia), strati-fied in the urban and rural, were selected using a simple random sampling technique from the list of enumer-ated kebeles in each stratum. We selected 11 from the 54 urban and ten from the 52 rural kebeles. Then, we applied a simple random sampling technique to select the study households by generating sample household numbers using a random integer generator.[27] The alloca-tion of the kebeles in the urban and rural study sites and households in the study kebeles was based on a sample proportional to size. We used a simple random sampling method to select the study participants from the sampled households. A lottery method was employed using one coloured and the other plain match sticks; the eligible household members would pick from a vessel, and one who picked the coloured match stick was considered the study participant.

Sample size

The sample size was determined using Epi Info V.7 Stat-Calc. This is a study with a sample size of 2486. Initially, the overall sample size was computed to assess variations in dietary intake and nutrition transition among rural and urban populations in Wolaita using the following assumptions: 95% confidence level, 90% power, one for the ratio of unexposed to exposed groups, 5.3% propor-tion of smokers in rural areas and 10.7% proportion of smokers in urban areas,[28] 10% non--response rate and design effect of 2. The sample size calculated for this study was based on the number of major modifiable CVD risk factors. Thus, it is adequate for this study using the following assumptions: confidence level=95%, power of the study=85%, unexposed to exposed ratio=1, the occurrence of having two modifiable CVD risk factors in rural=44.0% and urban=53.6%, design effect=2 and the non--response rate=10%.[29] Accordingly, the required sample size becomes 2227.

Table 1 Weighted prevalence and magnitude of major modifiable CVD risk factors across the residential areas in Wolaita, southern Ethiopia

Major modifiable CVD risk factors	Rural (n=1240) n	Rural (n=1240) Weighted prevalence % (95% CI)	Urban (n=1243) n	Urban (n=1243) Weighted prevalence % (95% CI)	Overall (N=2483) n	Overall (N=2483) Weighted prevalence % (95% CI)	P value urban–rural
Smoking							
No	1227	99.0 (97.2 to 99.6)	1238	99.6 (99.0 to 99.8)	2465	99.2 (97.9 to 99.7)	0.058
Yes	13	1.0 (0.4 to 2.8)	5	0.4 (0.2 to 1.0)	18	0.8 (0.3 to 2.1)	
Hypercholesterolaemia							
No	1193	96.2 (94.8 to 97.3)	1148	92.4 (90.5 to 93.9)	2341	95.0 (93.6 to 96.1)	<0.001
Yes	47	3.8 (2.7 to 5.2)	95	7.6 (6.1 to 9.5)	142	5.0 (3.9 to 6.4)	
Hypertriglyceridaemia							
No	1054	85.0 (81.6 to 87.8)	1036	83.3 (79.7 to 86.5)	2090	84.5 (82.0 to 86.7)	0.259
Yes	186	15.0 (12.2 to 18.4)	207	16.7 (13.5 to 20.3)	393	15.5 (13.3 to 18.0)	
Low HDL-C							
No	925	74.6 (56.3 to 87.0)	691	55.6 (49.1 to 61.9)	1616	68.7 (56.0 to 79.1)	<0.001
Yes	315	25.4 (13.0 to 43.7)	552	44.4 (38.1 to 50.9)	867	31.3 (20.9 to 44.0)	
High SBP							
No	993	80.1 (77.2 to 82.7)	901	72.5 (64.1 to 79.6)	1894	77.8 (74.4 to 80.8)	<0.001
Yes	247	19.9 (17.3 to 22.8)	342	27.5 (20.4 to 35.9)	589	22.2 (19.2 to 25.6)	
High DBP							
No	991	79.9 (77.3 to 82.3)	898	72.2 (63.3 to 79.7)	1889	77.6. (74.2 to 80.6)	<0.001
Yes	249	20.1 (17.7 to 22.7)	345	27.8 (20.3 to 36.7)	594	22.4 (19.4 to 25.8)	
Physical inactivity							
No	864	69.7 (64.4 to 74.5)	308	24.8 (17.1 to 34.6)	1172	55.9 (44.7 to 66.4)	<0.001
Yes	376	30.3 (25.5 to 35.6)	935	75.2 (65.4 to 82.9)	1311	44.1 (33.6 to 55.3)	
Obesity							
No	1236	99.7 (99.1 to 99.9)	1138	91.6 (89.2 to 93.5)	2374	97.2 (94.9 to 98.5)	<0.001
Yes	4	0.3 (0.1 to 0.9)	105	8.4 (6.5 to 10.8)	109	2.8 (1.5 to 5.1)	
Hyperglycaemic							
No	1208	97.4 (96.6 to 98.0)	1165	93.7 (92.2 to 95.0)	2373	96.3 (95.2 to 97.1)	<0.001
Yes	32	2.6 (2.0 to 3.4)	78	6.3 (5.0 to 7.8)	110	3.7 (2.9 to 4.8)	

CVD, cardiovascular disease; DBP, diastolic blood pressure; HDL--C, high--density lipoprotein cholesterol; SBP, systolic blood pressure.

Data collection techniques

We used structured questionnaires, laboratory investiga-tions and anthropometric measurements for data collec-tion. A series of questions about the modifiable CVD risk factors and related variables were adapted from the WHO protocol for chronic NCDs (WHO STEPS survey).[30] A team of data collectors consisting of nurses, laboratory technicians, supervisors, coordinators and data clerks was recruited and given a -week training on data collection instruments, interviewing skills, laboratory procedures and analysis, and storage of samples. We conducted a pretest on 5% of the total sample size. Based on the expe-riences gained during the pretest, retraining was given to the data collection team.

Self--reported daily fruit and vegetable intakes were assessed using food frequency questions adapted from the WHO.[30] Physical activity was assessed based on the self--reported performance of moderate--intensity and vigorous--intensity activities, walking, time spent in minutes to carry out each activity and metabolic equiv-alents (MET) value of the respective activity. MET--min/ week for a particular activity was computed by multiplying the number of days/week taken to perform each activity with the time spent in min/day to perform the activity and the respective MET value of the activity.[30 31] Finally, a combination of MET--min/week of walking and moderate-- intensity and vigorous--intensity activities was considered as the total MET--min/week.[30 31]

Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Weight was measured to the nearest 0.1 kg using a portable digital weighing scale (Seca electronic scale, 22 089 Hamburg, Germany). The study subjects were weighted standing with light clothes on the scale with their shoes off. Height was measured

Table 2 Magnitude and weighted prevalence of major modifiable CVD risk factors by sociodemographic and lifestyle variables among adults in Wolaita, southern Ethiopia

	Magnitude and weighted prevalence of major modifiable CVD risk factors					
Variables (N=2483)	**None n (%)**	**1 n (%)**	**2 n (%)**	**3 n (%)**	**4 n (%)**	**≥5 n (%)**
Age (years)						
25–34	240 (28.8)	399 (35.5)	264 (21.0)	121 (10.3)	45 (3.2)	16 (1.2)
35–44	127 (23.2)	232 (36.4)	181 (24.2)	83 (10.6)	35 (4.0)	16 (1.6)
45–54	65 (19.5)	111 (28.2)	106 (23.1)	77 (15.1)	61 (10.7)	21 (3.4)
55–64	38 (16.3)	70 (27.0)	74 (26.4)	47 (14.4)	32 (9.7)	22 (6.2)
Gender						
Female	228 (26.0)	399 (33.1)	295 (22.2)	142 (11.2)	76 (5.4)	30 (2.1)
Male	242 (22.7)	413 (33.9)	330 (23.5)	186 (12.0)	97 (5.5)	45 (2.4)
Residence						
Rural	405 (32.7)	433 (34.9)	238 (19.2)	114 (9.2)	37 (3.0)	13 (1.0)
Urban	65 (5.2)	379 (30.5)	387 (31.1)	214 (17.2)	136 (11.0)	62 (5.0)
Education						
Primary and below	353 (28.7)	467 (33.7)	320 (21.3)	168 (10.6)	72 (4.1)	30 (1.6)
High school	72 (22.7)	131 (35.3)	103 (22.5)	57 (12.8)	23 (4.4)	11 (2.3)
College+	45 (9.3)	214 (31.5)	202 (29.0)	103 (14.6)	78 (11.1)	34 (4.5)
Occupation						
Employee	44 (8.1)	196 (30.8)	198 (30.4)	99 (15.3)	71 (11.1)	29 (4.3)
Merchant	86 (33.2)	102 (30.6)	76 (19.8)	40 (10.8)	17 (3.4)	11 (2.2)
Farmer	251 (34.8)	255 (35.1)	143 (19.1)	59 (7.3)	22 (2.7)	10 (1.0)
Housewife	62 (16.1)	184 (36.7)	137 (24.8)	77 (14.6)	37 (5.9)	12 (1.9)
Retired	11 (9.7)	30 (23.9)	36 (26.6)	33 (22.7)	13 (9.4)	10 (7.7)
Students	11 (17.8)	32 (41.5)	18 (23.3)	8 (12.6)	5 (4.8)	0 (0.0)
Unemployed	5 (10.4)	13 (26.8)	17 (27.2)	12 (18.5)	8 (12.9)	3 (4.2)
Wealth index						
Poor	141 (22.8)	248 (32.7)	186 (21.8)	126 (14.4)	63 (6.4)	20 (1.9)
Medium	158 (24.7)	259 (34.2)	199 (23.0)	92 (10.3)	55 (4.9)	30 (2.9)
Rich	171 (25.0)	305 (33.7)	240 (23.8)	110 (10.4)	55 (5.1)	25 (2.0)
Marital status						
Single	31 (23.9)	63 (37.7)	35 (19.8)	22 (13.4)	8 (4.4)	2 (0.8)
Ever married	439 (24.2)	749 (33.3)	590 (23.1)	306 (11.6)	165 (5.5)	73 (2.3)
Fruit consumption						
Not daily	7 (14.0)	17 (30.7)	18 (28.5)	14 (20.8)	3 (4.5)	1 (1.5)
Daily	463 (24.4)	795 (33.6)	607 (22.8)	314 (11.5)	170 (5.4)	74 (2.3)
Vegetable consumption						
Not daily	22 (20.1)	35 (25.8)	33 (24.6)	23 (17.2)	14 (9.8)	4 (2.5)
Daily	448 (24.4)	777 (33.9)	592 (22.8)	305 (11.4)	159 (5.3)	71 (2.2)
Sugar--sweetened beverage intake per month						
No	384 (26.3)	579 (34.4)	418 (21.7)	210 (10.9)	106 (4.7)	46 (2.0)
Yes	86 (17.7)	233 (31.0)	207 (26.4)	118 (14.0)	67 (7.7)	29 (3.2)
Sugar--sweetened food intake per month						
No	141 (30.0)	191 (35.9)	124 (20.3)	45 (7.4)	37 (5.2)	7 (1.2)
Yes	329 (22.4)	621 (32.8)	501 (23.7)	283 (13.0)	136 (5.5)	68 (2.6)
Alcohol drinking						

Continued

Table 2 Continued

Variables (N=2483)	Magnitude and weighted prevalence of major modifiable CVD risk factors					
	None n (%)	1 n (%)	2 n (%)	3 n (%)	4 n (%)	≥5 n (%)
No	467 (24.4)	801 (33.7)	601 (22.8)	323 (11.6)	165 (5.3)	70 (2.2)
Yes	3 (10.4)	11 (26.3)	16 (30.2)	5 (13.3)	8 (12.2)	5 (7.6)
Overall	470 (24.2)	812 (33.5)	625 (22.9)	328 (11.7)	173 (5.4)	75 (2.3)

CVD, cardiovascular disease.

using a portable stadiometer (Seca, 22 089), which consisted of a simple triangular headboard. For height measurement, the study subjects took off their shoes, stood straight and held their head erect. The external auditory and the lower borders of the eyes were kept in one horizontal plane. The buttocks, shoulder blades and heels touched the scale, while legs with their knees stayed together and arms hung by their sides. Height was measured to the nearest 0.1 cm.

Blood pressure was measured using a digital sphygmo-manometer (Riester, Germany). It was measured three times while the study subject was in a sitting position with the right upper arm placed at the level of the heart and after the subject had a 10 min rest. The average of the two measurements was considered to compute SBP and diastolic blood pressure (DBP). There was a 10 min interval between two blood pressure measurements.

We took blood specimens in the morning within the participants' homes after overnight fasting and wiping the skin with 70% alcohol. Vacutainer tubes containing EDTA were used to collect whole venous blood specimens. The test tubes with the blood specimens were stored in the icebox and transferred to the university hospital for anal-ysis. The laboratory analysis was undertaken within 12 hours of the blood specimen collection. Finally, the lipid profiles were analysed with a BS--200 chemistry analyser. The blood glucose level was assessed at the place of data collection with a glucose metre (SensoCard).

Operational definitions

Major modifiable CVD risk factors: according to the AHA, major modifiable CVD risk factors are smoking, elevated TC, high LDL--C, low HDL--C and triglyceride (TG), high blood pressure, physical inactivity, obesity and being over-weight, and diabetes.[15] However, based on our data, the major modifiable CVD risk factors included smoking, elevated total cholesterol (TC), low HDL--C, raised TG, high SBP, high DBP, physical inactivity, obesity and hyper-glycaemia. The number of major modifiable CVD risk factors was an outcome variable and generated by adding the aforementioned nine variables considered as compo-nents of major modifiable CVD risk factors. Hypergly-caemia is characterised by having a blood glucose level of 7.0 mmol/L or more, and/or being under medication for diabetes.[32] An elevated TC level is defined as a TC level of 5.2 mmol/L or more.[33] A low HDL--C is a measure of HDL--C concentration in blood with <1.0 mmol/L in men and <1.3 mmol/L in women.[33] A raised TG is a blood TG concentration of 1.7 mmol/L or more.[33] Hypertension was defined according to the 2018 European Society of Cardiology and the European Society of Hypertension guidelines for the management of arterial hypertension (SBP of 140 mm Hg or more and/or DBP of 90 mm Hg or more) and/ or self--reported for medication.[34] Obesity is a nutritional status with a BMI value of ≥30 kg/m^2.[35] Physical inactivity is the accomplishment of vigorous or moderate physical activity less than 600 MET--min/week or higher otherwise.[30 31] Smoking is defined based on the current use of smoked or smokeless tobacco.

Data analysis

Statistical analysis was performed using Stata V.15 soft-ware. The wealth index was constructed using 40 variables for rural and 28 variables for urban areas related to the ownership of household assets using a principal compo-nent analysis. During the analysis, in each study setting, 11 components with factor loading of >0.4 were identi-fied and retained (see online supplemental file 2). The wealth index values were calculated by summing up the scores of 11 components in each study setting. Finally, the three socioeconomic categories were generated by splitting the wealth index values into three equal classes. The weighting of the data was done using finite popu-lation corrections for kebele/cluster and also household selections. Finally, we generated the weighted prevalences after declaring the data as survey data and incorporating the computed sampling weights.

The outcome variable (number of major modifiable CVD risk factors) was a count variable that comprises values from 0 to 7. The event was analysed using Poisson regression to assess its association with explanatory variables.[36] We have checked the assumptions for the requirements of Poisson regression. Accordingly, the independence of observations was checked using the multicollinearity test, and all observations were found independent of each other. The outcome variable also satisfied the assumption of the equality of the mean and variance. Further, we conducted an interaction analysis of modifiable variables by stratifying in sociodemographic characteristics with the number of major modifiable CVD risk factors. There was no sufficient evidence for the pres-ence of interaction. Therefore, the model without the interaction term is presented. Variables with p values of <0.2 in the bivariate analysis were considered a candidate

for the multivariate Poisson regression analysis. The test statistics for the deviance and Pearson goodness--of--fit tests of the simple Poisson regression model were insig-nificant, indicating our final model was a good fitting model. To identify the best fitting model, we computed the Akaike information criterion (AIC) after carrying out the simple and multilevel (the cluster variable being kebele) analysis with the *estat ic* command. Accordingly, we found a smaller AIC for the multilevel model; there-fore, we selected a multilevel model for the final regres-sion analysis. The 95% CI of the adjusted incidence rate ratios (IRRs) (may also be labelled as 'ratios of means', given the cross--sectional nature of the data) that did not include one declared the presence of an association.

PATIENT AND PUBLIC INVOLVEMENT

There was no patient and public involvement in this study.

RESULTS

Profiles of the study participants

We intended to study 2486 adult people, but we studied 2483. The study comprised 1243 (50.1%) urban and 1240 (49.9%) rural residents. Out of the total adults included in the study, 52.9% (1313) were men. The median age of people who participated in the study was 35 (IQR 30–47) years. Generally, 676 (27.2%) people attended college education or higher, while 397 (16%) and 789 (31.8%) attended high school and primary school education. Six hundred thirty--seven (25.6%) of the study population were employees; 332 (13.4%) were merchants; and 740 (29.8%) were farmers by occupation. The socioeconomic status of the study participants was classified into three based on principal component analysis. Accordingly, 906 (36.5%) were rich; 793 (31.9%) were medium level; and 784 (31.6%) were poor. Overall, 1785 (71.9%) adults in the study were married.

Of the total adult people under the study, 1743 (70.2%) had a practice of drinking sugar--sweetened beverages, and 545 (21.9%) had a practice of taking sugar--sweetened food at least once a month. Two thousand four hundred twenty--three (97.6%) people reported having the habit of eating fruits daily, and 2352 (94.7%) people reported having the practice of daily vegetable consumption. Regarding the nutritional status of the adult people in the study, 109 (4.4%) were obese.

Weighted prevalence and magnitude of major modifiable CVD risk factors

The weighted prevalence of physical inactivity of the adult people under the study was 44.1% (95% CI 33.6% to 55.3%). A few adult people used smokeless or smoked tobacco products with a weighted prevalence of 0.8% (95% CI 0.3% to 2.1%). Generally, hyperglycaemia was found in 3.7% (95% CI 2.9% to 4.8%) of the people in the study. We found hypercholesterolaemia in 5.0% (95% CI 3.9% to 6.4%) and hypertriglyceridaemia in 15.5% (95% CI 13.3% to 18.0%) of the study participants (see table 1). The distribution of major modifiable CVD risk factors by sociodemographic characteristics is presented in online supplemental table 1.

Weighted prevalence and co-occurrences of major modifiable CVD risk factors

In general, 470 study participants did not have major modifiable CVD risk factors with a weighted prevalence of 24.2%. Overall, the numbers of participants having ≥1, ≥2 and ≥3 major modifiable CVD risk factors in the study area were 2013, 1201 and 576 with a weighted prevalence of 75.8%, 42.3% and 19.4%, respectively. There was an increasing trend of having major modifiable CVD risk factors with increasing age and living in urban areas (see table 2). Generally, there were 28 different combinations of major modifiable CVD risk factor co--occurrences. The combination of physical inactivity with low HDL--C was found in 488 (19.7%) of the study participants, followed by physical inactivity with hypertension in 443 (17.8%) (see table 3).

Factors associated with the number of major modifiable CVD risk factors

There was a 40% higher number of major modifiable CVD risk factors among urban residents compared with those who resided in a rural area (IRR=1.53, 95% CI 1.29 to 1.81). Furthermore, the number of major modifiable CVD risk factors among men was 10% greater than that of women (IRR=1.13, 95% CI 1.05 to 1.23). Similarly, people who consumed sugar--sweetened food at least once a month had a 10% higher number of major modi-fiable CVD risk factors than those who did not consume (IRR=1.14, 95% CI 1.05 to 1.24). Moreover, for each year increase in age, the number of major modifiable CVD risk factors increased by 1% (IRR=1.01, 95% CI 1.009 to 1.02). On the other hand, being a farmer was inversely associated with the number of major modifiable CVD risk factors (IRR=0.80, 95% CI 0.70 to 0.92) (see table 4).

DISCUSSION

The numbers of participants having ≥1, ≥2 and ≥3 major modifiable CVD risk factors were 2013, 1201 and 576 with a weighted prevalence of 75.8%, 42.3% and 19.4%, respectively. The combination of physical inactivity with low HDL--C was the largest co--occurrence, followed by physical inactivity with hypertension. The frequency of major modifiable CVD risk factors in the study area was high. Urban residence, male gender, sugar--sweetened food consumption and older age had a positive asso-ciation with the number of major modifiable CVD risk factors, while being a farmer and walking as physical activity had a negative association.

The association we found between urban residence and the number of major modifiable CVD risk factors is consis-tent with the findings of other studies.[17 18 37–39] This could be due to the lifestyle of people living in urban environments.

Major modifiable CVD risk factors (N=2483)	Smoking n(%)	Hypercholesterolaemia n (%)	Hypertriglyceridaemia n (%)	Low HDL-C n (%)	Hypertension (high blood pressure) n (%)	Physical inactivity n (%)	Obesity n(%)
Smoking	2 (0.1)						
Hypercholesterolaemia	4 (0.2)	85 (2.7)					
Hypertriglyceridaemia	5 (0.2)	107 (3.4)	175 (7.1)				
Low HDL-C	6 (0.2)	76 (3.1)	165 (6.7)	301 (12.1)			
Hypertension (high bloodpressure)	6 (0.2)	110 (3.5)	213 (8.6)	488 (19.7)	443 (17.8)		
Physical inactivity	1 (0.04)	8 (0.3)	18 (0.7)	35 (1.4)	59 (2.4)	(3.4)	
Obesity	2 (0.1)	(0.9)	45 (1.8)	27 (1.1)	57 (2.3)	(2.9)	14 (0.6)
Hyperglycaemia							

CVD, cardiovascular disease; HDL-C, high-density lipoprotein cholesterol.

Therefore, to prevent the growing threat from CVD, public health measures against major modifiable CVD risk factors have to be taken, targeting vulnerable groups. Contrary to our finding, another study from Nepal reported the absence of variation in the number of major modifiable CVD risk factors between urban and rural areas.[40] This might be due to the difference in the socioeconomic and demographic conditions of the populations in the study areas. Similarly, the male gender was positively associated with the number of major modifiable CVD risk factors, which is comparable with the findings from other LMICs.[18 38 41] However, there are also findings from other studies which relate female gender with the number of major modifiable CVD risk factors.[37 42] Therefore, additional investigation in ascertaining the relationship between the number of major modifiable CVD risk factors and gender may be needed. Additionally, the number of major modifiable CVD risk factors was associated with older age. This is in line with the findings reported by other community-based studies.[18 39 43 44] The observed association could be explained by a combination of genetic and lifestyle factors.

Furthermore, having major modifiable CVD risk factors increased with the consumption of sugar--sweetened food, and this was higher in the urban areas. This might be due to positive energy balance leading to developing any related risk factors of CVD.[45] Therefore, reduction of sugar--sweetened food consumption should be promoted in the urban areas while maintaining the practice in the rural areas. On the other hand, being a farmer had a negative association with the number of major modifiable CVD risk factors, which is commonly practised in rural areas. Farmers in Ethiopia are smallholder farmers relying on their physical labour for producing crops and hence more energy expenditure.[46] Therefore, farming--related or similar physical exercises should be promoted in rural areas to prevent major modifiable CVD risk factors.

Experiences from various Asian countries demonstrated that targeting combinations of CVD risk factors for prevention, such as treatment of hypertension, diabetes and hyperlipidaemia, reduces CVDs such as heart attack and stroke among people having these conditions.[47–50] Healthy behaviours such as halting smoking, reducing high cholesterol diets and regular exercising were also reported to reduce the risk of CVDs.[48–50] In our study, physical inactivity, hypertension and hyperlipidaemia were found common and more prevalent in the urban areas. In the study area, there is no detection, treatment and control of NCDs. In addition, there are no essential medicines, and medical equipment in the primary healthcare facilities for the detection, treat-ment and control of NCD, and the health extension workers are not trained in the diagnosis and treatment of NCD. The health system in Ethiopia was designed to treat and control communicable diseases. It was not intended to detect, treat and control NCD. Recently, in an effort made to realise universal health coverage through primary healthcare, the prevention and control of NCDs were addressed within the health extension programme policy.[51] Therefore, detection, treatment and control of hypertension and hyperglycaemia

Table 4 Multilevel Poisson regression model of major modifiable CVD risk factors among adults in Wolaita, southern Ethiopia

Variables		Number of major modifiable CVD risk factors IRR (95% CI)	P value
Age (years)		1.01 (1.009 to 1.02)	<0.001**
Gender	Female	1.0	
	Male	1.13 (1.05 to 1.22)	0.002*
Residence	Rural	1.0	
	Urban	1.54 (1.31 to 1.82)	<0.001**
Marital status	Single	1.0	
	Ever married	1.06 (0.92 to 1.23)	0.419
Education	Primary nd below	1.0	
	High school	1.01 (0.91 to 1.11)	0.847
	College+	1.08 (0.97 to 1.21)	0.161
Occupation	Employee	1.0	
	Merchant	0.98 (0.86 to 1.12)	0.784
	Farmer	0.80 (0.70 to 0.92)	0.002*
	Housewife	1.12 (0.99 to 1.27)	0.065
	Retired	1.07 (0.94 to 1.23)	0.289
	Students	0.99 (0.80 to 1.23)	0.919
	Unemployed	1.06 (0.87 to 1.29)	0.562
Wealth index	Poor	1.0	
	Medium	0.97 (0.89 to 1.05)	0.411
	Rich	0.92 (0.85 to 1.00)	0.053
Fruit consumption	Not daily	1.0	
	Daily	1.05 (0.86 to 1.28)	0.603
Vegetable consumption	Not daily	1.0	
	Daily	1.09 (0.95 to 1.25)	0.237
Sugar--sweetened beverage intake at least a once a month	No	1.0	
	Yes	1.03 (0.96 to 1.11)	0.358
Sugar--sweetened food intake at least once a month	No	1.0	
	Yes	1.14 (1.05 to 1.24)	0.002*

*P<0.01, **P<0.001.
CVD, cardiovascular disease; IRR, ratio of means; IRR, incidence rate ratio.

might be an important strategy to prevent NCD, targeting the urban population in the study area and similar settings in Ethiopia. In addition, promoting healthy lifestyles such as cessation of smoking, and promotion of regular physical exercise may also reduce the risk of having NCD. The local government may need to provide training for the primary healthcare workers on the detection, treatment and control of NCD; improve the diagnosis and treatment of hyperten-sion and hyperglycaemia; and ensure the availability of essen-tial medicines and medical equipment.

This is the first community--based study in Ethiopia assessing the prevalence, magnitude and factors associated with the number of major modifiable CVD risk factors. We included nine risk factors as a component of major modifiable CVD risk factors based on the American Heart Association defini-tion. However, low LDL--C is missing as we did not have data on it. Other important modifiable risk factors, including fruit and vegetable intakes, were not taken into account as part of our outcome variable. Even though the study participants were instructed to come fasting for blood glucose analysis, we cannot be certain that all persons would have had at least 8 hours of fasting before the analysis. The assessment of behavioural variables was based on the study participants' self--report, which might be subjected to social desirability bias. The study had a weakness in the temporal relation due to the cross--sectional study design. Even though our study design was cross--sectional, the findings have a policy impli-cation in directing the need to focus on NCD treatment and control. They are also important for public health practices in preventing CVDs from the study area and similar settings in the country.

CONCLUSIONS

The prevalence and magnitude of major modifiable CVD risk factors in the study area were high. The combination

of physical inactivity with low HDL--C was the largest co--oc-currence, followed by physical inactivity with hypertension. Urban residence, male gender, sugar--sweetened food consumption and older age had a positive association with the number of major modifiable CVD risk factors, while being a farmer had a negative association. The most preva-lent components of the major modifiable CVD risk factors combinations should be targeted. In general, there is a need to focus on NCD. Therefore, the local government may need to take public health measures against major modifiable CVD risk factors such as promotion of physical exercise and reduction of sugar--sweetened food consumption targeting the vulnerable groups such as urban residents and older age in the study area, and similar settings in the country.

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Contributors WPK, BL and EL conceptualised and planned the study; performed the formal analysis of the data, review and editorial activities; and approved the final version of the manuscript. WPK carried out the protocol development, data collection and supervision activities, and prepared the original manuscript. WPK is the guarantor for the overall work of the study.

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Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by institutional review board at the College of Medicine and Health Sciences, Hawassa University, in Ethiopia (IRB/005/10) and the Regional Committee for Medical Research Ethics Northern Norway, REK North (2017/2248/REK nord). Participants gave informed consent to participate in the study before taking part.

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Paper III

Appendices

Appendices I English Consent and Questionnaire

Written consent form

Hallo, Dear participant, my name is: _____, I am working as data collector for PhD study.
Protocol Title: Diet and Nutrition Transition in Wolaita, Southern Ethiopia: A community-based cross-sectional study

Wondimagegn Paulos Kumma (PhD candidate); Hawassa University, and University of Bergen
Supervisors: Bente Elisabeth Moen (MD, PhD, professor); University of Bergen
Eskindir Loha (MSc, PhD); Hawassa University

Information sheet for written consent

Purpose of the research project: In Ethiopia people are adapting modern lifestyle with increasing urbanization. The burden of non-communicable diseases is also increasing. The aim of my visit is to measure differences in dietary intake and nutritional related non-communicable diseases. We are inviting you to participate in this study. The results of this study will help to promote healthy lifestyle, healthy dietary intake and prevent progression of non-communicable diseases.

Participants: A total of 2486 participants will be involved in this study, all in the age-group 25-64 years of age. Your selection for this study is by chance.

Expectation from the respondent: If you are willing to participate, I will ask you questions about household, behavioral issues, dietary pattern, physical activity, and history of hypertension or diabetes. Besides, we will take physical and biomedical (blood samples) measurements. The overall data collection process will take about 45 minutes.

Risk and benefits: We believe there are no risks for your health because of your participation in this study. There are no sensitive questions. There is no invasive procedure that will be performed on you. WHO recommended aseptic technique will be applied to avoid contaminations while taking samples. You will be benefited by helping to prevent the progression of non-communicable diseases in Ethiopia. Persons with fasting blood sugar level 126 mg/dl or above, high blood pressure and other serious ailments will be linked to the nearest health facility.

Confidentiality: Your selection for this study is random. Your identification will be kept confidential. The formats used for data collection will be kept for five years in secured file cabinet at the university. Only the research team will be able to observe the information. You have the right to access information recorded about you and make corrections if needed. The tests (blood glucose and lipid) that are taken from you will be stored in Ethiopian Public Health Institute Laboratory during laboratory investigation and will be destroyed at the end of the project. Mr Wondimagegn Paulos is the principal investigator of this research, if you have any question you may call at +251-0911727183. You may also call Dr Eskindir at +251-0913233294, if you feel that your treatment during data collection is un-fair.

Future use of information: Only information related with the objective of this study will be used. Your privacy, anonymity and confidentiality will be maintained for future use of the information collected during this survey.

Right to participate and withdraw: Participation will be voluntary. You can choose not to answer part or all of the questions. You have the right to withdraw from the study at any time.
Compensation: There is no compensation payment for participants involved in this research project. We appreciate your participation in this study. We hope that you participate, since your opinion is important.

If you are willing to participate, please put your signature or thumb print in the space provided below.
Participant's signature or left thumb print: _____ Date: _____
Interviewer's signature: _____ Date: _____
Thank you for your cooperation.

Code	Question	Response
	1. survey information	
101	Participant's ID number	
102	Residential address	Woreda _____ Town (for urban only) _____ Sub city (for urban only) _____ Kebele/FA _____
	2. Household information	
201	What is your source of drinking water?	**Improved source** Piped into dwelling 1 Piped into yard/plot 2 Public tap/ stand pipe 3 Borehole 4 Protected well 5 Protected spring 6 Rain water 7 Bottled water 8 **Non-improved source** Unprotected well 9 Unprotected spring 10 Tunker truck/ cart with small tank 11 Surface water (river/lake/pond/stream dam) 12 Other/specify _____ 13
202	How do you light your house?	None 0, Fire 1, Lantern 2, Beer can with gas/candle 3, Battery 4, generator 5, Biogas 6, Solar lamp 7, Electricity 8, Other/ specify _____ 9
203	What are the building materials for the house floor?	Earth/sand 1, Dung 2, Plastic 3, Wood/planks 4, Palm/bamboo 5, Parquet/polished wood 6, Vinyl/asphalt strips 7, Ceramic tiles 8, Cement 9, Carpet 10, Other/ specify _____ 11
204	What are the building materials for the house wall?	Earth 1, Plastic 2, Wood 3, Local brick 4, Cement/ cement brick 5, Other/ specify _____ 6, Refused 99
205	What are the building materials for the house inside ceiling?	No ceiling 0, Thatch 1, Plastic 2, Cloth 3, Corrugated iron sheet 4, Wood 5, Local brick 6, Cement/ cement brick 7, Other/ specify _____ 8
206	What are the building materials for the house roof?	Earth 1, Thatch 2., Plastic 3, Wood 4, Corrugated iron sheet 5, Local brick 6, Cement/ cement brick 7, Other/ specify _____ 8
207	What is the number of rooms used for sleeping?	No separate sleeping room 0, One 1, Two 2, Three or more 3
208	Do you have your own house in town?	Yes 1, No 0
209	What cooking methods do you use? Enter up to three main methods used	Electricity 1, Liquid petroleum gas/natural gas/biogas 2, kerosene 3, Charcoal 4, Wood 5, Straw/shrubs/grass 6, Agricultural crop 7, Animal dung 8, No food cooked in the house 9, other/ specify _____ _____ 10
210	Where do you cook food?	In the living house 1, In a separate building 2, outdoors 3, Others 4, No cooking at home 5
211	Where do the animals sleep?	Inside family living quarters 1, outside/ no specific shelter 2, outside, open shelter (just walls) 3, outside/ with a covering overhead 4, other/ specify _____5
212	What kind of toilet facility do you use?	**Improved, not shared facility** Flush/ pour flushed to piped sewer system 1, Flush/ pour flush to septic tank 2, Flush/ pour flush to pit latrine 3, ventilated improved pit (VIP) latrine 4, Pit latrine with slab 5 Composting toilet 6

		Non-improved facility Flush/ pour flush not to piped sewer system/ septic tank/ pit latrine 7, Pit latrine without slab/open pit 8, Hanging toilet/hanging latrine 9, No facility/ bush/open field 10, Other/ specify _____ 11
213	Do you share toilet facility with other households?	No 0 Yes 1, if yes with how many households ____
214	Do you own any of the following animals? (yes 1, no 0), If yes how many?	Milk cows 1, 0; Oxen 1, 0; Bulls 1, 0; Horses/Mules 1, 0; Donkeys 1, 0; Goats 1, 0; Sheep 1, 0; Chickens 1, 0
215	Do you have farm land?	Yes 1 No 0, If yes area in hectare ___/ Timad ___
216	Do you own any of the following items? (yes 1, no 0)	Electricity 1, 0; Kerosene lamp/ pressure lamp 1, 0; Radio that works 1, 0; Television that works 1, 0; Mobile phone that works 1, 0; Fixed telephone 1, 0; Chair 1, 0; Table 1, 0; Bed with cotton/ sponge/spring mattress 1, 0; Refrigerator 1, 0; Bicycle that works 1, 0; Motor bicycle that works 1, 0; Vehicle that works 1, 0; Electric injera baker that works 1, 0; Stove that works 1, 0; Electric oven that works 1, 0
	3. Demographic Information	
301	Sex	Female 1 Male 2
302	How old are you? In Years	_____
303	What is the **highest level of education** you have completed?	No formal schooling 1, Primary school 2, Primary school completed 3, Secondary school completed 4, High school completed 5, College/ University completed 6, Post graduate degree 7
304	What is your ethnic group **background**?	Wolaita 1, Gamo 2, Gofa 3, Hadiya 4, Kembata 5, Sidama 6, Amhara 7, Oromo 8, Gurage 9, Tigre 10 Others/ _____ 11
305	What is your **marital status**?	Never married/ single 1, Currently married 2, Separated 3, Divorced 4, Widowed 5, Cohabitating 6
306	Which of the following best describes your **main work** status over the past 12 months?	Government employee 1, Non-government employee 2, Private sector employee 3, Merchant 4, Daily laborer 5, Farmer 6, Student 7 Homemaker/ housewife 8, Retired 9, Unemployed 10, Other (specify): _____ 11
307	How many individuals live together in this household?	_____
	Behavioral Measurements	
	4.Tobacco Use	
	Question	**Response**
401	Do you currently smoke any **tobacco products**, such as cigarettes, cigars or pipes? (USE SHOWCARD	No 0, If No, go to 403 Yes 1
402	Do you currently smoke tobacco products **daily**?	Yes 1 No 0,
403	Do you **currently use** any **smokeless tobacco** such as [snuff, chewing tobacco, betel]? (USE SHOWCARD)	No 0, If No go to Q501 Yes 1
404	Do you **currently use smokeless tobacco** products **daily?**	No 0 Yes 1
	5. Alcohol Consumption	

501	During the past 30 days have you ever consumed an alcoholic drink such as beer 285ml, wine 120ml, spirits 30ml, tella 200ml or tadji 150 ml? (USE SHOW CARD OR SHOW EXAMPLES)	No 0, If No go to Q 601 Yes 1
502	During the past 30 days, did you drink for **men**: **five or more** for **women**: **four or more** standard alcoholic drinks?	No 0, Yes 1
	6. Diet	
	Question	**Response**
601	In a typical week, on how many days do you **eat fruit**? (USE SHOW CARD)	Number of days ____
602	In a typical week, on how many days do you **eat vegetables**? (USE SHOW CARD)	Number of days _____
603	In a typical month, on how many days do you **take sweet drinks**? (USE SHOW CARD)	Number of days _____
604	In a typical month, on how many days do you **eat sweet food**? (USE SHOW CARD)	Number of days _____
	7. Physical Activity	
	Question	**Response**
	Work	
701	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 EXAMPLES] (USE SHOW CARD)	Yes 1 No 0, If No go to 704
702	In a typical week, on how many days do you do Vigorous-intensity activities as part of your work?	Number of days_____
703	How much time do you spend doing vigorous intensity activities at work on a typical day?	Hours : minutes _____: _____ hrs mins
704	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 EXAMPLES] (USE SHOW CARD)	Yes 1 No 0, If No go to 707
705	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days_____
706	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes _____: _____ hrs mins
	Travel to and from places: work, shopping, market, worship	
707	Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?	Yes 1 No 0, If No go to 710
708	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_____
709	How much time do you spend walking or bicycling for travel on a typical day?	Hours : minutes _____ : _____ hrs mins
	Recreational activities: sports, fitness and recreational activities (leisure)	

710	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? [INSERT EXAMPLES] (USE SHOWCARD)	Yes 1 No 0, If No go to 713
711	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?	Number of days_____
712	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours : minutes _____ : _____ hrs mins
713	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, and volley ball] for at least 10 minutes continuously? [INSERT EXAMPLES] (USE SHOW CARD)	Yes 1 No 0, If No go to 901
714	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?	Number of days _____
715	How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?	Hours : minutes _____: _____ hrs mins
	8. History of Raised Blood Pressure	
801	Have you ever had your blood pressure measured by a doctor or other health worker?	Yes 1 No 0
802	Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?	Yes 1 No 0, , If No go to 901
803	Did you take drugs (medication) in the past two weeks for raised blood pressure?	Yes 1 No 0
	9. History of Diabetes	
901	Have you ever had your blood sugar measured by a doctor or other health worker?	Yes 1 No 0,
902	Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?	Yes 1 No 0
903	Did you take drugs (medication) in the past two weeks for raised blood sugare or diabetes?	Yes 1 No 0
904	Do you have member of your family who has a history of diabetes?	Yes 1 No 0
	10. Physical Measurements	
	Height and weight	
	Interviewer ID	⌊_⌊_⌊_⌋
1001	Height in Centimeters (cm)	Reading 1 _____ Reading 2 _____ Reading 3 _____
1002	Weight in Kilograms (kg)	Reading 1 _____ Reading 2 _____ Reading 3 _____
	Blood Pressure	
1003	Reading 1	Systolic (mmHg) _____

		Diastolic (mmHg) _____
	Reading 2	Systolic (mmHg) _____
		Diastolic (mmHg) _____
	Reading 3	Systolic (mmHg) _____
		Diastolic (mmHg) _____
	11. Biochemical Measurements	
	Blood Glucose	
1101	During the past 12 hours have you had anything to eat or drink, other than water? Double check that the participant has fasted	Yes 1 No 0
1102	Time of day blood specimen taken (24 hour clock)	Hours:minutes _____: _____ Hrs mins
1103	Fasting blood glucose	mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____
	Blood Lipids	
1104	Total cholesterol	mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____
1105	Triglycerides	mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____
1106	HDL Cholesterol	mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____ mmol/l _____ or mg/dl _____

24 hour dietary intake history

Interviewer: Scale no.: Interview date: Day food eaten:			Location: Subject ID: Sex: Age: Weight:
Time	Place	Food/drink	Details/brand, preparation and cooking method

Appendices II Amharic Consent and Questionnaire

ስለይሁንታ ወይም ፈቃደኝነት የጽሁፍ ማረጋገጫ መሙያ ፎርም

ሃሎው፣ ውድ ተሳታፊ፣ የእኔ ስም: _____ ይባላል, እኔ ለሶስተኛ ዲግሪ ትምህርት የመመረቂያ ጥናት መረጃ ሰብሳቢ ነኝ፡፡

የፕሮቶኮሉ ርዕስ: ስነ-ምግብና የስነ-ምግብ ሽግግር በወላይታ፣ ደቡብ ኢትዮያ፡ ማህበረሰባዊ ክሮስ-ሴክሽናል ጥናት ይባላል፡፡

ወንድማገኘ ጳውሎስ (የሶስተኛ ዲግሪ ተማሪ)
ተቆጣጣሪዎች፡ እስክንድር ሎሃ (ኤም.ኤስ.ሲ፣ ፒ.ኤች.ዲ)፣ ሀዋሳ ዩኒቨርሲቲ
ቤንት ሊንድትጆርን (ዶ/ር ፒ.ኤች.ዲ፣ ፕሮፌሰር)፣ በርገን ዩኒቨርሲቲ

ስለ ይሁንታ ወይም ፈቃደኝነት የመረጃ መስጫ ወረቀት

የምርምሩ ዓላማ፡ በኢትዮጵያ ውስጥ ከተማና ከተማነት እየጨመረ በመምጣቱ ሰዎች አዳዲስ የኑሮ ዘይቤዎችን እየተላመዱ መጥተዋል፡፡ ከዝህ ጋር ተያይዞ ተላላፊ ያልሆኑ በሽታዎች ስርጭትና ይዘት ጨምሯል፡፡ የእኔ ጉብኝት ዓላማ በማህበረሰቡ ውስጥ የምግብ አወሳሰድ እና ከአመጋገብ ጋር ተያያዥነት ያላቸውን ተላላፊ ያልሆኑ በሽታዎችን መለካት ነው፡፡ እኛ እርስዎ በዝህ ጥናት ውስጥ እንዲሳተፉ እንጋብዝዎታለን፡፡ የዝህ ጥናት ውጤት ጤናማ የሆኑ የአኗኗር ዘይቤዎችን፣ ጤናማ የሆኑ የአመጋገብ ሁኔታዎችን ለማስረጽ እና ከአመጋገብ ጋር ተያዥነት ያላቸውን ተላላፊ ያልሆኑ በሽታዎችን ለመከላከል ይረዳል፡፡

ተሳታፊዎች፡ የዝህ ጥናት ተሳታፊዎች ጠቅላላ ቁጥር 2486 ሲሆን የዕድሜ ክልላቸውም ከ25 - 64 ዓመት ነው፡፡ እርስዎ በዝህ ጥናት ውስጥ እንዲሳተፉ የተመረጡት በዕድል ነው፡፡

ከጥናቱ ተሳታፊ የምንጠብቀው፡ እርስዎ በጥናቱ ለመሳተፍ ፈቃደኛ ከሆኑ እኔ አንዳንድ ጥያቄዎችን ለምሳሌ ያክል ስለ ቤተሰብ፣ ስነ-ባህሪ፣የአመጋገብ ዜይቤዎችን፣ የሰውነት እንቅስቃሴና የደም ግፊት ወይም የስኳር በሽታ ቅድመ ታሪክ እጠይቅዎታለሁ፡፡ ከዝህ በተጨማሪ የሰውነት አካላትን እና የደም ናሙና ልኬት እንወስዳለን፡፡ የመረጃ አሰባሰቡ ሂደት በጠቅላላ 45 ደቂቃ ሊወስድ ይችላል፡፡

ጥቅሞችና ጉዳቶች፡ በዝህ ጥናት በመሳተፍዎ ምክንያት ሊደርስብዎት የሚችል የጤና እክል እንደሌለ እናምናለን፡፡ ስሜትዎን ሊያስቆጡ የሚችሉ ጥያቄዎች የሉም፡፡ በእርስዎ ላይ ከልክ ባለፈ ሁኔታ ወይም በማስጨነቅ የሚፈፀም የናሙና አወሳሰድ ወይም የአለካክ ዘዴ የለም፡፡ ናሙና ሲወሰድ ተላላፊ የሆኑ በሽታዎችን ለመከላከል የአለም አቀፉ ጤና ድርጅት ያዘጋጀውን ተላላፊነትን የምንከላከልበትን ዘዴ ተግባራዊ እናደርጋለን፡፡ እርስዎ በኢትዮጵያ ውስጥ ተላላፊ ያልሆኑ በሽታዎችን ስርጭትና ይዘት ለመቆጣጠር የሚደረገውን እንቅስቃሴ በመደገፍዎ በዝህ ተጠቃሚ ይሆናሉ፡፡ የደም ውስጥ የስኳር መጠናቸው ከ126 ሚግ/በዴሊ ወይም ከዝያ በላይ የሆናቸው፣ ከፍተኛ የደም ግፊት ያለባቸው እና ሌላም አሳሳቢ ህመም ያለባቸው ግለሰቦች ከጤና ተቋማት ጋር እንዲገናኙ ይደረጋል፡፡

ምስጢረኝነት፡ ለዝህ ጥናት የእርስዎ አመራረጥ በዕድል ወይም በዘፈቀደ ነው፡፡ የእርስዎ መለያ ወይም መታወቂያ በምስጢር እንዲያዝ ይደረጋል፡፡ መረጃ ለማሰባሰብ የተጠቀምናቸው ፎርሞች በዩኒቨርሲቲ ውስጥ አስተማማኝ በሆነ ፋይል ካቢኔት ውስጥ ለአምስት አመት እንዲቀመጥ ይደረጋል፡፡ መረጃውን ለማየት የሚችሉት በጥናቱ ውስጥ የተሳተፉት ተመራማሪዎች ብቻ ናቸው፡፡ እርስዎ ስለራስዎ የተዘገበውን መረጃ የማግኘት መብት ያለዎት ሲሆን የአዘጋገብ ስህተት ካለም እንዲስተካከል ማድረግ ይቻላል፡፡ የደም ውስጥ የስኳር መጠንንና የደም ውስጥ የስብ መጠንን ለመለካት የተወሰደው የደም ናሙና የሚቆየው በኢትዮጵያ ህብረተሰብ ጤና ተቋም ላቦራቶሪ ውስጥ ሲሆን ጥናቱ እንዳበቃ እንዲወገድ ይደረጋል፡፡ አቶ ወንድማገኘ ጳውሎስ የጥናቱ ዋና ተመራማሪ ስለሆኑ ጥያቄ ካለዎት በስልክ ቁጥር 0911727183 ደውለው ሊያገኙዋቸው ይችላሉ፡፡ በተጨማሪም በመረጃ አሰባሰብ ወቅት መጠየቅ የሚፈልጉት ጥያቄ ካለ ፕሮፌሰር ቤንትን በስልክ ቁጥር 0912633861 እና ዶ/ር እስክንድርን በስልክ ቁጥር 0913233294 ደውለው ሊያገኙዋቸው ይችላሉ፡፡ **የወደፊት የመረጃ አጠቃቀም፡** ከዝህ ጥናት ዓላማ ጋር ተያያዝነት ያላቸው መረጃዎች ብቻ ጥቅም ላይ ይውላሉ፡፡ ወደፊት ለዝህ ጥናት የተሰበሰበውን መረጃ ለመጠቀም ቢያስፈልግ የእርስዎ ግላዊ መብትዎና ምስጢርዎ የተጠበቀ ይሆናል፡፡ **በጥናቱ የመሳተፍና የመውጣት መብት፡** ተሳትፎ በፈቃደኝነት ላይ የተመሰረተ ይሆናል፡፡ ጥያቄዎችን በሙሉ ወይም በከፊል ያለመመለስ መብትዎ የተጠበቀ ነው፡፡ ከጥናቱ በማንኛውም ጊዜ የመልቀቅ መብትዎ የተጠበቀ ነው፡፡ ምትክ ወይም ካሳ፡ በዝህ ጥናት በመሳተፍዎ ምክንት የሚከፈልዎ ልዩ ክፍያ የለም፡፡ **በዝህ ጥናት ውስጥ በመሳተፍዎ እጅግ በጣም አድርገን እናደንቅዎታለን፡፡ የእርስዎ ሀሳብ እጅግ በጣም ጠቃሚ ስለሆነ በጥናቱ ላይ እንደሚሳተፉ ተስፋ እናደርጋለን፡፡**

ለመሳተፍ ፈቃደኛ ከሆኑ እባክዎትን ከታች በተቀመጠው ክፍት ቦታ ፊርማዎን ወይም የጣት አሻራዎን ያስቀምጡልን፡፡
የተሳታፊው ፊርማ ወይም የጣት አሻራ፡ _____ ቀን: _____
የመረጃ ሰብሳቢው ፊርማ: _____ ቀን:: _____
ስለ ትብብርዎ እናመሰግናለን!

ኮድ	ጥያቄ	ምላሽ
	1. የጥናቱ መረጃ	
101	የቃለመጠይቁ መለያ ቁጥር (ID)	_____
102	የመኖሪያ አድራሻ	ወረዳ _____ ከተማ (ለከተማ ነዋሪ ብቻ) _____ ክፍለ ከተማ (ለከተማ ነዋሪ ብቻ) _____ ቀበሌ/ገበሬ ማህበር _____
	2. የቤተሰብ መረጃ	
201	የመጠጥ ውሃ ከየት ነው የሚያገኙት?	**የተሻሻለ የውሃ ምንጭ** የቤት ውስጥ ቧንቧ 1, በጊቢ ውስጥ ካለ ቧንቧ 2, ከህዝብ ቦኖ/ከሰፈር ቧንቧ 3, ከጥልቅ ጓድጓድ ውሃ 4, ከተሸፈነ/ከተከለለ ጓድጓድ ውሃ 5, ከተሸፈነ/ከተከለለ የምንጭ ውሃ 6, ከዝናብ ውሃ 7, የታሸገ ውሃ 8 **ያልተሻሻለ የውሃ ምንጭ** ካልተሸፈነ/ካልተከለለ ጓድጓድ ውሃ 9, ካልተሸፈነ/ካልተከለለ የምንጭ ውሃ 10, ከቦት ውሃ/ውሃ ከሚጭን ጋሪ 11, ከፈሸ ውሃ (ወንዝ/ኩሬ/ግድብ ውሃ) 12, ሌላ ካለ ይጥቀሱ _____ 13
202	ለቤትዎ ብርሀን የሚያገኙት ከዬት ነው?	ከምንም 0, እሳት 1,ፋኖስ 2, ኩራዝ/ ሻማ 3, ባትሪ 4, ጀነሬተር 5, ባዮጋዝ 6,የሶላር አምፑል 7, የኤሌክትሪክ ማብሪት 8, ሌላ ካለ ይጥቀሱ _____ 9
203	የቤትዎ ወለል የተሰራው ከምንድነው?	ከጭቃ/አሸዋ 1, ከእበት የተወለወለ, 2, ፕላስቲክ 3, እንጨት 4, ከቀርከሃ 5, ከተወለወለ ጣውላ 6, ከአስፋልት መስሪያ ፊንጅ 7, ከሸክላ ንጣፍ, 8 ከሲሚንቶ 9, ከምንጣፍ 10, ሌላ ካለ ይጥቀሱ _____ 11
204	የቤትዎ ግድግዳ የተሰራው ከምንድነው?	ከጭቃ 1, ፕላስቲክ 2, እንጨት 3, ሸክላ 4, ስሚንቶ/ ብሎኬት 5, ሌላ ካለ ይጥቀሱ _____ 6
205	የቤትዎ የውስጥ ጣራ (ኮርኒስ) የተሰራው ከምንድነው?	ኮርኒስ የለውም 0, ሳር 1, ፕላስቲክ 2, ጨርቅ 3, ከቆርቆሮ 4, ከእንጨት 5,ሸክላ 6, ስሚንቶ/ ብሎኬት 7, ሌላ ካለ ይጥቀሱ _____ 8
206	የቤትዎ ጣሪያ የተሰራው ከምንድነው?	ከጭቃ 1, ሳር 2, ፕላስቲክ 3, ከእንጨት 4, ከቆርቆሮ 5, ከሸክላ 6, ስሚንቶ/ ብሎኬት 7, ሌላ ካለ ይጥቀሱ _____ 8
207	ስንት የመኝታ ክፍል አለዎት?	የተለየ የመኝታ ክፍል የለኝም 0, አንድ 1, ሁለት 2, ሶስትና ከሶስት በላይ 3
208	በከተማ ውስጥ የግልዎ ቤት አለዎት?	አዎ 1 የለም 0
209	ምግብ የሚያበስሉት በምን ዘዴ ተጠቅመው ነው? የሚጠቀሙበትን እስከ ሶስት ዘዴ መጥቀስ ይችላሉ	ኤሌክትሪክ 1, ከፈሳሽ ነዳጅ ጋዝ/የተፈጥሮ ጋዝ/ባዮ ጋዝ 2, ኬሮሲን 3, ከሰል 4, እንጨት 5, ቅጠላ ቅጠል/ሳር 6, ከግብርና ምርት 7, ከከብት ኩበት 8, በቤቴ ውስጥ ምግብ አላበስልም 9, ሌላ ካለ ይጥቀሱ _____ 10
210	ምግብ የት ነው የሚያበስሉት?	በመኖሪያ ቤት ውስጥ 1, ከመኖሪያከፍል የተለየ ኩሽና 2, ወጭ/ሜዳ ላይ 3, ሌላ ካለ ይጥቀሱ _____ 4, ምግብ አላበስልም 5
211	የእንሰሳት ማደሪያ የት ነው?	በቤተሰብ መኖሪያ ውስጥ 1, ውጭ/ የተዘጋጀ መጠለያ የላቸውም 2, ው/አጥር ውስጥ 3, ውጭ,የጣሪያ ሽፋን ያለው መጠለያ 4, ሌላ ካለ ይጥቀሱ _____ 5
212	የትኛውን ዓይነት መፀዳጃ ቤት ነው የሚጠቀሙት?	**የተሻሻለ የጋራ ያልሆነ መፀዳጃ** በውሃ የሚሰራ/ውሃ የሚደፋበት ከፍሳሽ ማስወገጃ መስመር ጋር የተገናኘ 1, በውሃ የሚሰራ/ውሃ የሚደፋበት ሆኖ ከፍሳሽ ቆሻሻ ጉድጓድ ጋር የተገናኘ 2, በውሃ የሚሰራ/ውሃ የሚደፋበት ከደረቅ መፀዳጃ ቤት ጉድጓድ ጋር የተገናኘ 3, ሽታ አልባ መፀዳጃ ቤት (VIP) 4, በሲሚንቶ የተሰራ ደረቅ መፀዳጃ ቤት 5, ኮምፖስት መፀዳጃ ቤት 6 **ያልተሻሻለ መፀዳጃ** በውሃ የሚሰራ/ውሃ የሚደፋበት ከፍሳሽ ማስወገጃ መስመር/ከፍሳሽ ቆሻሻ ጉድጓድ/ከሽንት ቤት ጋር ያልተገናኘ 7, በሲሚንቶ ያልየተሰራ ደረቅ መፀዳጃ ቤት/ ከለላ የሌለው ጉድጓድ 8, ተንቀሳቃሽ መፀዳጃ ቤት 9, መፀዳጃ የለም/ጫካ/ሜዳ ላይ 10, ሌላ ካለ ይጥቀሱ _____ 11
213	ይህን መፀዳጃ ከሌላ ቤተሰብ ጋር በጋራ ነው ወይ የሚጠቀሙት?	አይደለም 0 አዎ 1, መልስዎ አዎን ከሆነ ስንት አባወራ ይጠቀመዋል _____
214	ከተጠቀሱት እንስሳት ውስጥ የትኛው አለዎት? (አለ 1, የለም 0)	የወተት ላም 1, 0; እርሻ በሬ 1, 0; ቅልብ በሬ 1, 0; ፈረስ/በቅሎ 1, 0; አህያ 1, 0; ፍየል 1, 0; በግ 1, 0; ዶሮ 1, 0
215	በሄክታር ወይም በጥማድ የእርስዎ የእርሻ መሬት ስንት	አዎ 1, የለም 0, መልሱ አዎን ከሆነ ስንት ሄክታር _____ /ጥማድ _____

	ይሆናል	
216	ከተዘረዘሩት የዕቃ ዝርዝር መካከል የትኛው አልዎት? (አለ 1, የለም 0)	ኤሌክትሪክ 1, 0; ፋኖስ 1, 0; ራዲዮ የሚሰራ 1, 0; ተሌቪዥን የሚሰራ 1, 0; ሞባይል የሚሰራ 1, 0; የቤት ስልክ 1, 0; ወንበር 1, 0; ጠረጴዛ 1, 0; አልጋ ፍራሹ ጥጥ/አስፖንጅ/አስፕሪንግ 1, 0; ፍሪጅ 1, 0; ብስክሌት የሚሰራ 1, 0; ሞተር ብስክሌት የሚሰራ 1, 0; መኪና/ ተሽከርካሪ የሚሰራ 1, 0; የእንጀራ ምጣድ የሚሰራ 1, 0; የኤሌክትሪክ ስቶቭ/ ምድጃ የሚሰራ 1, 0; የኤሌክትሪክ ምድጃ የሚሰራ/ትልቁ 1, 0
	3. የስነ-ሕዝብ መረጃ	
301	*ፆታ*	ሴት 1 ወንድ 2
302	ዕድሜዎት ስንት ነው? በዓመት	_____
303	የርስዎ የመጨረሻው የትምህርት ደረጃ ምንድነው?	መደበኛ ትምህርት አልተከታተልኩም 1, የመጀመሪያ ደረጃ ትምህርት 2, የመጀመሪያ ደረጃ ትምህርት ያጠናቀቀ 3, የሁለተኛ ደረጃ ትምህርት ያጠናቀቀ 4, የከፍተኛ ሁለተኛ ደረጃ ትምህርት ያጠናቀቀ 5, የኮሌጅ/ ዩኒቨርሲቲ ትምህርት ያጠናቀቀ 6, የድህረ ምረቃ ትምህርት ያጠናቀቀ 7
304	ብሔረሰብዎ ምንድነው?	ወላይታ 1, ጋሞ 2, ጎፋ 3, ሀዲያ 4, ከምባታ 5, ሲዳማ 6, አማራ 7, ኦሮሞ 8, ጉራጌ 9, ትግሬ 10, ሌላ ካለ ይጥቀሱ _____
305	የጋብቻ ሁኔታዎ እንዴት ነው?	ያላገባ/ች 1, በአሁኑ ሰዓት ያገባ/ች 2, የተለያየ/ች 3, የተፋታ/ች 4, ባል/ ሚስት የሞተባት/በት 5, አብሮ የሚኖር/ የምትኖር 6, ከመመለስ እታቀባለሁ 88
306	ላለፉት 12 ወራት የርስዎን ዋና የስራ ሁኔታ በደንብ የሚገልጸው የቱ ነው?	የመንግስት ሠራተኛ 1, መንግስታዊ ባልሆነ ድርጅት ተቀጣሪ 2, በግል ድርጅት ተቀጣሪ 3, ነጋዴ 4, የቀን ሰራተኛ 5, ገበሬ 6, ተማሪ 7, የቤት እመቤት 8, በጡረታ የተገለለ 9, ስራ የሌለው / ላት 10, ሌላ ካለ (ይጥቀሱ) _____ 11
307	በዝህ ቤት እርስዎን ጨምሮ የሚኖሩ ሰዎች ስንት ናቸው?	_____
	ባህሪን የሚመለከቱ ጥያቄዎች	
	4. ትምባሆ መጠቀም ወይም ማጨስ	
	ጥያቄ	**ምላሽ**
401	በአሁኑ ጊዜ የትምባሆ ምርት ያጨሳሉ፡- ለምሳሌ፡- ሲጃራ፣ በሁለቱም ጫፍ ከፍት የሆነ ሲጋራ፣ ፒፓ፣ ጋያ፣ በእጅ የተጠቀለለ፣ ሌላ? (ስዕላዊ መግለጫውን አሳይ)	የለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 403 ይሂዱ አዎ 1
402	በአሁኑ ጊዜ የትምባሆ ምርት በየቀኑ ያጨሳሉ?	አዎ 1 የለም 0
403	በአሁኑ ጊዜ ጭስ አልባ የትምባሆ ምርት ይጠቀማሉ?ለምሳሌ [ሱረት, የሚታኝክ ትምባሆ? (ስዕላዊ መግለጫውን አሳይ)	የለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 501 ይለፉ አዎ 1
404	በአሁኑ ጊዜ ጭስ አልባ የትምባሆ ምርት በየቀኑ ይጠቀማሉ?	አዎ 1 የለም 0
	5. አልኮል መጠጥ አወሳሰድ	
501	ባለፉት 30 ቀናት እንደ ቢራ 285 ሚሊ፣ ወይን 120 ሚሊ፣ አረቄ 30 ሚሊ፣ ጠጅ 150 ሚሊ ወይም ጠላ 200 ሚሊ ያሉ መጠጦችን ጠጥተው ያውቃሉ? (ስዕላዊ መግለጫውን አሳይ ወይም በምሳሌ አስረዳ)	አዎ 1 የለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 601
502	ባለፉት 30 ቀናት ውስጥ ለወንዶች፡ 5 እና ከዚያ በላይ ለሴቶች፡ አራትና ከዚያ በላይ የታወቀ መጠጥ ጠጥተው ያውቃሉ?	አዎ 1 የለም 0
	6. አመጋገብ	
	ጥያቄ	**ምላሽ**
601	በሳምንት በመደበኛ ሁኔታ ስንት ቀናት ወስጥ ፍራፍሬ ይመገባሉ (ስዕላዊ መግለጫውን አሳይ)	ቀናት ብዛት_____
602	በሳምንት በመደበኛ ሁኔታ ስንት ቀናት ወስጥ አትክልትና ቅጠላቅጠል ይመገባሉ ? (ስዕላዊ መግለጫውን አሳይ)	ቀናት ብዛት_____
603	በወር በመደበኛ ሁኔታ ስንት ቀናት ወስጥ ጣፋጭ	ቀናት ብዛት_____

	መጠጥ ይጠጣሉ? (ስዕላዊ መግለጫውን አሳይ)	
604	በወር በመደበኛ ሁኔታ ስንት ቀናት ወስጥ ጣፋጭ ምግብ ይመገባሉ ? (ስዕላዊ መግለጫውን አሳይ)	ቀናት ብዛት_____
	7. የሰውነት እንቅስቃሴ	
	ጥያቄ	**ምላሽ**
	ስራ	
701	ስራዎት ብዙ ጉልበት የሚያስፈልገው ሆኖ አተነፋፈስዎን ወይም ደግሞ የልብ ምትዎን በጣም የሚጨምር ነው ወይ፣ ለምሳሌ ክብደት ያላቸውን ዕቃዎች መሸከምና ማንቀሳቀስ፣ የቁፋሮ ወይም የግንባታ ስራ ለተከታታይ 10 ደቂቃ ያክል መስራት? [ምሳሌዎችን አካትት] (ስዕላዊ መግለጫ አሳይ)	አዎን 1 አይደለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 704 ይለፉ
702	በሳምንት በመደበኛ ሁኔታ ስንት ቀናት ብዙ ጉልበት የሚስፈልገው ስራ የመደበኛ ስራዎት አካል ሆኖ ይሰራሉ?	የቀናት ብዛት_____
703	በቀን በስራ ቦታ ብዙ ጉልበት የሚያስወጣ ስራ ስንት ሰዓት ይሰራሉ?	ሰዓት : ደቂቃ _____ : _____ ሰዓት ደቂቃ
704	ስራዎት መጠነኛ ጉልበት የሚያስፈልገው ሆኖ አተነፋፈስዎን ወይም ደግሞ የልብ ምትዎን በትንሹ የሚጨምር ነው ወይ፣ ለምሳሌ ቀላል ክብደት ያላቸውን ዕቃዎች መሸከምና ማንቀሳቀስ፣ ፈጠን ባለ ሁኔታ መራመድ ለተከታታይ 10 ደቂቃ ያክል? [ምሳሌ ጨምር] (ስዕላዊ መግለጫ አሳይ)	አዎን 1 አይደለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 707 ይለፉ
705	በሳምንት በመደበኛ ሁኔታ ስንት ቀናት ወስጥ መጠነኛ ጉልበት የሚስፈልገው ስራ የመደበኛ ስራዎት አካል ሆኖ ይሰራሉ?	የቀናት ብዛት_____
706	በቀን በስራ ቦታ መጠነኛ ጉልበት የሚያስወጣ ስራ ስንት ሰዓት ይሰራሉ?	ሰዓት : ደቂቃ _____ : _____ ሰዓት ደቂቃ
	ከቦታ ወደ ቦታ መጓዝ: ስራ፣ ገበያ፣ አምልኮ ቦታ	
707	በየቀኑ ከእንድ ቦታ ወደ ሌላ ቦታ ለመንቀሳቀስ ቢያንስ በተከታታይ ለ10 ደቂቃ ያክል እርምጃ ይራመዳሉ ወይም ብስክሌት ይጋልባሉ?	አዎን 1 የለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 710 ይለፉ
708	በሳምንት በመደበኛ ሁኔታ ቢያንስ በተከታታይ ለ10 ደቂቃ ያክል ስንት ቀናት ከቦታ ወደ ቦታ ለመንቀሳቀስ እርምጃ ይራመዳሉ ወይም ብስክሌት ይጋልባሉ?	የቀናት ብዛት _____
709	በቀን ስንት ሰዓት እርምጃ ይራመዳሉ ወይም ብስክሌት ይጋልባሉ?	ሰዓት : ደቂቃ_____ : _____ ሰዓት ደቂቃ
	ከመዝናኛ ጋር የተያያዘ ጉዳይ፣ ስፖርት፣ በትርፍ ሰዓት የሰውነት ማነልበቻ እንቅስቃሴ ማድረግ የመሳሰሉ	
710	በቀን ለተከታታይ ቢያንስ ለ10 ደቂቃ ያክል አተነፋፈስዎን ወይም የልብ ምትዎን በብዙ የሚጨምር ከበድ ያለ ስፖርት፣ የሰውነት ማነልበቻ እንቅስቃሴ ወይም የትርፍ ጊዜ መዝናኛ ለምሳሌ[ሩጫ፣ እግር ኳስ ጫወታ] ይሰራሉ [ምሳሌ ጨምር] (ስዕላዊ መግለጫ አሳይ)	አዎን 1 የለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 713 ይለፉ
711	በሳምንት በመደበኛ ሁኔታ ስንት ቀናት ብዙ ጉልበት የሚስፈልገው ስፖርት፣ የትርፍ ጊዜ የሰውነት ማነልበቻ እንቅስቃሴና የመሳሰሉትን ይሰራሉ?	የቀናት ብዛት _____
712	በቀን ብዙ ጉልበት የሚስፈልገው ስፖርት፣ የትርፍ ጊዜ የሰውነት ማነልበቻ እንቅስቃሴና የመሳሰሉትን ስንት ሰዓት ይሰራሉ?	ሰዓት : ደቂቃ _____: _____ ሰዓት ደቂቃ
713	በቀን ለተከታታይ ቢያንስ ለ10 ደቂቃ ያክል አተነፋፈስዎን ወይም የልብ ምትዎን በትንሹ	አዎን 1 የለም 0, መልሱ አይደለም ከሆነ ወደ ጥያቄ 801 ይለፉ

	የሚጨምር መጠነኛ ጉልበት የሚያስፈልገው ስፖርት፣ የሰውነት ማነልበቻ እንቅስቃሴ ወይም የትርፍ ጊዜ መዝናኛ ለምሳሌ[ፈጠን ያለ እርምጃ፣ ብስክሌት ግልቢያ፣ ዋና፣ መረብ ኳስ ጫወታ] ይሰራሉ [ምሳሌ ጨምር] (ስዕላዊ መግለጫ አሳይ)	
714	በሳምንት በመደበኛ ሁኔታ ስንት ቀናት መጠነኛ ጉልበት የሚያስፈልገው ስፖርት፣ የትርፍ ጊዜ የሰውነት ማነልበቻ እንቅስቃሴና የመሳሰሉትን ይሰራሉ?	የቀናት ብዛት _____
715	በቀን መጠነኛ ጉልበት የሚያስፈልገው ስፖርት፣ የትርፍ ጊዜ የሰውነት ማነልበቻ እንቅስቃሴና የመሳሰሉትን ስንት ሰዓት ይሰራሉ?	ሰዓት : ደቂቃ _____: _____ ሰዓት ደቂቃ
	8. የደም ግፊት መጨመር ሁኔታ	
801	በሐኪም ወይም ሌላ የጤና ባለሙያ የደም ግፊትዎን ተለክተው ያውቃሉ?	አዎን 1 የለም 0
802	ቀደም ሲል በሐኪም ወይም በሌላ የጤና ባለሙያ ከፍ ያለ የደም ግፊት ወይም የደም ግፊት በሽታ እንዳለብዎት ተነግሮዎት ያውቃል?	አዎን 1 የለም 0, መልሱ የለም ከሆነ ወደ ጥያቄ 901 ይለፉ
803	ባለፉት 2 ሳምንታት ውስጥ ለደም ግፊት የወሰዱት መድኃኒቶች (ህክምናዎች) አሉ?	አዎ 1 የለም 0
	9. የስኳር በሽታ ሁኔታ	
901	ቀደም ሲል በሐኪም ወይም በሌላ የጤና ባለሙያ የደም ውስጥ የስኳር መጠን ተለክተው ያውቃል?	አዎን 1 የለም 0
902	ቀደም ሲል በሐኪም ወይም በሌላ የጤና ባለሙያ ከፍ ያለ የደም ውስጥ የስኳር መጠን ወይም የስኳር በሽታ እንዳለብዎት ተነግሮዎት ያውቃል?	አዎን 1 የለም 0
903	ባለፉት 2 ሳምንታት ውስጥ ለስኳር በሽታ የወሰዱት መድኃኒቶች (ህክምናዎች) አሉ?	አዎ 1 የለም 0
904	ከከዝህ በፊት በቤተሰብ ውስጥ በስኳር በሽታ የታመመ ሰው ነበረ?	አዎ 1 የለም 0
	10. የአካል ክፍሎች መለኪያ	
	ቁመት እና ክብደት	
	የጠያቂው መለያ ቁጥር	_____
1001	ቁመት በሴንቲሜትር (cm)	ንባብ 1 _____ ንባብ 2 _____ ንባብ 3 _____
1002	ክብደት በኪሎ ግራም (kg)	ንባብ 1 _____ ንባብ 2 _____ ንባብ 3 _____
	የደም ግፊትና ልብ ምት	
1003	ንባብ 1	ሲስቶሊክ (mmHg) _____
		ዲያስቶሊክ (mmHg) _____
	ንባብ 2	ሲስቶሊክ (mmHg) _____
		ዲያስቶሊክ (mmHg) _____
	ንባብ 3	ሲስቶሊክ (mmHg) _____
		ዲያስቶሊክ (mmHg) _____
	11. የባዮኬሚካል ልኬቶች	
	የደም ውስጥ ስኳር መጠን	
1101	ባለፉት 12 ሰዓታት ውስጥ ከውሃ ውጭ የተመገቡት ምግብ ወይም የጠጡት መጠጥ አለ? የጥናቱ ተሳታፊ መጾሙን መላልሰህ አረጋግጥ	አዎ 1 የለም 0
1102	በዕለቱ የደም ናሙናው የተወሰደበት ሰዓት (በ24 ሰዓት ቆጠራ)	ሰዓት : ደቂቃ _____ : _____

1103	ከጾሙ በኃላ የሚወሰድ የደም ውስጥ የስኳር መጠን	ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____
	Blood Lipids (የደም ውስጥ ቅባት)	
1104	ጠቅላላ ኮሌስትሮል	ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____
1105	ትራይግሊሰሪድ	ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____
1106	ኤች ዲ ኤል ኮሌስትሮል	ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____ ሚ.ሞል/ሊ. _____ ወይም ሚግ/ዴሊ. _____

ያለፉት ሃያ አራት ሰዓታት የአመጋገብ ትውስታ

የጠያቂው ስም: ከብደት መለኪያ ቁጥር.: ጥያቄው የተካሄደበት ቀን: ምግቡ የተበላበት ቀን:			የአከባቢው ስም: የተጠያቂው መለያ ቁጥር: ፆታ: ዕድሜ: የተጠያቂው ከብደት:
ሰዓት	የተመገቡበት ቦታ	የምግቡ/የመጠጡ ዓይነት	ዝርዝር/ለየት ያለ ስሙ, አዘገጃጀቱና የበሰለበት መንገድ

Appendices III: Wolaytato consent and questionnaire
Qofan mayidooga xufiyaan errisiyogaa

Saaro, Bonchetida ha xinaatiyaan shaakiyaageeto, tasuntay: _____ geetetes. Tani heezanto digriyaaw ootiyoo xinaatiyaw naqaashaa shiishiyaaga.
Projectiyaa suntay: qumaa hanotaane muusara gayitidi hawodiyaa kaseegara xeeliyoode diyaa hanotaa Wolayitaan, Tohossa Tophiyaa: Deriyaa giduwaan oosetiyaa cross-sectional xinatiyaa

Wondimagegn Paulos Kumma (PhD Taamariyaa); Hawassa Universitiyaane Bergen Universitiyaa
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Eskindir Loha (MSc, PhD); Hawassa Universitiyaa

Qofan mayidooga xufiyaan errisiyogaw qofaa immiyoo woraqataa
Ta yusaw yousho qofay qumaa Hanota, bola wara, isuawape isuwaw aadhena hargia gasotane sutara gayitiya naqaashaa shishanasa.Hagape betiya naqaashaa go'etiyooge hagara gaytiya halchuwa xalalassa. Nenine ne na"ay ha oyishan shahetido gishaw galatos. Neni 18 laytappe garsaara diyaaba gidiko so asape ne kafiyaw ne sheniya ekidoga erisos.Gidikoka ha oyshan betiyoge ne mata gidiyoga erisos. Ha oyshay mulera 20 daqiqape bolara ekenaga erisos. Ha oyshan ne betoy zoniyaa payateta oso ketawne Tohosa payateta oso ketaw isuawape isuwaw a"ena hargiyaa xaysanaw woyiko teqanaw kehipe mades. Ha oyishaw ne doretidoge qadaa. Ha oyishan ne betoy ne shene. Nenateetaa hara'saw qonchisenaga erisos.Neni zaruwa imanaw koyena oyshati diko aganage neshene.Gidikoka; neni ha oyshan beettasaa woyko shaakkasa gidi qoposi gasotayka ne qofay kehipe koshiyoo woyiko maadiyoo giishataasa.

Oyishay woyiko hara metoy diyaaba gidiko, garsan wotido silkiyaa shocanaw dandayeeta.
Mr Wondimagegn Paulos huuphe xinatiyaa otiyaaga garsara xaafetida silkiyaan deemeta at +251-0911727183. Qasika ha xinaatiyaa bolaara kaaliyaa asata dawalidi demanaw dandayeeta. Prof Bernta +251-0912633861 qasiika Dr Eskindira at +251-0913233294.

Qofaan mayidaba gidiko garssan wotido sohan inte firma woyiko biraadhiyaa mlaataa wotite.
Xinaatiyaan shaakiyaagaw firma woyiko biradhiyaa malaataa: _____ Gaalassaa: _____
Oyishaa shiyishiyaa firmaa: _____ Gaalassaa: _____
Oyishaan shaakido giishshaw galatoos!

Kodiya	Oyishaa	Zaruwa
	1. Oyishaa naqaashaa	
101	Oyshaa dumayiyaa payduwaa	_____
102	De'iyoo sohoy	Alaanaa _____ Katamaa (Katama xalalaw) _____ Kifle katamaa (Katama xalalaw) _____ Qabaliyaa/GM _____
	2. Keeta'asaa naqaashaa	
201	Uyiyo haattaa awupe demay?	**Lo'iosetida ushaa haattaa** Sogarssan de'iyaa buwanbuwappe 1, Dirsagarssan de'iyaa buwanbuwappe 2, Kabaliya buwanbuwappe 3, Mazagaja ciimma gurgadiyappe 4, Kamidi nagido gurgadiyappe 5, Kamidi nagido pultuwappe 6, Iraa haattaa 7, Lastiqiyan gozidi bayiziyo haattaa 8 **Lo'iosetibena ushshaa haattaa** Kamidi nagibeena gurgadiyappe 9, Kamidi nagibeena pultuwappe 10, Botte makinaa haattaa/haattaa caaniyaa gaariyaappe 11, Gogiyaa haattaape (Shaafaa/ deeliliyaa/ gidibiyaa haatttaa) 12, Harabaa/Xaafa _____ 13

202	Keettaa po'isanaw go'etiyo xompe?	Baawa 0, Taamaa 1, Paanosiyaa 2, Lambaa/Shaamaa 3, Batriyaa 4, Genereteriya 5, Bayogaziya 6, Soolariyaa xompiyaape 7, Xoompiyaa 8, Harabaa/ Xaafa --------- 9
203	Keetassi basoy aybipe oosetide?	Biittaappe/shaafiyaappe 1, wooruwaan tiyetidaagaa 2, Lastiqiyaappe 3, Miitaappe 4, Shonboquwappe 5, Xawlaappe 6, Asfaltiyaa otiyoo reenjiyaappe 7, Shaklaappe 8, Simintuwap 9, Irpaniyaa/minxaafaape 10, Harabaa/ Xaafa ---------- 11
204	Keettassi goday aybipe oosetidee?	Biittaape 1, Lastiqiyaape 2, Mittaape 3, Shaklaappe 4, Simintuwaape/ bloketiyaa 5, Harabaa/ Xaafa ------- 6, koyike 88
205	Keettaayo kaaraa garsay (kornisee) aybipe oosetide?	Baawaa 0, Maataape 1, Lastiqiyaape 2, Carqiyaape 3, Qorqooruwape 4, Mittaape 5, Shakilaape 6, Simintuwaape/ bloketiyaape 7, Harabaa/ Xaafa ---------- 8
206	Keettayoo bolay (kaaraa) aybiin kamettidee?	Biittaape 1, Maataape 2, Lastiqiyaape 3, Mittaape 4, Qorqooruwaape 5, Shakilaape 6, Simintuwaape/ bloketiyaape 7, Harabaape/ Xaafa ---------- 8
207	Sogarsan woqu hiittaa kiflee de'ii	Duma kifle baawaa 0, Isuwaa 1, Naa'a, Heezaane hegaape daariyaagee 3
208	Katamaa garsaan niyoo ketay de'i?	De'es 1, Baawa 0
209	Kattaa katanaw aybiin go'etay? Heezaa gakanaw xeesanaw dandayaasa!	Eletrikiyaa 1, Lambaape/bayo gaaziyaape 2, keerosiniyaape 3, Kasaliyaape 4, Mitaape 5, Mittaa hayttaape/maataape 6, Gooshshaa heeraan beetiyaagaape 7, Melida oshaa 8, Harabaa/ Xaafa ---------- 9, Qumaa son katike 10
210	Kattaa awun kateti?	De'iyoo keetan 1, De'iyo keetape duuma kushshinaan 2, Kaaren 3, Kumaa son katike 4, Harabaa/ Xaafa ------ 5
211	Miizay awun aqi?	Asay de'iyosan 1, Kareen/ Deriyan 2, Kareen/ dirsaan 3, Kareen/ Bollaara kamoy diyoogan 4, Harabaa/ Xaafa ---5
212	Inte go'etiyoo sheeesha keetay awugee?	**Lo"ii oosetida buzo gidena sheesha keettaa** Haattaan oottiyaa/haattaa gujiyoo haaxatiyaa qoshaasha ogiyaan gayitiyaaga 1, Haattaan oottiyaa/haattaa gujiyoo haaxatiyaa qoshaasha ollan geliyaaga 2, Haattaan oottiyaa haattaa gujiyoo/haaxatiyaa qoshaasha sheesha keetaan geliyaaga 3, Pheenuwa teqiyaa sheeshsha keettaa (VIP) 4, Simintuwan oosetida sheeshsha keettaa 5, Kompposte sheeshsha keettaa 6 **Lo"ii oosetibeena sheesha keettaa** Haattaan oottiyaa/haattaa gujiyoo haaxatiyaa qoshaasha ogiyaan/ haaxatiyaa qoshaasha ollan sheeshsha keetaan hayitennaagaa/gelennaagaa 7, Simintuwan oosetibeenaa sheeshsha keettaa/ keettay baynna sheeshsha keettaa 8, Issisaan uuttennaa sheeshsha keettaa 9, Sheeshsha keettay baawa//woran/deriyaan 10, Harabaa/ Xaafa ---------- 11
213	Ha sheeshsha keettaa shooruwaara iissippe go"etteti?	Erike 0 Ero 1
214	Kaaliddi xeesetidda mehetuppe intiyoo awuge de"ii? (Des 1, Deena 0) De"iyaaba gidiko issoy issoy woqqay de'ii?	Maaxiyaa miizzaa 1, 0; Goshsha booraa 1, 0; Xiiko booraa 1, 0; Paraa/ baluquwaa 1, 0; Hariyaa 1, 0; Deeshshaa 1, 0; Dorssaa 1, 0; Kuttuwaa 1, 0
215	Hektariyaan woyiko goshsha waattan ne gadee woqqa gidaane?	Des 1, Deena 0; Diko woqqe, Hektariyaan __ Waattan ___

216	Hagape sintan xafidogetupe neeyo awge de'i? (de"es 1, baawa 0)	Oottiyaa mashuwaa 1, 0; Mabratiyaa (mabrat hayliyaa xompiyaa) 1, 0; Oottiyaa Radoniyaa 1, 0; Oottiyaa Televizhiniyaa 1, 0; Oottiyaa Mobayiliyaa 1, 0; So-silkiyaa 1, 0; Wonbaraa 1, 0; Xarapheezaa 1, 0; Algaa fraasheeka, fuutuwaa/sponjiyaa/springiyaa 1, 0; Frijiyaa 1, 0; Oottiyaa Bishkiletiyaa 1, 0; Ottiyaa motorcycliyaa 1, 0; Oottiyaa Kaamiyaa 1, 0; Oottiyaa Eletrike Bashiyaa 1, 0; Oottiyaa Stoviyaa 1, 0; Oottiyaa Eletrike oveniya 1, 0
	3. Demographiyaa naqaashaa	
301	Niyo mattumay Ayibe	Maccaa 1 Attumaa 2
302	Ne layitay woqee? Layitaan	_____
303	Ne timirtiyaan ay xeekkaa gakadi?	Eretida timirte tamarabiike 1, Koyiro xekaa 2, Koyiro xeekka wursas 3, Na"anto xeekka wursas 4, Hay skooliya wursas 5 Collejiya/Umburshiya wursas 6, Na"anto/ hezanto dgriya 7
304	Ne kochchay aybe?	Wolayta 1, Gamo 2, Gofa 3, Hadiya 4, Kembata 5, Sidama 6, Amara 7, Oromo 8, Gurage 9, Tigre 10, Others/ ----- 11
305	Ne ekoyne-geloy aymale?	Ekabike/ gelabike 1, Ekas/ gelas 2, Shahetida 3, Birshetas 4 Aznay/ machiya hayqis/qas 5, Issipe dusaa 6
306	Ha sintaan qoncidagetupe 12 aginaa garsaan ne huuphee oossoy awge?	Kawo ossancha 1, Kawo gidena ossancha 2, Buzo/Gille drijitiyaan ossancha 3, Zal"nchchaa 4, Galla galla ootti aqiyaa ossancha 5, Goshshanchchaa 6, Tamare 7 Keettaa ayiyoo 8, Xurataan shemppidaagaa 9, Oossoy baynaagaa 10, harabaa (xaafaa) _____ 11
307	Haasson woqu aassay de'i?	_____
	Asaa eeshshaa waraa	
	4.Tambuwaa Go'etiyoogaan	
Kodiya	**Oyishaa**	**Zaruwaa**
401	Hawodiyaan ne tanbuwaa cuwassay, lemisuwaw sijara, sigara woyko pipaa (gaayiyaa)? (msliyaan bessa)	Erike 0, Zaaroy Erike gidiko oyshaa 403 aaqqa Ero 1
402	Hawodiyaan tambuwaara gaytidabaa galasi-galasi cuwayay?	Ero 1 Erike 0
403	Hawodiyaan cuway bayna ay gidida tambuwaa go'etaylemisuwaw [siriyara sorgiyoga, comiyo tambuwa]? (msliyaan bessa)	Ero 1 Erike 0, Zaaroy Erike gidiko oyshaa 501 aaqqa
404	Hawodiyaan cuway bayna tambuwa galasi-galasi go'etay**?**	Ero 1 Erike 0
	5.Uushshaa go'etiyogara gayitidaba	
501	Aqiddaa 30 galassatun lemisuwaw, biiraa 285ml, woyni xajyaa 120ml, araqiyaa 30ml, parsuwaa 200ml woyiko xajjiyaa 150ml [hara lemisuwaa guuja]?(msliyaan bessa)	Ero 1 Erike 0, Zaaroy Erike gidiko oyshaa 601 aaqqa
502	Aadhdhida 30 galassatun, "eretida (standard)" Aatumatuusii: ichchasha woyko bollaara, macatusii: oyida woyko bollaara uushshaaa uyadii?	Eeraayis 1 Erike 0
	6. Muussaara gaytidaba	
	Oyshaa	**Zaaruwaa**

601	Saamintaa garsaan, woqu galassi frafriyaa maadii?(msliyaan bessa)	Galassatu payduwaa _____
602	Saamintaa garsaan, woqu galassi darko kattata/ **vegetables** maadii? (msliyaan bessa)	Galassatu payduwaa _____
603	Aginaa garsaan, woqu galassi laqlaqiyaa uushshaa uuyaadii? (msliyaan bessa)	Galassatu payduwaa _____
604	Aginaa garsaan, woqu galassi laqlaqiyaa quumaa maadii? (msliyaan bessa)	Galassatu payduwaa _____
	7. Bollaa mintetuwaara gayitidaba	
	Ooyshaa	**Zaaruwaa**
	Oosuwaa	
701	Ne oossoy daro wolqaa koyiyo gape dendidaagan daro dafursa woyko carkuwaa eesuwara ekana malane wozana shochchaa gujiyabee, leemisuwaw [daro wolqa koyiyaa toho oosuwaa, bookyoogaa woyko ginbata oosuwaa] guuxis giko 10 daqiqaw isigutan oottiyogaa? [leemisuwaa gujja] (msliyaan bessa)	Ero 1 Erike 0, Zaaroy Erike gidiko oyshaa 704 aaqqa
702	Saamintaa garsan, daro wolqa koyiyaa oosoy ne ooso kiyin woqu galasaa oottay?	Gallasaa payduwaa _____
703	Issi galassan ne ooso sohuwaan, daro wolqa koyiyaa oosuwaa ootayida aykeena wodiyaa aattay?	Sa'atiyaa : daqiqa _____ : _____ Sa'atiyaa daqiqa
704	Ne oossoy gidotiyaa wolqa koyiyo gape dendidaagan makakalayna daafursa woyko carkuwaa makakalaynaan ekana malane wozana shochchaa gujiyabe leemisuwaw [daro wolqa koyena toho oosuwaa woyko hemetaa] guxis giko 10 daqiqaw issigutaw oottiyoogaa? [leemisuwaa gujja] (msliyaan bessa)	Ero 1 Erike 0, Zaaroy Erike gidiko oyshaa 707 aaqqa
705	Saaminttaa garsan, makakalayna wolqaa koyiya oosoy ne ooso kiyin woqu galassaa oottay?	Galassaa payduwaa _____
706	Issi galassan ne ooso sohuwaan, makakalayna wolqa koyiyaa oosuwa ootayida aykeena wodiyaa aattay?	Sa'atiyaa : daqiqa _____ : _____ Sa'atiyaa daqiqa
	Sohuuwape sohuwaa simretiyooga: osuwaw Suuqiyaa, giyaa, wosiyoo keettaa	
707	Sohuuwape sohuuwaw simretanaw hemetay woyko bishkiletiyaa guuxis giiko 10 daqiqaw issigutaw go'etay?	Ero 1 Erike 0 hanenaba gidiko oyshaa 710
708	Saaminttaa garsan, Sohuuwape sohuuwaw simretanaw woqu galassaa hemetay woyko bishkiletiyaa guuxis giko 10 daqiqaw issigutaw go'etay?	Galassaa payduwaa _____
709	Issi galassan, sohuwape sohuwaw	Sa'atiyaa : daqiqa _____ : _____

	simretanaw aykena wodiyaa hemetay woiko bishkiletiyaa laagay?	Sa'atiyaa daqiqa
	Shempo oosuwaa: sportiyaa, maznaynaa/hardhiyaa/	
710	Daro wolqaa koyiyaa sportiyaa oottay, hardhiyaara gaytidaba gididi daro wolqa koyiyoogape dendidaagan daro dafursa woyko carkuwa eesuwara ekana malane wozana shochcha gujjiyabe leemisuwaw [wottaa, toho kuwasiyaa kaassaa] guuxis giko 10 daqiqaw issigutaw ottiyoga? [leemisuwaa gujja] (msliyaan bessa)	Ero 1 Erike 0, Zaaroy Erike gidiko oyshaa 713 aaqqa
711	Saaminttaa garsan, daro wolqa koyiyaa sportiyaa woyko hardhiyaara gayitidaba woqu galassaa oottay?	Galassaa payduwaa _____
712	Issi galassan, daro wolqa koyiyaa sportiyaa woyko hardhiyaara gaytidaba oottayida woqu wodiyaa go'etay?	Sa'atiyaa : daqiqa _____ : _____ Sa'atiyaa daqiqa
713	Daro wolqaa koyena woyko hardhiyaara gayitidaba gididi guta carkuwa ekisiyaba woyko guta wozana shochcha dentiyaba leemisuwaw [hemetaa, bishkiletiyaa togaa, hatta waraa, kushe kaassaa] guuxis giko 10 daqiqaw qanxenan woyko dutenan oottay? [leemisuwaa gujja] (msliyaan bessa)	Ero 1 Erike 0, Zaaroy Erike gidiko oyshaa 801 aaqqa
714	Saaminttaa garssan, sportiyaa woyko hardhiyaara gayitida oosso gididi daro wolqa koyenna oossuwan aykeena galassaa aattay?	Galassaa payduwaa _____
715	Issi galassaan, sportiyaa woyko hardhiyaara gayitida oosso gididi daro wolqa koyenna oossuwan aykeena wodiyaa aattay?	Sa'atiyaa : daqiqa _____ : _____ Sa'atiyaa daqiqa
	8. Suuttaa sugettaa guujiyaaba	
801	Dotoriyan woyko hara hakimiyaan ne suuttaa sugettaa xeelissa eray?	Ero 1 Erike 0
802	Dotore woyko hara hakimee ne suuttaa sugettay gujidoogaa woyko suuttaa sugettaa hargee nebola diyoogaa odi eryoona?	Ero 1 Erike 0, , Zaaroy Erike gidiko oyshaa 901 aaqqa
803	Aadhdhida 2 saamintatu garsan suuttaa sugettaaw xaliyaa go'eta eray?	Ero 1 Erike 0
	9. Sukaariyaa hargiyaa	
901	Dotoriyan woyko hara hakimiyaan ne suuttaa sukaariyaa xeelissa eray?	Ero 1 Erike 0
902	Dotore woyko hara hakimee ne suuttaa sukaaree gujidoogaa woyko sukaare harge nebola diyoogaa odi eriyoonaa?	Ero 1 Erike 0
903	Aadhdhida 2 saamintatu garsan suukkaaariyaa hagiyaaw xaliyaa go'eta eray?	Ero 1 Erike 0
904	Hagape kasse so'saa garssan sukaariyaa gujuwaa hargiyan sahetta uri d'i?	Ero 1 Erike 0

	10. Boollaa waraa	
	Geesaane deexuwaa	
	Oychiyaagaa duumayiyaa payduwaa	☐☐☐
1001	Geesaa Centimetryan (cm)	Nibabiyaa 1 _____ Nibabiyaa 2 _____ Nibabiyaa 3 _____
1002	Deexuwaa Kilogramyan (kg)	Nibabiyaa 1 _____ Nibabiyaa 2 _____ Nibabiyaa 3 _____
	Suuttaa sugettaa wozanaa shochchaa	
1003	Nibabiyaa 1	Systolikiya (mmHg) _____
		Diastolikiya (mmHg) _____
	Nibabiyaa 2	Systolikiya (mmHg) _____
		Diastolikiya (mmHg) _____
	Nibabiyaa 3	Systolikiya (mmHg) _____
		Diastolikiya (mmHg) _____
	11. Bayokemikaliyaa waraa	
	Suuttaa sukaariyaa	
1101	Aadhdhidaa 12 sa'atetun haattape duma midobi woyko uyidobi de'i? (Xomidoogaa zaarada ooycha siya)	Ero 1 Erike 2
1102	Galassa garssan suuttay eketido sa'ate awgee (24 sa'atiyaa qoodan)	Sa'tiyaa : daqiqa _____ : _____ Sa'tiyaa daqiqa
1103	Xoomaan diishiin ekido suuttaa sukaariyaa	mmol/l _____ woiko mg/dl _____ mmol/l _____ woiko mg/dl _____ mmol/l _____ woiko mg/dl _____
	Blood Lipids	
1104	Mule kolestroliyaa	mmol/l _____ woiko mg/dl _____ mmol/l _____ woiko mg/dl _____
1105	Trayglayseridiyaa	mmol/l _____ woiko mg/dl _____ mmol/l _____ woiko mg/dl _____ mmol/l _____ woiko mg/dl _____
1106	HDL kolestroliyaa	mmol/l _____ woiko mg/dl _____ mmol/l _____ woiko mg/dl _____ mmol/l _____ woiko mg/dl _____

24 Sa’atiyaa Garssan Miidoogaa Hassayiyoogaa

Oychiyaaga sunttaa: Deexuwaa wochchiyoo payduwaa: Gaallassaa payduwan: Quumay meetetido galassaa:			Heeraa sunttaa: Oyshshetiyagaaw imido payduwaa: Mattumay: Layittaa: Bollaa deexuwaa:
Sa'atiyaa	Miido sohuwa	Qumaa/ uushshaa qomuwaa	qommuwaa/duma sunttaa, gigido hanottane ka'ido hanotaa

Appendices IV: Ethical clearance was obtained from the Regional Committee for Medical Research Ethics Northern Norway, REK North (2017/2248/REK Nord).

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK nord			05.12.2017	2017/2248/REK nord
			Deres dato:	Deres referanse:
			31.10.2017	

Vår referanse må oppgis ved alle henvendelser

Bernt Lindtjørn
Postboks 7804

2017/2248 Endringer i ernæringsstatus og kroniske sykdommer i Wolaita i sør Etiopia

Forskningsansvarlig institusjon: Universitetet i Bergen
Prosjektleder: Bernt Lindtjørn

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK nord) i møtet 23.11.2017. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10.

Prosjektleders prosjektomtale
Background: Developing countries are undergoing nutrition transition because of economic growth, urbanization and adaptation to modern lifestyles. Such changes changes may lead to an increase in overweight and prevalence of non-communicable diseases (NCDs). Objective: To measure differences in dietary intake, nutritional status and distribution of NCDs among rural and urban population of Wolaita aged 15 - 64 years, Southern Ethiopia. Methods: The design is a population based cross sectional survey. We shall measure dietary intake, nutritional status and the occurrence of hypertention and diabetes. Randomly selected individuals from rural and urban settings will be included. The total sample size will be 1243 people. Relevance of the study: it will provide baseline data for policy decisions towards issues related to nutrition transition.

Vurdering

Om prosjektet
Prosjektet er et tverrsnittstudie på representative deltagere fra den urbane og den landlige befolkninger i Wolaita i sør Etiopia. Det planlegges å samle inn data om bolig, utdanning og inntekt, mat og informasjon om sykdomshistorie, med spesiell vekt på diabetes og hypertensjon. Det vil foretas en fysisk undersøkelse av hver deltaker, hvor man vil måle næringsstatus og blodtrykk. Hver deltaker vil også bli bedt om å avgi en blodprøve hvor man måler blodsukker og lipidnivåer.

Det fremgår av protokollen at man vil søke godkjenning med Institutional Review Board at Hawassa University i tillegg til denne REK søknaden.

Innsamling av data og gjennomføring av prosjektet vil i sin helhet foregå i Sør-Etiopia.

Komiteen har ingen innvendinger til prosjektet og under forutsetning av godkjenning fra Institutional Review Board at Hawassa University, godkjennes prosjektet.

Besøksadresse: MH-bygget UiT Norges arktiske universitet 9037 Tromsø
Telefon: 77646140
E-post: rek-nord@asp.uit.no
Web: http://helseforskning.etikkom.no/

All post og e-post som inngår i saksbehandlingen, bes adressert til REK nord og ikke til enkelte personer

Kindly address all mail and e-mails to the Regional Ethics Committee, REK nord, not to individual staff

Vedtak
Med hjemmel i helseforskningsloven §§ 2 og 10 godkjennes prosjektet.

Sluttmelding og søknad om prosjektendring
Prosjektleder skal sende sluttmelding til REK nord på eget skjema senest 30.06.2020, jf. hfl. § 12. Prosjektleder skal sende søknad om prosjektendring til REK nord dersom det skal gjøres vesentlige endringer i forhold til de opplysninger som er gitt i søknaden, jf. hfl. § 11.

Klageadgang
Du kan klage på komiteens vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes til REK nord. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK nord, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Med vennlig hilsen

May Britt Rossvoll
sekretariatsleder

Kopi til:bernt.lindtjorn@cih.uib.no

Appendices V: Ethical clearance was obtained from the Institutional Review Board at Hawassa University (IRB/005/10).

ሀዋሳ ዩኒቨርሲቲ
ህክምናና ጤና ሳይንስ ኮሌጅ
የምርምር ስነ-ምግባር ገምጋሚ
ቦርድ

HAWASSA UNIVERSITY
COLLEGE OF MEDICINE AND
HEALTH SCIENCES
Institutional Review Board

Ref. No: IRB/005/10

Date: 29/09/2017

To: *Wondimagegn Paulos, Bernt Lindtjorn and Eskindir Loha*

Re: **Renewal of ethics approval of your research protocol entitled "*Diet and nutrition transition in Wolaita, southern Ethiopia*"**

It is recalled that you have recently applied to the Institutional Review Board (IRB) of the College of Medicine and Health Sciences, Hawassa University, Hawassa, Ethiopia requesting renewal of ethics approval to your previously approved protocol (Ref. No.: IRB/004/09; date: 23/09/2016) entitled "*Diet and nutrition transition in Wolaita, southern Ethiopia*".

Considering, based on your application, that your study has not yet commenced for various reasons and also considering that the protocol has not been amended since the last approval, our IRB has granted renewal of the ethics approval of your protocol.

The renewal granted will be valid for a one year period from the date it is issued (until 29th September 2018).

Yours faithfully,

Ayalew Astatkie (PhD),
Institutional Review Board Chairperson.

Institutional Review Board, Hawassa University, College of Medicine & Health Sciences

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