



**WOLKITE UNIVERSITY COLLEGE OF HEALTH SCIENCE AND
MEDICINE DEPARTMENT OF PUBLIC HEALTH**

**PREVALENCE AND FACTORS ASSOCIATED WITH
UNDERNUTRITION AMONG ADULT TUBERCULOSIS PATIENTS IN
GURAGE ZONE SOUTHERN, ETHIOPIA.**

MPH THESIS

By

Yibeltal Bereket (BSc)

WOLKITE UNIVERSITY, WOLKITE, ETHIOPIA

August, 2022

**PREVALENCE AND FACTORS ASSOCIATED WITH
UNDERNUTRITION AMONG ADULT TUBERCULOSIS PATIENTS IN
GURAGE ZONE SOUTHERN, ETHIOPIA.**

MPH THESIS

By

Yibeltal Bereket (BSc)

Major Advisor: Tadele Girum (MPH, Assistant Professor)

Co-Advisor: Tigist G/Mariam (MPH/Nutrition)

**A RESEARCH THESIS TO BE SUBMITTED TO WOLKITE UNIVERSTIY
COLLEGE OF MEDICINE AND HEATLH SCIENCE, DEPARTMENT OF
PUBLIC HEALTH IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR MASTER OF PUBLIC HEALTH IN PUBLIC
HEALTH NUTRITION.**

August, 2022

APPROVAL SHEET
SCHOOL OF GRADUATE STUDIES
WOLKITE UNIVERSITY
ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled “prevalence and factors associated with undernutrition among adult tuberculosis patients in public health facilities in Gurage zone, southern Ethiopia”: submitted in partial fulfillment of the requirements for the degree of Master's with specialization in public health nutrition, the Graduate Program of the Department of public health, and has been carried out by Yibeltal Bereket Id. No MHSGR/019/12, under my/our supervision. Therefore I/we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

Name of major advisor	Signature	Date
-----------------------	-----------	------

Name of co-advisor	Signature	Date
--------------------	-----------	------

APPROVAL SHEET
SCHOOL OF GRADUATE STUDIES
WOLKITE UNIVERSITY
EXAMINERS' APPROVAL SHEET

This is to certify that the thesis entitled “prevalence and factors associated with undernutrition among adult tuberculosis patients in public health facilities in Gurage zone, southern Ethiopia”: submitted in partial fulfillment of the requirements for the degree of Master's with specialization in public health nutrition, the Graduate Program of the Department of public health, and has been carried out by Yibeltal Bereket Id. No MHSGR/019/12, under our supervision. Therefore we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

Name of the Chairperson	Signature	Date
Name of Major Advisor	Signature	Date
Name of Internal Examiner	Signature	Date
Name of External examiner	Signature	Date
SGS Approval	Signature	Date

Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the School of Graduate Studies (SGS) through the Department/School Graduate Committee (DGC/SGC) of the candidate's department.

Stamp of SGS Date: _____

ACKNOWLEDGMENT

First of all, I would like to thank my God who keeps me every day in health and to stay in life. I acknowledge my family that they gave me moral and financial support to continue my class. My gratitude goes to Wolkite University College of medicine and health science, department of public health department teachers and my advisors Mr. Tadele Girum and Mrs. Tigist G/Mariam for their ultimate encourage me to do this research. Finally I would like to thank Gurage Zone Health Department, Woreda Health Offices, participants, data collectors, and all health professionals working in TB clinics in Gurage zone southern Ethiopia.

Table of Contents

ACKNOWLEDGMENT.....	V
LIST OF TABLES.....	IX
LIST OF FIGURES.....	X
ACRONYMS AND ABBREVIATIONS.....	XI
ABSTRACT.....	XII
1. INTRODUCTION.....	1
1.1 Background.....	1
1.2 Statement of the Problem.....	2
1.3 Significance of the study.....	5
2. LITERATURE REVIEW.....	6
2.1 Magnitude of undernutrition in TB patients.....	6
2.2 Factors associated with undernutrition among TB patients.....	7
2.2.1 Socio economic and demographic factors.....	7
2.2.2 HIV Status.....	9
2.2.3 Food Supplementations to TB Patients.....	9
2.2.4 Nutrition as integral components of TB treatment and care.....	10
2.3 Conceptual framework.....	11
3. OBJECTIVES.....	12
3.1. General Objective:.....	12
3.2. Specific Objectives.....	12
4. METHODS AND MATERIALS.....	13
4.1. Study Area.....	13
4.2. Study Period.....	13
4.3. Study Design.....	13
4.4 Population.....	13
4.4.1 Source Populations.....	13
4.4.2 Study Populations.....	13
4.5 Inclusion and Exclusion Criteria.....	14
4.5.1 Inclusion Criteria.....	14
4.5.2 Exclusion Criteria.....	14
4.6. Sample size determination.....	14

4.7 Sampling Technique	16
4.8 Data Collection Methods and Instruments	18
4.9 Study Variables	20
4.9.1 Dependent Variable.....	20
4.9.2 Independent variables	20
4.10 Operational definition and definition of terms	20
4.11 Data Quality Assurance	21
4.12 Data Processing and Analysis	21
4.13 Ethical Considerations	22
4.14 Dissemination of Results	22
5. RESULTS	23
5.1 Socio-Demographic and Household Related Characteristics	23
5.2 Behavioral and Dietary Characteristics of the Study Participants	25
5.3 Health Status Related Characteristics	27
5.4 Magnitude of Undernutrition	28
5.5 Factors Associated with Undernutrition.	29
6. DISCUSSION	32
6.1 Strength and Limitations of the study	34
7. CONCLUSIONS AND RECOMMENDATIONS	35
7.1 Conclusions.....	35
7.2 Recommendations.....	35
8. REFERENCE.....	36
9. INFORMATION SHEET	41
9.1. Institution Information Sheet and Informed Consent Form.....	41
9.2. Participant Information Sheet and Informed Voluntary Consent Form.....	43
9.2.1. English Version Participant Information Sheet and Informed Voluntary Consent Form for adult TB patient attending health facility TB clinic.....	43
10. ANNEXES.....	45
10.1 Annex1: Participant information sheet and informed consent form	45
10.2. Consent Form English Version	46
10.3 Questionnaires.....	47
10.3.1 English version of the questionnaire	47

10.3.2 Amharic Version Questionnaire..... 57

LIST OF TABLES

Table 1: Sample size determination for factors associated with undernutrition among adult TB patient attending public health facilities in Gurage zone, SNNPR, Ethiopia, 2022.....	15
Table 2: Socio-demographic and household characteristics of TB patients in Government Health institutions of Gurage zone, Ethiopia 2022.....	23
Table 3: Behavioral and Dietary Related Characteristics information of Adult TB Patients in Government Health institutions of Gurage zone, Ethiopia, 2022.....	25
Table 4: Health Status Related Characteristics of Adult TB Patients in Government Health facilities of Gurage, Ethiopia 2022.....	27
Table 5: Factors associated with Undernutrition among Adult TB patients in Government Health institutions of Gurage Ethiopia 2022.....	31
Table 6: Factors Significantly Associated with Undernutrition among Adult TB patients in Government Health institutions of Gurage Ethiopia 2022.....	32

LIST OF FIGURES

Figure 1: The conceptual framework of the factors assumed to affect nutritional status of TB patients, Source: modified and adapted from United Nation International Children’s Emergency Fund, UNICEF, 1991.....	11
Figure 2: Schematic Presentation of the Sampling Procedure of study on the prevalence and factors associated with undernutrition among adult TB patients in Gurage zone southern, Ethiopia 2022.....	17
Figure 3: Magnitude of undernutrition among Adult TB patients in Government Health institutions of Gurage zone, Ethiopia 2022.....	28

ACRONYMS AND ABBREVIATIONS

AIDS: Acquired Immunodeficiency Syndrome

AOR: Adjusted Odds Ratios

BMI: Body Mass Index

CI: Confidence Interval

DDS: Dietary diversity score

DOT: Direct Observed Treatment Short course

FAO: Food Agricultural Organization

FANTA: Food and Nutrition Technical Assistance

HIV: Human Immune Deficiency

IQR: Inter Quartile Range

IRERC: Institutional Research Review Committee

MDR: Multi Drug Resistance

MPH: Master of Public Health

NGO: Non-Government Organization

PCA: Principal Component Analysis

PEM: Protein Energy Malnutrition

PI: Principal Investigator

PTB: Pulmonary Tuberculosis

SES: Socioeconomic Status

SPSS: Statistical Package for Social Science

TB: Tuberculosis

USAID: United States Agency for International Development

WFP: World Food program

WHO: World Health Organization

VIF: Variance Inflation Factor

ABSTRACT

Background- Undernutrition and tuberculosis (TB) are interconnected in a complex relationship. There is a high prevalence of undernutrition among adult tuberculosis patients worldwide, specifically in developing countries including Ethiopia. Tuberculosis causes undernutrition through raised metabolic demands, by decreasing nutritional intake and by decreasing necessary immune functions. Therefore this study aimed to assess the prevalence and associated factors of undernutrition among adult tuberculosis patients in Gurage zone southern, Ethiopia.

Methods: A facility based cross-sectional study was conducted in Public Hospital and Health centers of Gurage zone from April-May 2022. A total of 257 tuberculosis patients participated in the study. The outcome variable, undernutrition, was determined by using Body Mass Index (BMI). Interviewer administered structured questionnaire, anthropometric measurements and patients' document review were done. Bivariable and multivariable logistic regressions were done to identify factors associated with undernutrition. Crude odds ratios and adjusted odds ratios with 95% confidence intervals and P-values < 0.05 were employed to declare the significance and strength of association.

Results: A total of 257 TB patients with a mean age of 34 were enrolled in the study. The prevalence of undernutrition was 40%, (95% CI: 34.1-45.9). The odds of undernutrition were higher among tuberculosis patients with family size of greater than five (AOR=2.0, 95% CI: 1.0-3.9), being a rural place of residence (AOR= 2.0, 95% CI: 1.1-3.6), not obtain dietary counseling (AOR=3.8, 95% CI: 2.0-7.2) and not provided nutrition support and care (AOR=2.9, 95% CI: 1.5-5.4).

Conclusion: The magnitude of undernutrition was found to be high. Having an extended and large family size, place of residence, lack of nutrition support and care, and did not receive dietary counseling were the factors independently associated with undernutrition of tuberculosis patients. The nutritional derangement could call for fast nutritional intervention in the management of tuberculosis patients. Regular nutritional screening and management should be strengthened.

Key word: - Prevalence, TB, Undernutrition, BMI, public Health facilities.

1. INTRODUCTION

1.1 Background

Undernutrition is defined as a condition in which the nutrient and energy intake is inadequate to meet an individual's needs to sustain good health (1). Undernutrition is a major public health problem in low income countries. It may result due to illness that impairs nutrient intake and metabolism or result from inadequate intake of macronutrients, micronutrients or both (2). Undernutrition is a predictor of increased risk of death and TB relapse among TB infected patients (3).

Undernutrition makes people more susceptible to the development of active TB, and active TB contributes to the development of undernutrition. This vicious circle impacts not only on individuals but can easily transfer to their families and their communities (4). Individuals become undernourished when their diet does not provide them with adequate calories and proteins for maintenance and growth. Illness can further result in decreased intestinal absorption (5).

Tuberculosis is an infection disease caused by *Mycobacterium tuberculosis* and it is the leading cause of infectious mortality in the world (6). Tuberculosis patients have decreased in appetite; have decreased in nutrient intake, micro nutrient malabsorption, and changed metabolism. These problems lead to wasting. Both protein-energy malnutrition (PEM) and micronutrients deficiencies increase risk death among TB patients. Undernourished TB patients have delayed recovery and higher mortality rates than well-nourished TB patients (7). Tuberculosis (TB) causes undernutrition through raised metabolic demands and decline in nutrition intake, and nutritional deficiencies may exacerbate the TB disease, or it takes longer recovery by decreasing necessary immune functions (8). Malnutrition is recurrently detected in tuberculosis patients (9).

Undernutrition and tuberculosis tend to interact with each other. The risk of complication including death from infections is influenced by the nutritional status of an individual, but the nutritional status of an individual and utilization of nutrients are also adversely affected following an infection (10). Most individuals with active TB are in a catabolic state and experience weight loss. Weight loss among those with TB can be caused by several factors, including reduced food intake due to loss of appetite, nausea and abdominal pain; nutrient losses

from vomiting and diarrhea and metabolic alterations caused by the disease (11). Low body mass index (BMI) (lower than 18.5 kg/m²) and lack of adequate weight gain with TB treatment are associated with an increased risk of death and TB relapse (12).

Hard to determine exactly what the nutritional status of patients with active TB was earlier the onset of the disease, making it difficult to fix whether malnutrition directed to the advancement of the disease or whether active TB directed to malnutrition. Number studies described that patients with active TB are more likely to be wasted or have a lower body mass index than the healthy person (2).

Malnutrition and tuberculosis are directly related problems in considerable magnitude for most of the underdeveloped countries. Nutrition problem is one of risk factor for different types of diseases. So assessing the nutritional status of TB patients is enables to intervene for treatment and responds timely as well as to address and identify the possible influencing factors. At present, even if there is large population size in Gurage zone, there is no sufficient study conducted in the area.

1.2 Statement of the Problem

Undernutrition is a major public health problem on the globe particularly in the developing regions. It selectively compromises cell-mediated immunity, which is the principal defense against Mycobacterium tuberculosis and, thereby, increases the risk of reactivation of latent infection to disease. Moreover, poor nutritional status is associated with risk of TB relapse and mortality (13). There is evidence to suggest that Undernutrition, and the consequential weakness in immune function, makes it more likely that exposure to TB bacteria will result in full tuberculosis, rather than development of the latent form of the disease that is found in 2 billion people around the world (14).

Undernutrition can lead to secondary immunodeficiency that increases the host's susceptibility to infection. In patients with tuberculosis, it leads to nutrient malabsorption, micronutrient malabsorption, and altered metabolism leading to wasting. Both, protein-energy malnutrition and micronutrients deficiencies increase the risk of tuberculosis. It has been found that malnourished tuberculosis patients have delayed recovery and higher mortality rates than well-nourished patients (15).

In the world, from a single infectious agent, above HIV/AIDS, tuberculosis (TB) is one of the top ten and leading causes of death. According to the WHO 2019 Global tuberculosis report, there were 10 million infections and 1.2 million deaths among HIV-negative people. HIV infection increases the risk of TB and in 2018 there were 251 thousand TB deaths among HIV-infected people (16). According to TB reports from all countries and age groups around 90% were adults (aged ≥ 15 years) and 9% were people living with HIV from this 72% were in Africa. Globally by 2030, the ambition is to reduce TB mortality by 90% compared with 2015 (17). Among the twenty two highest tuberculosis burdened countries, Ethiopia ranks third in Africa and eighth in the world. The incidence rate of the total TB rate is 151 per 100,000 populations. The TB case detection rate, the treatment success rate, and the TB cure rate were 74%, 82.5%, and 67%, respectively (16).

TB is an infectious disease affecting millions of people worldwide; globally, an estimated 10 million people developed TB disease in the past two years; and there were an estimated 1.4 million TB deaths; of which 95% of the cases occur in developing countries (18). TB is a significant public health concern of developing countries as it has been strongly associated with poverty and unsanitary living condition (4, 19, 20). There are a number of adult tuberculosis (TB) patients suffering from profound undernutrition in the world especially in developing countries (3, 21). It is estimated that undernutrition causes about one quarter of all new TB cases globally (22). This can have serious public health impacts if those with undernourished adult TB are not identified early (23).

Tuberculosis has been described as a “social disease with medical implications” which occurs disproportionately among the disadvantaged groups like the homeless, undernourished, or overcrowded (24). At least 75% of all TB cases are among people, who are 15–54 years of age and in their prime working years, and most of the TB patients are undernourished, Adults who are undernourished allocate fewer days to heavy labour and are more likely to fail to appear for work owing to illness or exhaustion. As a result of this it affects countries development (19).

Undernutrition and TB are two of the key global health issues in the world. TB is one of the big three deadly public health threats, along with HIV/AIDS and Malaria, and causes 1.5 million deaths every year (19). The body of a person suffering from TB has an increased demand for energy, which often causes a TB patient to lose a significant amount of weight and this can

worsen acute undernutrition. In fact, over half of TB patients are malnourished when they are diagnosed with TB. This includes those around 17% of patients who are with severe acute malnutrition (25).

Behavioral factors are also associated with undernutrition, for instance, smoking amplifies the risk of undernutrition which might have been related to a reduction in appetite as well as increased resting energy expenditure mediated by the effects of nicotine on body metabolism (26, 27). Moreover, alcoholism and illicit drug use were found to exacerbate undernutrition among TB patients (28). On the other hand, poor socioeconomic status, low educational status, being female, sputum smear-positive, unable to work functional status, and not receiving dietary counseling were a risk for undernutrition among TB patients (29-32).

Ethiopia is ranked third and seventh in Africa and the world, respectively, in terms of the burden of TB (33). Surprisingly, TB is the eighth leading cause of hospital admissions and the third leading cause of hospital deaths in Ethiopia (34). Besides, few studies demonstrated that considerable proportions of TB patients are undernourished (31, 32). Poor anti-TB treatment adherence has also been the commonest Phenomenon among undernourished patients which might increase the risk of developing multi-drug resistant (MDR) type TB, one of the current challenging public problems in Ethiopia and the globe at large (35).

There have been very few reports on prevalence, severity and implications of under-nutrition among TB patients in Ethiopian. Berihun Dargie and his colleague tried to study Prevalence and associated factors of undernutrition among adult tuberculosis patients in public health facilities of Addis Ababa (31); but important factors like smear status, type of TB, duration on treatment, History of previous treatment, hygiene factors, household food insecurity and dietary diversity were not considered. This study is proposed to fill this gap by studying the magnitude and factors associated with undernutrition of Adult TB patients considering important factors in Gurage zone southern, Ethiopia.

1.3 Significance of the study

The outcome of this study is to generate information on magnitude of nutritional status and predictors of undernutrition in TB patients and to create awareness to adopt action. Knowing the level of undernutrition and different factors contributing to undernutrition is important to design appropriate targeted interventions that will effectively address the problem of undernutrition in TB patients. The primary beneficiaries of this study will be TB patients and the Community in Gurage Zone. Other outcome of the study includes good recommendation to Hospitals/Health centers and different responsible bodies like Gurage Zone Health Department office; donors and other stakeholders in the study Area. Moreover, the findings will serve as a source of information for researchers who are interested in conducting research in this area in the future.

2. LITERATURE REVIEW

2.1 Magnitude of undernutrition in TB patients.

A Cross-sectional study on nutritional status and change in body mass index with treatment outcome in smear-positive pulmonary TB patients on DOTS/directly observed therapy in Amritsar city, conducted in 2011, showed that, 69.2% patients were underweight; among which 34% were severely underweight having BMI < 16 kg/m²; and 29.6% cases were having normal BMI (36). Another Study on nutritional status of Adult Patients with Pulmonary Tuberculosis in Rural Central India, which was conducted in 2009, revealed as 80% of women and 67% of men had moderate to severe undernutrition (BMI<17.0 kg/m²). Fifty two percent of the patients (57% of men and 48% of women) had stunting indicating chronic undernutrition. Half of women and one third of men remained moderately to severely underweight (37).

Even more higher magnitude was observed in study on prevalence and predictors of undernutrition on secondary hospitals in Chhattisgarh state, central India, which used 1695 study participants, It revealed as more than 85% of men and almost 95 % of women were underweight at (BMI <18.5 kg/m²), and two-thirds of women and half of men were severely underweight (BMI < 16 kg/m²) (37). Another study on nutritional assessment of newly diagnosed tuberculosis patients in a tertiary care hospital of Tripura, India nutritional status of Adult patients with tuberculosis, which was conducted in 2017, revealed as 66% of 410 study populations were having malnutrition (BMI <18.5kg/m²) (38).

A Cross-sectional study on magnitude of Malnutrition among pulmonary tuberculosis in Timor and Rote Islands which was conducted in 2008, Indonesia on 492 study participants revealed, 87% of TB patients had malnutrition compared to healthy persons. The mean body mass index (BMI), family history of TB, family size and employment status are the associated factors with undernutrition of TB patients (39). Study conducted in Pokhara, Nepal in 2016 shows undernutrition among 133 TB patients taking anti-tubercular drug found that 36.1% were underweight and 11.35% were overweight during the time of registration (40).

Study on predictors of change in nutritional and hemoglobin status among adults treated for tuberculosis in Dar es Salaam, Tanzania, Which was conducted in 2010 on 887 patients with pulmonary TB, of 471 HIV-positive and 416 HIV-negative adults with pulmonary TB were

prospectively followed and about 40% of HIV positive and 47% of HIV-negative TB patients were malnourished (BMI < 18.5 kg/m²) at the time of diagnosis (38). Other study on evaluation of nutritional status of pulmonary TB patients of the Effia-nkwanta regional Hospital, Secondi ,Ghana, which was conducted in 2006, showed total magnitude of undernutrition to be 51%; and 24%, 12% and 15% of patients respectively had mild, moderate and severe undernutrition (28). Other Cross-sectional study on Nutritional Status of Patients with Tuberculosis and Associated Factors in the Health Centre Region of Burkina Faso conducted in 2019, on 302 study participants' revealed 35.8% prevalence of undernutrition (41). Moreover, Study on Predictors of Low Body Mass Index among Patients with Smear Positive Pulmonary Tuberculosis patients on three high TB burden provinces in Kenya conducted in 2011, on 1298 study participants' revealed 43% prevalence of Undernutrition (42).

An Institution-based cross-sectional study conducted in 2020, on Prevalence and associated factors of undernutrition among adult TB patients attending Amhara National Regional State hospitals, Northwest Ethiopia on 405 study participants revealed as 42.2% of the TB patients were undernourished (43). Other Cross-Sectional Study on Prevalence of Pulmonary Tuberculosis and Associated Risk Factors in Gamo Goffa Zone, South Ethiopia revealed as 50% of the TB patients had BMI <18.5. The mean BMI among TB patients in this study was 17.4 (44). Lower prevalence of undernutrition than these two studies was observed in another institution-based cross-sectional study on tuberculosis patients in two government hospitals and ten health centers in Shashemane Ethiopia. In this study the magnitude of undernutrition was 28.8% (45).

2.2 Factors associated with undernutrition among TB patients

2.2.1 Socio economic and demographic factors

Tuberculosis, a disease that is considered neglected, affects large population groups, especially in developing countries, where it is of significant magnitude and social importance; therefore, it is a major public health problem. Approximately 95% of the estimated number of tuberculosis cases occurs in resource-poor countries, and 82% are concentrated in 22 of these countries (3). The risk of TB transmission also increases with the intimacy and duration of contact to TB patients and infectiousness of the TB patients (46). Risk of TB is high among population living in poverty, low socioeconomic groups, low income, immune-suppressed (including AIDS), and

extreme age (old age and children) groups, certain ethnicity, migrants, and those exposed to animals (*Mycobacterium bovis*) (46, 47).

Cross-sectional study on wasting and body composition of adults with pulmonary tuberculosis in relation to HIV-1 co-infection, socioeconomic status, and severity of tuberculosis conducted in 2005, in Tanzania showed as undernutrition is positively associated with socioeconomic status indicators (48). Another study on evaluation of nutritional status of pulmonary TB patients of the Effia-nkwanta regional Hospital, Secondi, Ghana, conducted in 2006, Showed, as magnitude of undernutrition among TB patients was significantly associated with marital status, monthly income, educational status and family size at the time of starting TB treatment. Two months after initiating the TB treatment change in body mass index was significantly associated to age, marital status, employment status, and educational status (28).

A Cross-sectional study on nutritional status of TB patients attending district tuberculosis center in Gulbarga, North Karnataka, India, conducted in 2011, showed a significant association between nutritional status and literacy status ,where prevalence of undernutrition was high i.e. 68% among illiterates (49). Another institution based cross-sectional study on assessment of nutritional status and associated factors among adult TB patients on directly observed treatment of short course in health facilities at Adama Town, East Shewa Zone, Ethiopia showed that females (66.2%) were more malnourished than males (35.2%). The proportion of malnutrition status of patient is higher in those patients unable to write and to read (87.5%) and followed by started primary education (62%). While the proportion of patient malnourished with secondary education and advanced/college were found to be lower, 40.8% and 2%, respectively (30).

A Cross-sectional study in 2020 on Prevalence and associated factors of undernutrition among adult TB Patients attending Amhara National Regional State hospitals, Northwest Ethiopia conducted in 2020 showed that patients who were unemployed 2.59 times, housewives 2.59 times, and farmers' 2.59 times more likely undernutrition than governmental employed TB patients (43).

2.2.2 HIV Status

TB and HIV infections are both independently associated with undernutrition, co-infection with HIV may exacerbate the extent of undernutrition (50). Undernutrition is generally more severe in people with HIV/TB co-infection. On study of Predictors of Low Body Mass Index Among Patients with Smear Positive Pulmonary Tuberculosis patients, conducted in 2011 in Kenya; HIV status were identified as significant predictors of low BMI in smear positive TB cases (42). Study on Alteration in serum levels of trace elements in tuberculosis and HIV infection in Gondar, Ethiopia showed that the prevalence undernutrition in adult TB patients co-infected with HIV was 71.6% (51).

Similarly study on Prevalence and associated factors of malnutrition among adult hospitalized patients, which was conducted in 2014, at Amhara National Regional State Referral Hospitals, Ethiopia identified that the presence of HIV co/morbidity was a risk factor for malnutrition, 77% of HIV positive TB patients were undernourished whereas 54% of HIV negative TB patients were undernourished. Undernutrition was two times more common among HIV-positive patients (52). Study conducted in Uganda, no difference was found in BMI between HIV-positive and HIV-negative adults with pulmonary tuberculosis. Among HIV-positive subjects with tuberculosis, BMI was significantly lower among those with CD4 lymphocyte count <200 cells/ml compared with those who had >200 cells/ml (53).

2.2.3 Food Supplementations to TB Patients

Nutritional status appears to be an important determinant of clinical outcome during tuberculosis. In an influential study conducted in India, 163 patients with tuberculosis were treated either in a sanatorium with a well-balanced diet or at home on a markedly poorer diet. The overall treatment response was similar in both groups; however, those receiving better nutrition tended to show more rapid clearance of bacteria and radiographic changes in addition to greater weight gain (54). Study conducted on Nutritional Status of Patients with Tuberculosis and Associated Factors in the Health Centre Region of Burkina Faso in 2020 found that the majority of adult TB patients consumed a low frequency, 1 to 2 meals per day, and low daily food frequency was associated with increased odds of undernutrition (41).

Patients with low socioeconomic status may have insufficient dietary intakes and poor-quality diets, and may be vulnerable to food insecurity; however, measures of socioeconomic status and frequency of meat purchase were not associated with change in nutritional status in our study. A recent review concluded that there is insufficient evidence to suggest whether incorporating nutritional supplements during TB treatment may improve clinical outcomes (55).

2.2.4 Nutrition as integral components of TB treatment and care

An essential dietary nutrient is a substance that a person needs to consume in order to live, grow and be healthy. Nutrients are required to regulate body processes and build and repair tissues and thereby promote health and prevent disease. Undernutrition is commonly associated with illness and infections such as gastrointestinal disorders and malabsorption, pneumonia, TB and HIV. Food insecurity can be a cause of malnutrition, as can alcohol misuse and illicit drug use, and a number of other conditions. In any case, both the underlying condition associated with undernutrition and the malnutrition itself warrant evaluation and treatment (27).

The association between TB and undernutrition has long been known. TB makes undernutrition worse and undernutrition weakens immunity, thereby increasing the likelihood that latent TB will develop into active disease (56). Drugs to treat TB often do not work properly if a patient suffering from TB does not have a good, nutritious diet. Without an adequate amount of food, these drugs can even have an adverse effect on a person's health (25).

2.3 Conceptual framework.

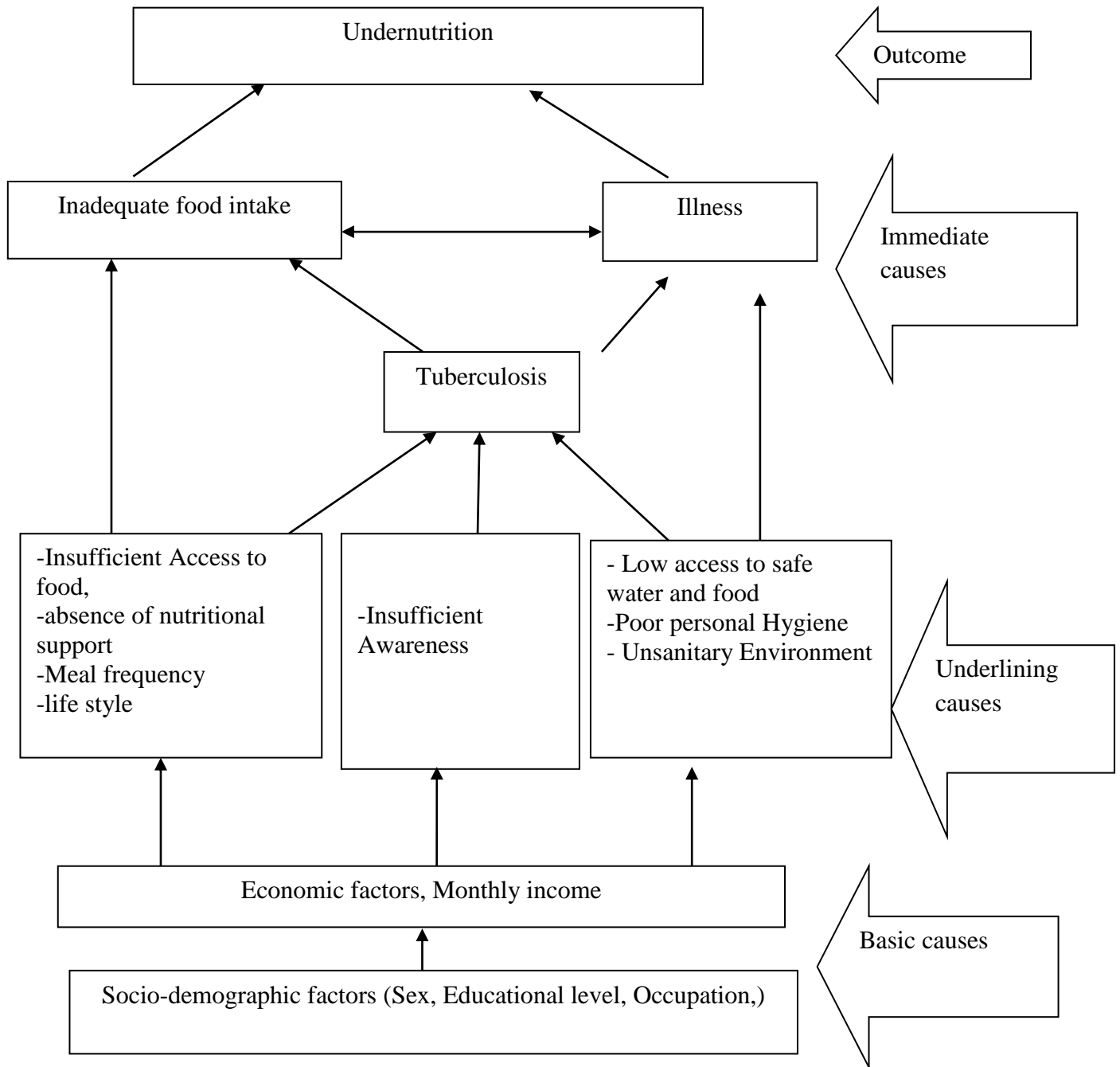


Figure 1: The conceptual framework of the factors assumed to affect nutritional status of TB patients, Source: modified and adapted from United Nation International Children’s Emergency Fund, UNICEF, 1998 (57).

3. OBJECTIVES

3.1. General Objective:

- To assess the prevalence and identify factors associated with undernutrition among adult TB patients in Gurage zone southern, Ethiopia April – May 2022.

3.2. Specific Objectives

- To measure the prevalence of undernutrition among adult TB patients in Gurage zone southern, Ethiopia 2022.
- To identify factors associated with undernutrition among adult TB patients in Gurage zone southern, Ethiopia 2022.

4. METHODS AND MATERIALS

4.1. Study Area

The study was conducted in Gurage Zone, Southern Ethiopia. Wolkite is the administrative center of the region 155km south of Addis Ababa and 345 km south of Hawassa. According to administrative reports, Gurage Zone has an estimated total population of 1,921,845 (male = 941,704 and female = 980,141) and house hold of 392,231. An annual plan of TB case in the Zone is around 2,690 in 2014 EFY. There are 1 specialized hospital, 1 General hospital, 6 primary hospitals, 70 health centers, 24 private clinics and 377 health posts (one in each kebele) constitute the primary health care system and deliver TB treatment services. There are 3426 health professionals and 308 HEWs all over health facilities. The major socio-economic activity in the study area is mixed one. There are 8 hospitals and 70 health centers in the Zone, which are owned by the government.

4.2. Study Period

The study was conducted in Gurage Zone, Southern Ethiopia among adult TB patients from April – May 2022.

4.3. Study Design

A facility based cross-sectional study was conducted to assess the prevalence and identify factors associated with undernutrition among adult TB patients in Gurage zone southern, Ethiopia 2022.

4.4 Population

4.4.1 Source Populations

All TB patients who were on follow up in TB clinics in Gurage zone.

4.4.2 Study Populations

All Adult TB patients who were on follow up in five government Hospitals (i.e. Wolkite University Specialized and Referral Hospital, Butajira General Hospital, Buee Primary Hospital, Agena Primary Hospital and Gunchire Primary Hospital) and eighteen government health centers (i.e. Arekit HC, Kebul HC, Emdibir HC, Darge HC, Wolkite HC, Butajira HC, Kela HC, Tiya HC, Wosherbe HC, Hawariate HC, Enge HC, Dinkula HC, Woyira HC, Bole HC, Wurerber HC,

Koshe HC, Enseno HC and Terhogn HC) TB clinics who fulfill eligibility criteria during data collection period were our study population.

4.5 Inclusion and Exclusion Criteria

4.5.1 Inclusion Criteria

- All randomly selected adult (age above 18 years) TB patients who had already started TB drugs were included in this study.

4.5.2 Exclusion Criteria

- Patients who were extreme ill, unable to communicate, pregnant woman, patients with mental disorders, TB related scoliosis, vertebral deformity, and a patient who develop edema due to different disease disorders were excluded from the study.

4.6. Sample size determination

For objective 1. The sample size was calculated by using the single population proportion formula with the following assumptions prevalence of undernutrition among TB patients to be 39.7% [32], 95% confidence level and maximum discrepancy of 5% between the sample size and the underlining population. An additional 10% will be added as contingency to compensate non-response rate. The following single population formula:

$$n = \frac{(Z\alpha/2)^2 p(1-p)}{d^2} = \frac{(1.96)^2 * 0.39(1-0.39)}{(0.05)(0.05)} = 366$$

Where, n =sample size, p = estimated percentage based on past study, 39.7%, d=error allowed 5%, Z= critical value at 95% CI is 1.96.

Then, the correction factor formula was used to determine final sample size because the source population was less than 10,000.

$$n = \frac{n_0 N}{n_0 + (N - 1)} = \frac{366 * 680}{366 + (680 - 1)} = 238$$

Where, n =sample size, n₀ = sample size calculated early, 39.7%, N = total number of populations in the study area, by adding 10% of non-response 238+24 = 262. The final sample sizes for the study was 262.

For objective two: The sample size required for the second objective was determined by considering various factors that are significantly associated with outcome variable, two sided confidence level of 95%, margin of error of 5% and power of 80% using Epi info version 7 statcalc. For each variable non-response rate of 10% was considered to get the minimum acceptable sample size.

Table 1: Sample size determination for factors associated with undernutrition among adult TB patient attending public health facilities in Gurage zone, SNNPR, Ethiopia, 2022.

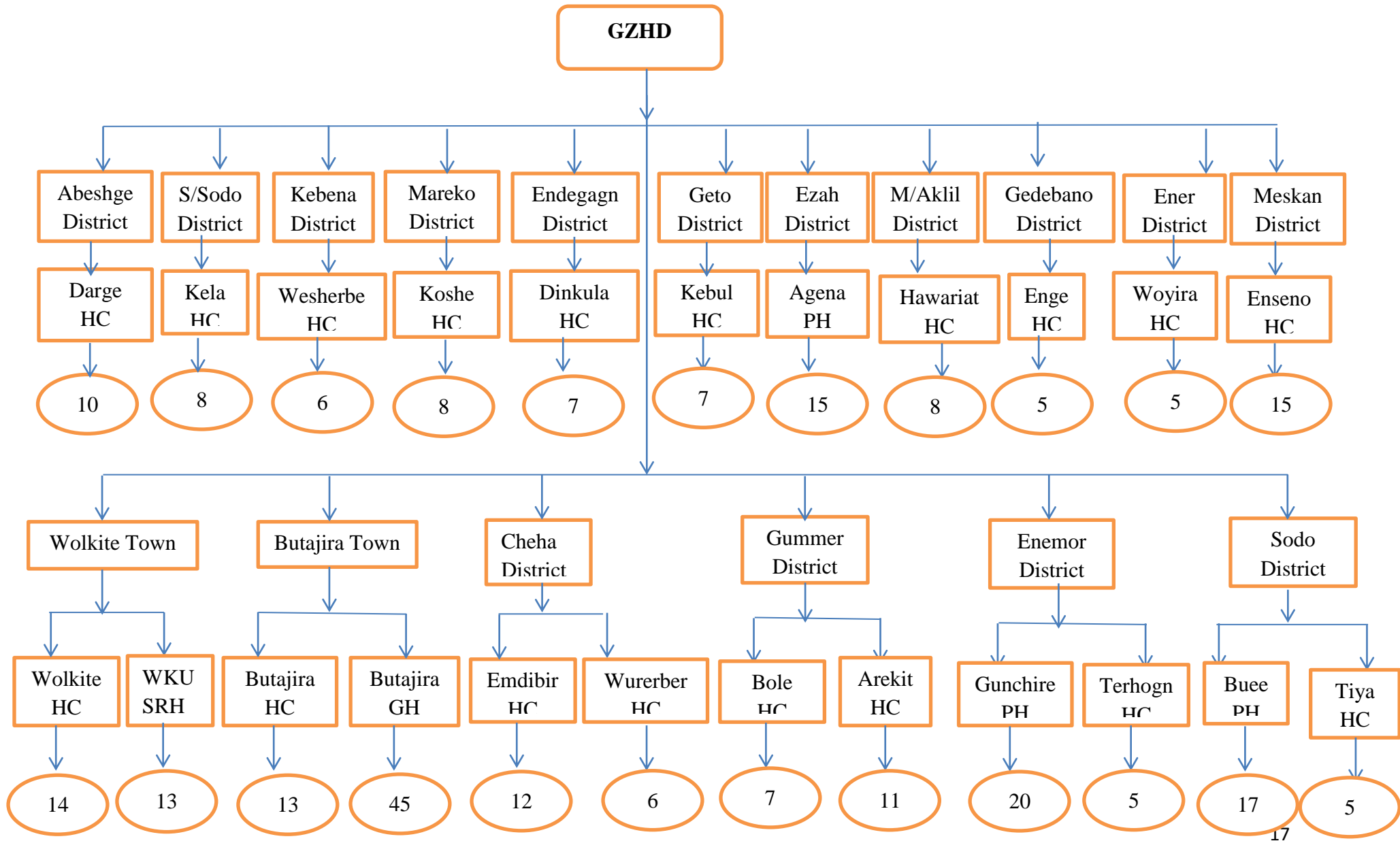
S.N	Variables	% of outcome in unexposed	AOR	CI	Sample size	10% non-response	Final sample	Reference
1	Sex	54.3	6.4	95%	66	7	73	(30)
2	HIV Status	52.5	5.06	95%	76	8	84	(58)
3	Educational Status	35.6	3.94	95%	82	8	90	(59)

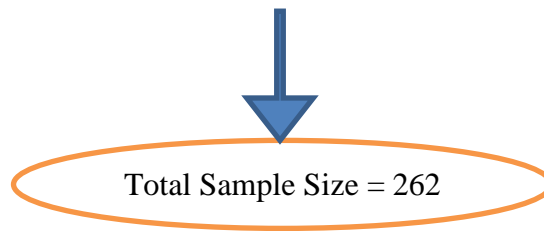
Using epicalc2000, taking 95% CI, 80% power, and the calculated sample size is 224 .Adding 10% non-response rates the final sample size becomes 247. However, there were 262 adult TB patients on follow up under eighteen health centers and five hospitals, taking all these, which were manageable, the final sample size for this study was 262.

4.7 Sampling Technique

TB treatment is given by Government Health institutions therefore, systematic random sampling technique was employed to select 262 study participants from 18 Health centers and the 5 Hospitals were included in the study. The patient flow in TB clinics of each Health institution per day on average is; 10-30 at Butajira General Hospital, 10-35 at Wolkite University Specialized & Referral Hospital, 10-25 Buee Primary Hospital, 2-7 at Gunchire Primary Hospital, 1-3 at Emdibir HC, 1-3 at Arekit HC, 2-5 at Wolkite HC, 0-3 at Kela HC, 1-3 at Darge HC, 0-3 at Kebul HC, 2-7 at Butajira HC, 1-3 at Tiya HC, 0-3 at Wosherbe HC, 2-4 at Hawariate HC, 0-2 at Enge HC, Dinkula HC, 1-3 at Woyira HC, 0-3 at Bole HC, Wurerber HC, 2-4 at Koshe HC, 1-3 at Enseno HC, 0-3 at Hamus Gebeya HC and 0-2 at Terhogn HC). The average total population of TB patients 680; therefore the sample was selected every two patients intervals. Then the total sample size (262) was proportionally allocated to the number of adult TB patients at each health facilities and participants were interviewed consecutively.

Figure 2: Schematic presentation of the sampling procedure of 23 selected health facilities of Gurage zone southern, Ethiopia 2022.





NB: GZHD-Gurage Zone Health Department, WKUSRH- Wolkite University Specialized and Referral Hospital, GH- General Hospital, PH- Primary Hospital and HC-Health Center.

4.8 Data Collection Methods and Instruments

An interviewer-administered questionnaire was used to collect the socio-demographic, health status, behavioral and nutritional characteristics of patients. Also, a chart review was carried out to ascertain HIV status, type of TB, duration of anti-TB treatment, and receiving supplements (vitamin B6 and Ready to Use Therapeutic Feeding).

Functional status was assessed by interviewing participants on the level of assistance they require in carrying out daily activities. Accordingly, patients who did not require any special assistance to do their daily activities were categorized as ‘Working’, patients who were unable to care for themselves and require institutional or hospital care were considered as ‘bed ridden’ whereas patients who were unable to work, able to live at home and able to care for most of the personal needs and requires occasional assistance were considered as ‘Ambulatory’(31).

Standard technique of anthropometric measurements was used; the height of the study participants was taken using a Seca-vertical height scale standing upright in the middle of the board. Participants were asked to take off their shoes and stand in the Frankfurt plane (stand erect, and look straight in horizontal plain). The occipital (back of the head), shoulder blades, buttocks, and heels were touched measuring board, and height was recorded to the nearest 0.01cm. The weight of the study participants was measured using digital weighing scales to the nearest 0.1Kg without shoes and all heavy clothing (e.g. jackets, jerseys, belts, etc.). The weighing scale was also checked against a standard weight for its accuracy on daily basis. Calibration was performed before weighing each study participant by setting it to zero.

Another variable, wealth status was computed based on the possession of household assets (i.e. refrigerator, sofa, bicycle, television, radio, ox, sheep, ownership of agricultural land and mobile telephone) was used as a proxy for the socio-economic status using principal component analysis; finally, the wealth index was ranked into three; poor, medium and high (60).

Dietary diversity was measured by using the 24-hours recall method and twelve food groups were used to summarize dietary intake as recommended by the Food and Nutrition Technical Assistance (FANTA) (61).

The questionnaire was developed through reviewing of various relevant literatures (28, 30, 31, 43, 45, 52). First it was prepared in English, translated to Amharic and then back to English in order to ensure its consistency. A pre-test was carried out on 5% of the sample size in Hole health center of Abeshge district one week before the actual data collection and possible modification and amendment of the tool was done based on result from the pretest.

Data were collected by using three BSc nurses and one public health officers as supervisor who was fluent in Amharic and Guragigna. Intensive training that lasts three days were provided for both data collectors and supervised by principal investigator, which focus on the aim of the study, procedures, data collection techniques, the art of interviewing, ways of collecting the data, and clarification on how to manage the data collection process. Face-to-face interview was employed using structured questionnaire at health facilities after they get TB care service. To maintain the quality of data, the investigators and supervisors were carried out regular supervision, spot-checking, and reviewing the completed questionnaire on daily basis.

4.9 Study Variables

4.9.1 Dependent Variable

- Undernutrition

4.9.2 Independent variables

4.9.2.1 Socio-demographic, economic and nutritional factors

- Age, Sex, Residence, Provision of food supplement, Provision of nutrition support, Dietary counseling, Problem with eating, Marital status, HH income, Educational status, Religion, Occupation, Family size.
- HIV status,
- Type of TB-PTB, Extra PTB
- History of previous treatment
- Functional status

4.10 Operational definition and definition of terms

- **Undernutrition:** This is a condition in which an adult person's with BMI <18.5 kg/ m² (62).
- **Household:** mean those of you that sleep under the same roof and take meals together at least four days a week (63).
- **Nutritional support:** Nutritional support is having numerous components like nutrition education and counseling in health facilities, water, and hygiene or food safety interventions to avert diarrhea as well as provision of sufficient quantity/quality of food and food aid by any organization (31).
- **Food supplements:** are concentrated sources of nutrients (i.e. mineral and vitamins) or other substances with a nutritional or physiological effect that are marketed in “dose” form (e.g. pills, tablet, capsules, liquids in measured doses) (64).
- **Functional status:** Ability to carry out normal daily activities (31).
- **Working:** Able to carry out normal daily activities and no special care needed (31).
- **Ambulatory:** Unable to work but able to live at home and able to care for most personal needs but requires occasional assistance (31).
- Severe thinness, moderate thinness, and mild thinness is a BMI < 16kg/ m², 16–16.99kg/m² and 17– 18.49kg/ m² (62).

4.11 Data Quality Assurance

To assure the data quality, data collection tool was prepared after intensive review of relevant literatures and similar studies. Properly designed data collection instruments were administered after translation into local language and appropriate training for data collectors and supervisors. Pre-testing of the questionnaire in Hole health center of Abeshge district, Gurage zone was carried out and all the necessary correction was made based on the pretest result to avoid any confusion and for better completion of the questions. The data collectors and supervisor were trained for three days, particularly in the proper filling of questionnaire, and the use of the weight and height scales in order to minimize inter and intra-observer errors. Every day the collected data were reviewed and cross-checked for completeness and relevance before data entry. Checking for double data entry, consistency, missing values and outliers were done by the supervisors and principal investigator and comments and measures were undertaken throughout the data collection period.

4.12 Data Processing and Analysis

To determine undernutrition, the first Body mass index (BMI) among TB patients was computed by dividing weight in kilograms by the square of the height in meters (kg/m^2). Using BMI, undernutrition was defined by $\text{BMI} < 18.5 \text{kg}/\text{m}^2$. Furthermore, undernutrition was stratified: severe ($\text{BMI} < 16 \text{kg}/\text{m}^2$), moderate ($\text{BMI} 16\text{--}16.99 \text{kg}/\text{m}^2$) and mild ($\text{BMI} 17\text{--}18.49 \text{kg}/\text{m}^2$) (65).

Patients' dietary diversity was classified into low if patients' dietary diversity score was ≤ 3 food groups, medium when dietary diversity score was 4–5 food groups, and high when dietary diversity score was ≥ 6 food groups (61).

The data were coded, cleaned, and entered by Epi-data version 3.1 and exported to statistical package for social science (SPSS) version 23.0 for analysis. Inconsistencies and missing values were checked by running frequencies and other data explorations. Descriptive statistics like frequency, proportions, mean, median, and standard deviation were computed. The model fitness was checked by using the Hosmer-Lemeshow goodness of fit test with ($P=0.77$). To run logistic regression analysis chi-square assumption was checked. The multicollinearity assumptions were also checked by using the variance inflation factor (VIF). Bivariate analysis was done primarily to check which independent variables had an association with that of the dependent variable. Independent variables with $p\text{-value} < 0.25$ in the bivariate analysis were entered in to a

multivariable logistic regression analysis in order to detect association with undernutrition. Finally, adjusted odds ratios (AOR) with 95% CI was estimated to assess the strength of associations and statistical significance was declared at a $p\text{-value} < 0.05$ and results were presented using tables, figures, and texts.

4.13 Ethical Considerations

Ethical clearance was obtained from Ethical review committee of Wolkite University, College of medicine and Health Science, department of Public Health. Following the approval, Official letter of co-operation was written to concerned bodies by Wolkite University department of Public Health. Permission was also obtained from Gurge Zone Health Department, respective hospitals and health centers. Clear information was given to inform respondents about the purpose and procedure of the study, the importance of their participation, and the right to withdraw at any time if they want and about privacy and confidentiality of the information given by each respondent kept properly and name was not recorded.

4.14 Dissemination of Results

The final finding of this study would be initially communicated and submitted to Wolkite University College of Medicine and Health Science, department of public health before and after final thesis defense. The finding of the research will be also disseminated to Woreda health office, Gurge zone health department and other concerned bodies at different managerial level. Furthermore, the paper can be presented at workshops, seminars, and on other professional meetings and an effort will be made to publish in peer reviewed journal.

5. RESULTS

5.1 Socio-Demographic and Household Related Characteristics

Out of 262 study participants initially sampled in the study, 257 have participated, making a response rate of 98%. The mean (\pm SD) age of the study participants was 34(\pm 12.8) years with a minimum age of 18 years and maximum age of 78 years. The majority of the respondents were male (141), constituting 54.9%, 178(69.3%) of the family had greater than five family size with the mean and SD of (5 \pm 2), including the respondent. Close to 13(5.1%) of study participants do not have latrine, for the majority 148 (57.6%) pipe water was their main water source, whereas 68(26.5%) use water from protected well water. Animals live in house in 95(37.0%) of study participants. The other socio demographic and household related characteristics were summarized below. (Table 2)

Table 2: Socio-demographic and household related characteristics of TB patients in Government Health institutions of Gurage zone, Ethiopia 2022. (n=257)

Variables	Category	Frequency	Percent
Sex	Male	141	54.9
	Female	116	45.1
Age	18-28 years	33	12.8
	29-38 years	44	17.1
	39-48 years	90	35.0
	>48 years	90	35.0
Marital status	Single	200	77.8
	Married	50	19.5
	Divorced	5	1.9
	Widowed	2	0.8
Family size	≤ 5	79	30.7
	>5	178	69.3
Occupational status	Farmer	135	52.5

	Merchant	45	17.5
	Daily laborer	20	7.8
	Government employer	23	8.9
	House wife	19	7.4
	Student	15	5.8
Residence	Urban	120	46.7
	Rural	137	53.3
Wealth status	Low	111	43.2
	Medium	106	41.2
	High	40	15.6
Ownership of latrine	Yes	244	94.9
	No	13	5.1
Type of latrine	Pit latrine	207	80.5
	VIP latrine	37	14.4
Main source of water	Pipe water	148	57.6
	Protected well	68	26.5
	Unprotected well	6	2.3
	Spring	29	11.3
	River	6	2.3
Animals living in the house	Yes	95	37.0
	No	162	63.0
Hand washing before eating	Always	99	38.5
	Often	94	36.6
	Sometimes	64	24.9
Hand washing after toilet	Always	96	37.4
	Often	98	38.1
	Sometimes	63	24.5

5.2 Behavioral and Dietary Characteristics of the Study Participants

Regarding Behavior and life style information 199(77.7%) of study participants do not do any physical exercise on average per week. 33(13%) and 64(25%) of study participants were cigarette smokers and alcohol drinkers respectively. The majority 155(60.3%) study participants eat three times per day. The other behavioral and dietary information were summarized below. (Table 3)

Table 3; Behavioral and Dietary Related Characteristics of Adult TB Patients in Government Health facilities of Gurage zone Ethiopia 2022. (n=257)

Variables	Category	Frequency	Percent
Origin of food	Own product	93	36.2
	Market purchase	20	7.8
	Own product and market purchase	135	52.5
	Food aid	9	3.5
Frequency of meal per day	One times	9	3.5
	Two times	58	22.6
	Three times	155	60.3
	Four and above four	35	13.6
Frequency of eating fruit per day	No intake	149	58.0
	One times	80	31.1
	Two times	17	6.6
	Three times and above	11	4.3
Frequency of eating Vegetables per day	No intake	125	48.6
	One times	99	38.5
	Two times	21	8.2
	Three times and above	12	4.7
Frequency of eating meat per week	No intake	165	64.2
	One times	62	24.1
	Two times	23	8.9
	Three times and above	7	2.7

Knowledge of balanced diet	Yes	183	71.2
	No	74	28.8
Provision of nutrition support and care	Yes	120	46.7
	No	137	53.3
Food supplement	Yes	99	38.5
	No	158	61.5
Food insecurity	Yes	201	78.2
	No	56	21.8
Dietary diversity	Low	37	14.4
	Medium	79	30.7
	High	141	54.9
Dietary counseling	Yes	146	56.8
	No	111	43.2

5.3 Health Status Related Characteristics

Of the 257 respondents, 123 (47.9%) of study participants had problem with eating, among these 88 (71.5%) had poor appetite and 16 (13.0%) had nausea or vomiting. One hundred thirteen (44.0%) of study participants had other illnesses, among these 73(64.6%) had febrile illnesses and 22 (19.5%) had diarrheal diseases, during the last two months. Regarding the type of TB, 219 (85.2%) had pulmonary TB. Twenty nine (11.3%) had previous history of TB treatment. Thirty five (13.6%) of study participants were HIV positive. The other general health status information's were summarized below. (Table 5)

Table 4; Health Status of Adult TB Patients in Government Health facilities of Gurage zone, Ethiopia 2022. (n=257).

Variables	Category	Frequency	Percent
Problem with eating	Yes	123	47.9
	No	134	52.1
Type of eating problem	Mouth ulcer	14	11.4
	Poor appetite	88	71.5
	Nausea or vomiting	16	13.0
	Difficulty of swallowing	5	4.0
Other illness	Yes	113	44.0
	No	144	56.0
Type of other illnesses	Febrile illness	73	64.6
	Diarrheal disease	22	19.5
	Hypertension	9	7.9
	Diabetes	5	4.4
	Other* (Fever and Back pain)	4	3.5
Type of TB	Pulmonary TB	219	85.2
	Extra pulmonary TB	38	14.8
TB treatment	New case	228	88.7
	Previous history of TB treatment	29	11.3
Duration of anti- TB treatment	≤four weeks	163	63.4
	>four weeks	94	36.6

HIV/AIDS status	Positive	35	13.6
	Negative	222	86.4
Functional status	Working	212	82.5
	Ambulatory	39	15.2
	Bed ridden	6	2.3

5.4 Magnitude of Undernutrition

In this study, the magnitude of undernutrition was found to be 40% (103 patients) (95% CI=34.2-45.9), of this 21.4% had mild, 12.4% had moderate and 6.2% had severe undernutrition. Furthermore, 54.8% had normal weight based on BMI classification. (Figure-3)

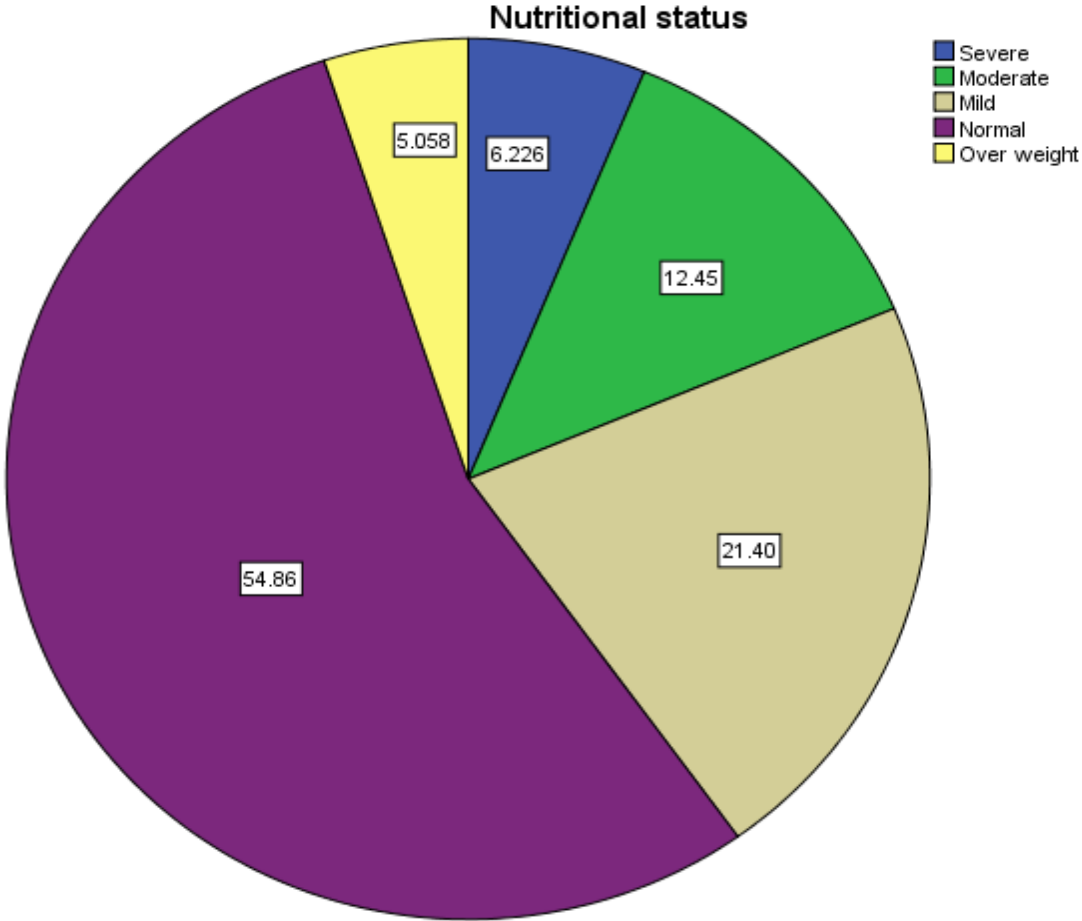


Figure-3: Magnitude of undernutrition among Adult TB patients in Government Health institutions of Gurage zone, 2022.

5.5 Factors Associated with Undernutrition.

In Bivariable logistic regression analyses; socio-demographic and economic characteristics such as family size of the study participant, current place of residence and wealth status. Nutrition and diet information include; provision of nutrition care and support, food supplement, and dietary counselling. Health Status also includes; history of TB treatment and functional status with $p\text{-value} < 0.25$ were a candidate variable for multivariate logistic regression.

In multivariable logistic regression analyses, TB patients with the family size of greater than five were two times more likely to have undernutrition than those with family size equal/less than five (AOR=2.04; 95% CI; 1.05-3.93). TB patients who come from rural kebeles were two times more likely to have undernutrition as compared to those who come from urban kebeles (AOR=2.04; 95% CI; 1.12-3.69).

Concerning those variables grouped under general health, and nutrition and diet related information's, dietary counseling and provision of nutrition support and care were found to be associated with undernutrition in multivariate analysis. TB patients who were not obtain dietary counselling were four times more likely to have undernutrition than those who were obtain dietary counselling (AOR=3.83; 95% CI; 2.02-7.24) and also participants who were not provided nutrition support and care were three times more likely to have undernutrition than those who were provided (AOR=2.93; 95% CI; (1.58-5.43) were significantly associated with undernutrition at $p < 0.05$.

Among those variables grouped in general health and health related information history of previous TB treatment, dietary counseling and functional status of the participant were found to be associated with undernutrition in bivariate analysis. However, when adjusted for confounding factors only dietary counseling was found to be significantly associated with undernutrition. (AOR=3.83, 95% CI; 2.02-7.24). (Table 5)

Table 5; Factors Associated with Undernutrition among Adult TB patients in Government Health institutions of Gurage Ethiopia 2022, (n = 257).

Variable	Category	Undernutrition		COR (95% CI)	P-value
		Yes	No		
Family size	≤5	24	55	1	0.000
	>5	79	99	1.83 (1.04-3.21)*	
Residence	Urban	38	82	1	0.000
	Rural	65	72	1.95 (1.16-3.24)*	
Wealth status	Low	49	62	2.37 (1.05-5.31)*	0.201
	Medium	44	62	2.13 (0.94-4.80)	0.162
	High	10	30	1	
Food supplement	Yes	27	72	1	0.101
	No	76	82	2.47 (1.43-4.24)*	
Nutrition care and support	Yes	28	92	1	0.005
	No	75	62	3.97 (2.31-6.82)*	
Dietary counseling	Yes	40	106	1	0.000
	No	63	48	3.48 (2.06-5.86)*	
Functional status	Working	76	136	1	0.079
	Not working	22	17	2.31 (1.15-4.62)*	
	Bed ridden	5	1	8.95 (1.02-77.99)*	
History of previous TB treatment	Yes	86	142	2.34 (1.06-5.13)*	0.096

	No	17	12	1	
--	----	----	----	---	--

*Significant at P-value<0.25, COR = Crude Odd ratio, CI = Confidence Interval.

Table 6; Factors Significantly Associated with Undernutrition among Adult TB patients in Government Health institutions of Gurage Ethiopia 2022, (n=257).

Variable	Category	Undernutrition		AOR (95% CI)	P-value
		Yes	No		
Family size	≤5	24	55	1	
	>5	79	99	2.04 (1.05-3.93)**	0.034
Residence	Urban	38	82	1	
	Rural	65	72	2.04 (1.12-3.69)**	0.018
Nutrition care and support	Yes	28	92	1	
	No	75	62	2.93 (1.58-5.43)**	0.001
Dietary counseling	Yes	40	106	1	
	No	63	48	3.83 (2.02-7.24)**	0.000

**Significant at P-value<0.05, AOR = Adjusted odd ratio, CI = Confidence Interval.

6. DISCUSSION

This study has attempted to assess the prevalence of undernutrition and its predictors among adult TB patients in Public Health facilities of Gurage Zone, Southern Ethiopia. Accordingly the magnitude of undernutrition was found to be 40%. Moreover, family size of participant, place of residence, dietary counselling and provision of nutrition support care and support were factors significantly associated with undernutrition among adult TB patients.

The magnitude was much lower than studies done in Zambia (57%) (24), Amritsar city, India (69.2%) (36), Timor and Rote Islands, Indonesia (87%) (39), and slightly lower than the study done in Effia-kwanta, Ghana (51%) (29). The difference may be explained by differences in the socio-economic status, study area, life style, feeding pattern and economic status of the countries and sample size of the study; moreover, participants of studies in India had higher rates of co morbidity for example, HIV/AIDS and diabetes mellitus..

From studies in Ethiopia the magnitude of undernutrition in this study was slightly lower than study conducted in Adama town East Ethiopia, (53%) (30); and much lower than studies done in Bale Zone, Southeast Ethiopia (63.2%) (66); the possible reasons could be the sample size matters and the behavioral and life style difference. In addition, over half of the respondents of these studies had TB symptoms for more than four weeks prior diagnosis and (11.6%) had co-morbidities, for example kidney disease, cardiovascular disease and asthma, which might have an effect on their nutrition.

This finding was consistent with the studies done in Ethiopia, Addis Ababa (39.7 %) (31); and Amhara region, Northwest Ethiopia, (42.2%) (43), Gamo Goffa Zone, South Ethiopia (50%) (44); and Hossana Town, Southern Ethiopia (38.9%) (58). This may be due to the similar methods used. Furthermore, these studies were carried out in health centers and hospitals that might deliver similar services to the participants as in our study. Whereas higher than study done in Shashemane Town Southern Ethiopia, (28.8%) (45). Moreover, in some of these studies the BMI of the participants was taken at the time of diagnosis before starting anti-TB medications. When patients have not recovered from their illness and were at the state of critical undernourishment which could overestimate the expected level of undernutrition.

Undernutrition among the study population can have different effects, it leads to poor outcome of the TB treatment, because undernourished TB patients have difficulty of drug metabolism; it affects productivity at personal, family and country level. Aggravation of the disease and death are other consequences of undernutrition like reduction in appetite, nutrient malabsorption, micronutrient malabsorption, and altered metabolism leading to wasting (45).

Undernutrition among TB patient was associated with family size which affects the amount of food intake by the patient. This study revealed that living in an extended and large family size was found to be associated with undernutrition among adult TB patients. This fact was in line with the finding of this study in which TB patient with a large number of family sizes was more likely to develop undernutrition when compared to those who have a small number of household family members Ghana (35), Indonesia (39), Hossana Town, Southern Ethiopia (58); and Northwest Ethiopia (67).

Household place of residence had showed significant association (AOR = 2.04; 95% CI; 1.12-3.69) with undernutrition. Adult TB patients living in rural kebeles were more likely to be undernourished than those living in urban kebeles. This could be due to the cumulative effect of series of less favourable socio-economic conditions which in-turn lead to less access to health care, balanced nutrition, safe water and sanitation in rural compared to urban areas. This finding was not in agreement with study conducted in Amritsar city, India, which showed opposite finding (36); but congruent with study done in Shashemane Town Southern Ethiopia (45).

Provision of nutrition support and care can breaks the vicious cycle of undernutrition and infection through two key mechanisms: Food and nutrition activities support nutritional stabilization and recovery, resulting in increased immune system strength, faster sputum clearance and faster weight gain. Food and nutrition activities also support access and adherence to treatment. This study has revealed as provision of nutrition support significantly associated with undernutrition, Adult TB patients who were not obtained food and nutrition supports and care were nearly three times more likely to be undernourished than those who were obtained. However, study done in Addis Ababa, Ethiopia, revealed no statistically significant difference in risk of undernutrition with provision of nutrition support and care (31). This difference could be explained by differences in the socio-economic status of the two populations; but congruent with study done in Shashemane Town Southern Ethiopia (45).

This study revealed that dietary counselling was strongly associated with undernutrition, Adult TB patients who did not receive dietary counselling were more likely to be undernourished compared with those who received dietary counselling. This fact was in line with study conducted in Addis Ababa (31). This might be because those TB patients who have received dietary counselling became more knowledgeable about the dietary issues and they might appropriately apply the advices to take adequate quantity and quality of variety of foods. Due to this reason those patients who received dietary counselling tends to be well nourished.

6.1 Strength and Limitations of the study

Strength

This study addressed an important public health concern, undernutrition, in a wider geographical area among TB patients where little is known about it before. It uses a pre-tested and modified questioner. The study had high response rate and try to provide proper training for data collectors to minimize biases.

Limitation

The causal inferences can never be drawn out of the findings since the study is a cross-sectional one and the study included samples from facilities; the findings may not be generalizable to those who did not attend the health centers and hospitals. Hygiene related factors needs observation. During interview there may be information, social desirability (to assess food insecurity and behavior and lifestyle factors). The study is not free from recall bias as the measurement of dietary diversity was relied on memory, nevertheless, efforts, such as training of data collectors and supervisors and appropriate probing techniques were used to minimize this bias.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The magnitude of undernutrition among adult TB patients was high with the majority of them having an extended and large family size, rural place of residence, lack of nutrition support and care, and lack of dietary counseling were all positively associated with undernutrition. In this study some associated factors of nutritional status such as age, low wealth status, food supplementation, history of previous TB treatment and functional status were didn't show significant effect on clients' nutritional status.

7.2 Recommendations

Based on the findings of this study the following recommendations are forwarded: - It is recommended that Regional, Zonal and Woreda health offices should incorporate nutrition supplementation and support measures to prevent malnutrition as integral component for TB treatment. Health facilities (health centers, hospitals) should implement regular undernutrition screening program for TB patients based on BMI and health extension worker should work hard on nutritional care and support. Health worker should work hard on nutrition education/counselling at community and health facility level for increasing awareness on risk factors of undernutrition. In addition, regular nutritional screening and management, as well as dietary interventions, should be strengthened as a pillar component of therapeutic interventions. Finally, as this is an institution-based study further community based studies are recommended for researchers to identify risk factors for undernutrition. Further studies should be conducted using other research design.

8. REFERENCE

1. K. M. Undernutrition. *Malawi medical journal: the journal of Medical Association of Malawi*. 2006;Dec; 18(4):189.
2. Papathakis P PE. Nutrition and Tuberculosis. A review of the literature and considerations for TB control programs United States Agency for International Development, Africa's Health 2010 Project. 2008:1.
3. WHO. Guideline: Nutritional Care and Support for Patients with Tuberculosis: World Health Organization. Geneva 2013.
4. WHO. Global tuberculosis report. Geneva: 2012.
5. Teshome MS; Gissa SB TB, et al. Undernutrition and its predictors among people living with HIV/AIDS attending antiretroviral therapy clinic in Jimma University Specialized Hospital. *Int J Nutr Metab*. 2017;9(8):67–74.
6. Raviglione MC; Snider DE KA. Global epidemiology of tuberculosis: morbidity and mortality of a worldwide epidemic. *JAMA*. 1995;273:20 –26.
7. Gupta KB; Gupta R AA, Verma M, Vishvkarma S. Tuberculosis and nutrition. official organ of Indian Chest Society. *Lung India*. 2009;26(1):9-16.
8. Sinclair D; Abba K GL, Sudarsanam TD. Nutritional supplements for people being treated for active Tuberculosis. *reviwe, Cochrane Collaboration*. 2011;2(11).
9. Miyata S; Tanako M ID. the prognostic significance of nutritional status using malnutrition universal screening tool in patients with pulmonary Tuberculosis. Miyata et al *Nutrition Journal* 2013;12(42).
10. Hanrahan CF; Golub JE ML, Tshabangu N, Modisenyane T, Chaisson RE, Gray GE, McIntyre JA, Martinson NA. Body mass index and risk of tuberculosis and death. *AIDS (London, England)*. 2010 Jun 6;24(10):1501.
11. LJ. P. Impact of malnutrition on clinical presentation, clinical course, and mortality in MDR-TB patients. *Epidemiol Infect*. 2011;139(113):20.
12. Krapp F; Veliz JC CE, Gotuzzo E, Seas C. Bodyweight gain to predict treatment outcome in patients with pulmonary tuberculosis in Peru. *Int J Tuberc Lu Dis*. 2008 (12):1153–9.
13. Mupere E; Parraga IM TD, Mayanja HK, Whalen CC. Low nutrient intake among adult women and patients with severe tuberculosis disease in Uganda. *BMC Public Health*. 2012;12(1050).
14. Monique van Lettow; Antony D Harries JJK, ED E Zijlstra, Tamara D Clark, Taha, and Richard D Semba. Micronutrient malnutrition and wasting in adults with pulmonary tuberculosis with and without HIV co-infection in Malawi. *BMC Infectious Disease*. 2004;4(61):1-8.
15. Krishna S; Frieden T R SR, Santha T, Narayanan P R. Additional risk of developing TB for household members with a TB case at home at intake: a 15-year study. *Int J Tuberc Lu Dis*. 2009 (11):282–8.
16. WHO. Global Tuberculosis Report 2019. Geneva, Switzerland: World Health Organization, 2019.

17. WHO. Global Tuberculosis Report 2018. Geneva, Switzerland: World Health Organization, 2018.
18. Chakaya J; Khan M NF, Aklillu E, Fatima R, Mwaba P, et al. Global Tuberculosis Report 2020—Reflections on the Global TB burden, treatment and prevention efforts. *Int J Infect.* 2021 (113):S7–12.
19. WHO. Global Tuberculosis Report. Geneva: 2013.
20. WHO. Global Health Observatory (GHO) Data. Overweight and Obesity, Adults Aged 18+. World Health Organization 2015 updated 16 June 2015.
21. NICUS. Tuberculosis and Malnutrition in South Africa. 2007.
22. FMOH. Participant manual for the Basic Chronic HIV Care, Antiretroviral Therapy and Prevention in Ethiopia: Federal Ministry of Health; 2008.
23. Zachariah R; Spielmann MP HA, Salaniponi FML. Moderate to severe malnutrition in patients with tuberculosis is a risk factor associated with early death. *Trans R Soc Trop Med Hyg.* 2002;96:291-4.
24. Society AT. Diagnostic Standards and Classification of Tuberculosis in Adults and Children. *American Journal of Respiratory Critical Care Med.* 2009;161:1376–95.
25. Kerr L. TB and Acute Malnutrition. 2015.
26. Collins LC; Walker J SB. Smoking multiple high-versus low-nicotine cigarettes: impact on resting energy expenditure. *Metabolism.* 1996;45(8):923–6. .
27. WHO. Management of severe malnutrition: a manual for physicians and other senior health workers: World Health Organization; 1999.
28. E D. Evaluation of nutritional status of new tuberculosis patients at the effia-nkwanta regional hospital. *Ghana Med J* 2008;42(1):22.
29. Indupalli AS; Sirwar SB SK. Nutritional status of tuberculosis cases registered under tuberculosis unit of Gulbarga city, North Karnataka, India. *Int J Bioassays.* 2013;2(3):616–9.
30. FF G. Assessment of nutritional status and associated Factors among adult TB patients on directly observed treatment of short course in health Facilities at Adama town, East shewa zone, Ethiopia. *Scholar Pract J.* 2016;1(1).
31. Dargie B; Tesfaye G WA. Prevalence and associated factors of undernutrition among adult tuberculosis patients in some selected public health facilities of Addis Ababa, Ethiopia: a cross-sectional study. *BMC Nutrition.* 2016;2(1):1–9.
32. WHO. Global tuberculosis control 2011. World Health Organization global tuberculosis control report 2009.
33. FMOH. Health and health related indicators. In: Health EFMo, editor. Addis Ababa 2011.
34. Seyoum B; Demissie M WA, Bekele S, Aseffa A. Prevalence and drug resistance patterns of *Mycobacterium tuberculosis* among new smear positive pulmonary tuberculosis patients in eastern Ethiopia. *Tuberc Res Treat* 2014. 2014:1–7.
35. Lonnroth K; Williams BG CP, Dye C. A consistent log-linear relationships between tuberculosis incidence and body mass index. *Int J Epidemiol.* 2010 39:149–55.

36. Nagpal M; Devgun P CN. A study on nutritional status and change in BMI with treatment outcome in smear-positive pulmonary TB patients on DOTS in Amritsar city. *Int J Med Sci Public Health*. 2015;4:454-7.
37. Anurag B; Madhuri C Yj, Bisswaroop C, Anju k. Nutritional status of Adult patients with Pulmonary Tuberculosis in Rural Central India and Its Association with Mortality. *PLoS ONE*. 2013;8(10).
38. Das S SSSA, Basuthakur S, Saha PK, Biswas C. A study of nutritional assessment of newly diagnosed tuberculosis patients in a tertiary care hospital of Tripura, India. *Int J Res Med Sci*. 2018;6:1382-7.
39. Pakasi TA; Karyadi E DW, Van der Meer JMW, Velden KV. Malnutrition and socio-demographic factors associated with pulmonary Tuberculosis in Timor and Rote Islands, Indonesia. *Int JTuberc Lung Dis*. 2009;13:755-9.
40. Gurung LM; Bhatt LD KIYD. Dietary Practice and Nutritional Status of Tuberculosis Patients in Pokhara: A Cross Sectional Study. *Front Nutr*. 2018;5:63.
41. Beatrice B; Musuenge GGPpP-CC. Nutritional Status of Patients with Tuberculosis and Associated Factors in the Health Centre Region of Burkina Faso. *Nutrients MDPI*. 2020:1-13.
42. Sitienei K; Kipruto H. BP, V. Nyambati, J. C. Kihara Anne-Beatrice and R. J. Predictors of Low Body Mass Index Among Patients with Smear Positive Pulmonary Tuberculosis patients on three high Tb burden provinces in Kenya. *International Journal of TROPICAL DISEASE & Health*. 2014;4(4):427-36.
43. E K. Prevalence and associated factors of undernutrition among adult TB patients attending Amhara National Regional State hospitals , Northwest. *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases*. 2022;26.
44. Zerihun Z; Girmay M. AW, Gobena A. Prevalence of Tuberculosis and Associated Risk Factors in Prisons of Gamo Goffa Zone, South Ethiopia: A Cross-Sectional Study. *American Journal of Health Research*. 2014;2(5):291-7.
45. al ATe. Determinants of Undernutrition among Adult Tuberculosis Patients Receiving Treatment in Public Health Institutions in Shashemane Town, Southern Ethiopia. *Journal of Nutrition and Metabolism Volume*. 2021:8 pages.
46. Gelaw SM. Socioeconomic Factors Associated with Knowledge on Tuberculosis among Adults in Ethiopia. *Hindawi Publishing Corporation*. 2016:11 page.
47. Bishai MSJaWR. Epidemiology and challenges to the elimination of global tuberculosis. *Clinical Infectious Diseases*. 2010;50:156–64.
48. Villamor E; Saathoff E MF, Bosch RJ. Wasting and body composition of adults with pulmonary TB in relation to HIV-1 infection, socioeconomic status, and severity of tuberculosis. *Eur J Clin Nutr*. 2006;60(16):171.
49. al ASe. Nutritional status of tuberculosis cases registerd under tuberculosis unit of Gulbarga city, north karnataka, india. *International Journal of Bioassays*. 2013;02(03):616-9.
50. Semba RD; Hill ID PS. Addressing tuberculosis in the context of malnutrition and HIV co-infection. *Food Nutr Bull*. 2010;31(4):345–64.

51. Kassu A; Yabutani T MZ, Mohammad A, Nguyen N, Hailemariam G, et al. Alterations in serum levels of trace elements in tuberculosis and HIV infections. *Eur J Clin Nutr.* 2006;60(5):580–6.
52. al HAe. Prevalence and associated factors of malnutrition among adult hospitalized patients at Amhara National Regional State Referral Hospitals, Ethiopia. *Integr Obesity Diabetes.* 2015.
53. Shah S; Whalen C KD, et al. Severity of human immunodeficiency virus infection is associated with decreased phase angle, fat mass and body cell mass in adults with pulmonary tuberculosis infection in Uganda. *J Nutr.* 2001;131:2843–7.
54. Ramakrishnan CV; Rajendran K JP, Fox W, Radhakrishna S. The role of diet in the treatment of pulmonary tuberculosis. An evaluation in a controlled chemotherapy study in home and sanatorium patients in south India. *Bull World Health Organ.* 1961;25:339–59.
55. Abba K; Sudarsanam TD GL, Volmink J. Nutritional supplements for people being treated for active tuberculosis. *Cochrane Database Syst Rev.* 2008 (4).
56. JP C. The relationship between malnutrition and tuberculosis: evidence from studies in humans and experimental animals. *Int J Tuberc Lung Dis.* 2004;8:286–98.
57. Unicef. Conceptual framework of the causes of malnutrition. New York: UNICEF; 1998.
58. Woldeyohannes D ea. Undernutrition and Associated Factors among Adult Tuberculosis Patients in Hossana Town Public Health Facilities, Southern Ethiopia. *Journal of Tropical Diseases.* 2018;6(1):1-7.
59. al Me. Undernutrition and Associated Factors Among Adult Tuberculosis Patients in Jigjiga Public Health Facilities, Somali Region, East, Ethiopia. *Research and Reports in Tropical Medicine.* 2021;12 123–33.
60. Piva SGN; Costa MDCN BF, Pereira SM. Prevalence of nutritional deficiency in patients with pulmonary tuberculosis. *Jornal Brasileiro de Pneumologia.* 2013;39(4):476–83.
61. P SAB. Household dietary diversity score (HDDS) for measurement of household food access: indicator guide. Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development; 2006.
62. L CKO. Guide to anthropometry. A Practical Tool for Program Planners, Managers, and Implementers.: USAID and FHI360; 2018.
63. BAIMG C. Anthropometric Indicators Measurement Guide. Washington, DC: FHI 360/FANTA; 2003.
64. EFSA. Food additives and nutrient sources added to food (ANS) adopted guidance on evaluation of nutrients and bioavailability of of nutrient from the sdources European Food Safety Authority; 2018.
65. USAID. Nutrition Assessment and Classification. Wshington,DC: USAID; 2016.
66. Hussien B; Hussien MM SA, et al. . . 12 (1):751. doi:. Nutritional deficiency and associated factors among new pulmonary tuberculosis patients of Bale Zone Hospitals, southeast Ethiopia. *BMC Res Notes.* 2019;12(1):751.

67. Wassei MM; Worku AG SJ. Weight gain and associated factors among adult Tuberculosis patients on treatment in Northwest Ethiopia. *J Nutr Disorders Ther.* 2014;2:143-62.

9. INFORMATION SHEET

9.1. Institution Information Sheet and Informed Consent Form

My name is Yibeltal Bereket (BSc) and I am attending my MPH study in public health nutrition in Wolkite University. I am here to conduct a study in your health facility, for partial fulfillment of Master in public health nutrition. Therefore, I kindly request you to give me your time to explain about the study importance, ethical issues and how the study will be conducted. First, I would like to thank you for your time and help.

Title of the study: To assess the prevalence and factors associated with undernutrition among adult TB patients in Gurage zone southern, Ethiopia, 2022.

Purpose of the study: The finding of this study can be important for the zone health department, district health office and for local NGOs working on nutrition to plan and address undernutrition among adult TB patient. Beside this, the aim of this study is to write a thesis as a partial requirement for the fulfillment of a Master's Program in public health nutrition for principal investigator.

Procedure and duration: I will be interviewing the adult TB patients by using questionnaire to provide me pertinent data that is helpful for the study. Height and weight of selected patients will be measured at TB clinic. The interview on each patient will take 35 minutes.

Risk and benefit: The risk of participating in this study is minimal. The study participants will be informed that participating in this study will not have risks associated with the research except for few minutes of their time. There would not be any direct payment for participating in this study. However, the findings from this research may reveal important information for the local health planners to improve nutritional status of adult TB patients.

Confidentiality: The information collected will be confidential. There will be no information that will identify the individual person in particular. The findings of the study will be general for the study area and will not reflect anything particular of individual persons. No reference will be made in oral or written reports that could link participants to the study.

Rights: Permitting data collection for this study is fully voluntary. Considering the importance of the research, you are free to decide. If any violation of ethical rules and conduct is seen throughout study, your health facility has full right to withdraw and stop study.

Contact address: If there are any questions or enquires any time about the study or the procedures, you can contact by using the following addresses.

Principal investigator: Yibeltal Bereket

Phone number: 0965824167

Email: yibebereka1992@gmail.com

Wolkite University College of Medicine and Health Science Institutional Research Ethical review Committee: Office phone: 0115432311

P.O.Box: 07, Wolkite, Ethiopia

Declaration of informed voluntary consent: I have read the institution information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I was informed that the participant has the right to withdraw from the study at any time and not to answer any question that they do not want. I was also informed that the health facility has the right to stop the study from being conducted if any misdeeds and unethical procedures are observed during data collection process. Therefore, I declare my voluntary consent on behalf of the health facility to allow this study to be conducted in the health facility with my own name and signature below.

Name of the health facility head: ----- signature-----Date: -----/-----/2022

Name of principal Investigator: Yibeltal Bereket Date: -----/-----/2022

Thank you for your cooperation!

9.2. Participant Information Sheet and Informed Voluntary Consent Form

9.2.1. English Version Participant Information Sheet and Informed Voluntary Consent Form for adult TB patient attending health facility TB clinic.

My name is ----- I am working as a data collector for the study being conducted in this health facility by Yibeltal Bereket who is studying his Master's degree at Wolkite University College of Medicine and Health Sciences. I kindly request you to lend me your attention to explain you about the study and being selected as the study participant.

Title of the study: To assess the prevalence and factors associated with undernutrition among adult TB patients in Gurage zone southern, Ethiopia, 2022.

Purpose of the study: The finding of this study can be important for the zone health department, district health office and for local NGOs working on nutrition to plan and address undernutrition among adult TB patient. Beside this, the aim of this study is to write a thesis as a partial requirement for the fulfillment of a Master's Program in public health nutrition for principal investigator.

Procedure and duration: I will be interviewing the adult TB patients by using questionnaire to provide me pertinent data that is helpful for the study. Height and weight of selected patients will be measured at TB clinic. The interview on each patient will take 35 minutes.

Risk and benefit: The risk of participating in this study is minimal. The study participants will be informed that participating in this study will not have risks associated with the research except for few minutes of their time. There would not be any direct payment for participating in this study. However, the findings from this research may reveal important information for the local health planners to improve nutritional status of adult TB patients.

Confidentiality: The information collected will be confidential. There will be no information that will identify the individual person in particular. The findings of the study will be general for the study area and will not reflect anything particular of individual persons. No reference will be made in oral or written reports that could link participants to the study.

Rights: Permitting data collection for this study is fully voluntary. Considering the importance of the research, you are free to decide. If any violation of ethical rules and conduct is seen throughout study, your health facility has full right to withdraw and stop study.

Contact address: If there are any questions or enquires any time about the study or the procedures, you can contact by using the following addresses.

Principal investigator: Yibeltal Bereket

Phone number: 0965824167

Email: yibebereka1992@gmail.com

Wolkite University College of Medicine and Health Science Institutional Research Ethical review Committee: Office phone: 0115432311

P.O.Box: 07, Wolkite, Ethiopia

Declaration of informed voluntary consent: I have read/ was read to me the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights of participating and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I was informed that I have the right to withdraw from the study at any time or not to answer any question that I do not want. Therefore, I declare my voluntary consent to participate in this study with my signature as indicated below.

Name and signature of participant: ----- signature-----Date: ----/--/2022

Name and signature of data collector: ----- signature-----Date: ----/--/2022

10. ANNEXES

10.1 Annex1: Participant information sheet and informed consent form

Good morning/afternoon dear participant! My name is _____. I am working as a data collector for the study being conducted in this hospital/health center on assessing the prevalence and factors associated with undernutrition among adult TB patients in Gurage zone by Yibeltal Bereket, who is studying for his master's degree at Wolkite University, college of Medicine and Health sciences. I kindly request you to lend me your attention to explain about the study and being you selected as the study participant.

The purpose of the study is to assess the prevalence and factors associated with undernutrition among adult TB patients in Gurage zone. Findings from the study can be used by the woreda/zone administration health office to design and develop locally appropriate plan to tackle problems related with recommended adult TB patients. This may take 30-40 minutes. All the information that you are going to provide me will remain confidential and you don't need to mention your name. For this reason, I kindly request you to give me your sincere and truthful answer.

All of your participation is completely on voluntary bases and you have the right to refuse from participation. Participation or non-participation and refusal to answer questions will have no effect on your life. If you have further questions or would like to know the results of this study, please feel free to contact the principal investigator; with the following address.

Principal investigator: Yibeltal Bereket (BSc)

Mobile phone: +251-965-82-41-67

E-mail: yibebereka1992@gmail.com

10.2. Consent Form English Version

I have read all the process and the objective of the study and I have understood the same as written that includes informed about the purpose, advantage, and disadvantage of this study titled, to assess the prevalence and factors associated with undernutrition among adult TB patients in Gurage zone. I also understood that the research imposes no risk and no compensation would be provided to me. I have been told that if I feel discomfort to respond to any of the question, I feel free to drop it any time I wish to do so. I have understood the information given and the participation is completely voluntary based.

I have been told that my answers to the questions will not be given to anyone and not expect to write my name. Now I am giving my consent to participate in the study voluntarily.

Could I have your permission to continue?

1. Yes _____ 2. No _____, Stop and thank the respondent.

Data collector: Name _____ Signature _____ Date _____

10.3 Questionnaires

10.3.1 English version of the questionnaire

I. Demographic and socioeconomic profile

100	How old are you? / When were you born?	_____ in years
101	Record sex of the patient	1.Male 2.Female
102	What is your current Marital status	1.married 2.Single 3.Widowed 4.Separated
103	What is your Family size?	
104	What is your Religion?	1.Orthodox Christian 2. Muslim 3. Protestant 4. Catholic 5. Traditional
105	Residence	1.Urban 2. Rural
106	What is your current Occupation ?	1.Farmer 2.Merchant 3.Daily laborer 4.Government employee 5.House wife 6.Student 7. Other, specify
107	Ethnicity	1.Guraghe 2.Amhara 3. Oromo

		4. Silti 5. Other specify
108	What is your current Educational status	1.No formal education 2.can Read and write 3.Primary school 4.Secondary school 5.Above secondary school
109	What is your average household income per month?	-----Ethiopian Birr

110	How many cattle's do you own?, for only farmers	1.None 2.One 3.Two 4.Three 5.Four and above four
111	Are you available at work place regularly? Do you often attend classes regularly? /for student	1.Yes 2.No
112	How do you rate your performance on your job/school?	1.Excellent 2.Very good 3.Good 4.Fair 5.Poor

II. Nutrition and diet information

200	What is the origin of the food currently being eaten?	1.Own product 2.Market purchase 3. Own product and market purchase 4. Food aid
-----	---	---

		5. Gift 6.loan
201	How many meals per day are you getting?	1.One times 2.Two times 3.Three times 4.Four and above four
202	How many times per day did you usually eat Vegetables?	1.No intake 2.One times 3.Two times 4.Three times and above
203	How many times per day did you usually eat fruit Such as orange ,banana?	1.No intake 2.One times 3.Two times and above
204	How many times per week you eat meat?	1.No intake 2.One times 3.Two times 4.Three times and above
205	During the past 30 days, how often did you go hungry because there was no enough food in your home?	1.Not at all 2.One times 3.Two times 4.Three times 5.Four times 6.Greater than four times
206	What do you do when your family faces shortage of food?	1.look for a loan 2. sell commodities 3. beg 4. migrate

207	Do you know the importance of balanced diet?	1. Yes 2. No
208	Did you ever receive any food supplement?	1. Yes 2. No

III. FOOD SECURITY QUESTIONARIE

S.No	Question	Response options
300	In the past four weeks, did you worry that your HH would not have enough food?	0 = No (skip to Q2.2) 1=Yes
300a	How often did this happen?	1 = Rarely (once or twice in the last 4 weeks) 2=Sometimes(3-10 times) 3=Often (more than ten times)
301	In the past four weeks, were you or any HH member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q2.3) 1=Yes
301a	How often did this happen?	1= Rarely (once or twice) 2=Sometimes (3-10 times) 3=Often (more than ten times)
302	In the past four weeks, did you or any HH member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q2.4) 1 = Yes
302a	How often did this happen?	1 = Rarely (once or twice) 2 = Sometimes (3-10 times) 3 = Often (more than ten times)
303	In the past four weeks, did you or any HH member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	0 = No (skip to Q2.5) 1 = Yes

303a	How often did this happen?	1 = Rarely (once or twice) 2=Sometimes (3-10 times) 3=Often (more than ten times)
304	In the past four weeks, did you or any HH member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q2.6) 1 = Yes
304a	How often did this happen?	1 = Rarely (once or twice) 2 = Sometimes (3-10 times) 3=Often (more than ten times)
305	In the past four weeks, did you or any other HH member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q2.7) 1 = Yes
305a	How often did this happen?	1 = Rarely (once or twice) 2 = Sometimes (3-10 times) 3=Often (more than ten times)
306	In the past four weeks, was there ever no food to eat of any kind in your HH because of lack of resources to get food?	0 = No (skip to Q2.8) 1 = Yes
306a	How often did this happen?	1 = Rarely (once or twice) 2 = Sometimes (3-10 times) 3=Often (more than ten times)
307	In the past four weeks, did you or any HH member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q2.9) 1 = Yes
307a	How often did this happen?	1 = Rarely (once or twice) 2 = Sometimes (3-10 times) 3=Often (more than ten times)

308	In the past four weeks, did you or any HH member go a whole day and night without eating anything because there was not enough food?	0 = No 1 = Yes
308a	How often did this happen?	1 = Rarely (once or twice) 2 = Sometimes (3-10 times) 3=Often (more than ten times)

Household Dietary Diversity Score

	Food group	Items	Consumed Yes =1 No=0
401	Grains, white roots and tubers, and plantains	Barley, corn, millet, maca, oats, sorghum, teff, wheat, potatoes, sweet potato, rice, and food made from this such as Porridge, bread, pasta/noodles or other foods made from grains White yams, manioc/cassava/yucca, cocoyam, taro or any other foods made from white-fleshed roots or tubers, or plantains	
402	Pulses (beans, peas and lentils)	Mature beans or peas (fresh or dried seed), lentils, soybean, or bean/pea products, including hummus, tofu and tempeh	
403	Nuts and seeds	Any tree nut, groundnut/peanut or certain seeds, or nut/seed “butters” or pastes Flaxseed, pumpkin, sesame seed, sunflower seed.	
404	Dairy	Milk, cheese, yoghurt or other milk products	
405	Meat, poultry and fish	Liver, kidney, heart or other organ meats or blood- based foods, including from wild game Cow, ox, sheep, goat, beef, pork, lamb, wild game meat, chicken, duck or other bird Fresh or dried fish, shellfish or seafood	
406	Egg	Raw eggs and foods prepared from eggs	
407	Dark green leafy vegetables	Spinach, kale, romaine and bibb lettuce	
408	Other vitamin A- rich fruits and vegetables	Carrots, pumpkin, red sweet pepper, mangoes, papaya, and deep yellow- or	

		orange-fleshed squash and fruit juice made from this group.	
409	Other vegetables	other vegetables (e.g. green pepper, mushroom, cucumber, okra, tomato, onion) , fresh/green pod of bean, pea, corn, etc. and including wild vegetables	
410	Any sugar or honey	Sugar, Honey, Sugar cane, Marmalade...	
411	Any cheese, yogurt, milk or other milk products	Cheese, yogurt, milk or other milk products	
412	Any other foods	such as condiments, coffee, tea, juice....	

IV. Behavior and life style

501	During the past 7 days, how many days did you do physical exercise/ hard work for a total of at least 30 minutes per day?	1.None 2.One day 3.Two days 4.Three days 5. Above three
502	Do you smoke cigarette?	1.Yes 2.No
503	Do you drink alcoholic drink?	1.Yes 2.No
504	During the past 30 days on how many days did you have at least one drinking containing alcohol	1.One 2.Two 3.Three and above

V. Household related characteristics

601	Do you have latrine?	1.Yes2.No
602	If yes which type of latrine?	1.Pit latrine 2.vip latrine
603	What is your main source of water	1.pipe water

		2. Protected well 3.Unprotected well 4.Spring 5.River 6.others
604	How long does it take to collect water?	1.Less than 5 minutes 2.5-10 minutes 3.15-30minutes 4.30minutes-1hours 5.Greater than 1hours
605	Do Animals live in the house?	1.yes 2.no
606	Housing condition Number of rooms..... Number of windows..... Types of floor.....	1.one 2.two 3.three 4.four 5. four and above 1. Zero 2.one 3.two 4. three 5.four and above Muddy ,other specify
607	How often did you wash your hands before eating?	1. Always 2.Often 3. Sometimes 4. Never
608	How often did you wash your hands after using the toilet or latrine?	1. Always 2.Often 3. Sometimes 4. Never
609	How often did you use soap when washing your hands?	1. Always

		2.Often 3. Sometimes 4. Never
--	--	-------------------------------------

VI. Health Status Related Questions

701	Family history of TB	1.yes 2.No
702	Do you get nutrition care and support during treatment?	1.Yes 2.No
703	Do you get dietary counseling?	1.yes 2.no
704	Do you have problem with eating?	1.yes 2.no
705	If yes, state the type of eating problem?	1. Mouth ulcer 2. poor appetite 3. Nausea or vomiting 4. difficulty of swallowing
706	Do you have any other attack of illness for the last 2 weeks/month	1.yes 2.no
707	If yes ,state the type of illness/ symptom	1. Febrile illness 2, Diarrheal disease 3. HTN 4. DM 5.Cancer 6. other ,specify
708	Functional status,	1. working 2. Ambulatory

		3. Bed ridden
--	--	---------------

VII: Record from health institution

801	Type of TB	1.Plumonery TB 2.Extra pulmonary TB
802	TB treatment	1.New case 2.Previous history of TB treatment
803	HIV/AIDS status	1. Positive. 2.negative
804	Duration of Anti-Tb treatment	1. <= 4 weeks 2. > 4 weeks
805	Smear result	1. smear positive 2. smear negative

VIII. Anthropometric Measurement

S.No	Measurements	Results	Code
Q901	Height in centimeter (cm)	
Q902	Weight in kilogram (Kg)	

Thank you very much.

10.3.2 Amharic Version Questionnaire

ክፍል አንድ: የተጠያቂው የማህበራዊና የኢኮኖሚያዊ መረጃ በተመለከተ መጠይቅ

⌚ ትክክለኛውን መልስ መርጠው ያክብቡ

ተራ. ቁ	መ□□ቅ	መልስ
101	ዕድሜ በሙስ አመት /መቶ ነው የተወለድከው /ሸው?	
102	ፆታ	1. ወንድ 2. ሴት
103	የጋብቻ ሁኔታ?	1. ያገባ 2. ያላገባ 3. ሚሥት/ባል/አግብተው የሞቱባቸው 4. የፈታ
104	እርስዎን ጨምሮ በቤተሰቡ ውስጥ ስንት አባል ይኖራል?	
105	ሀይማኖት?	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ካቶሊክ 5. ባህላዊ
106	መኖሪያ አካባቢ	1. ከተማ 2. ገጠር
107	ሥራ /የሙያው ዓይነት/	1. ገበሬ 2. ነጋዴ 3. የቀን ሠራተኛ 4. ሲቪል ሠራተኛ 5. የቤት ዕመቤት 6. ተማሪ 7. ሌላ ካለ ይጠቀስ
108	ብሔር	1. ጉራጌ 2. አማራ 3. አድሞ 4. ስልጤ 5. ሌላ ካለ ይጠቀስ

109	የትምህርት ደረጃ	1. መደበኛ ት/ት ያልተማሩ 2. ማንበብና መጻፍ 2. ከ1-8ኛ ክፍል 3. 9-12ኛ ክፍል 4. 12 ና ከዚያ በላይ
110	አማካኝ ወርሃዊ ገቢ ?	

ተ.ቁ	መጠይቅ	መልስ
111	ምን ያህል ከብቶች አለህ/አሉሽ?/ ለገበሬዎች	
112	በስራ ቦታ በቋሚነት በስራ ሰዓት ትገኛለህ? ለተማሪ ትምህርት ቤት በየዕለቱ ትገኛለህ?	1. አዎ
		2. አልፎ አልፎ ቀራለሁ
		3. ብዙ ጊዜ ቀራለሁ
113	የሥራ አፈፃፀምህን እንዴት ታየዋለህ?	1. እጅግ በጣም ጥሩ
		2. በጣም ጥሩ
		3. ጥሩ
		4. ምንም አይልም
		5. ዝቅተኛ
ከሥነ ምግብ ጋር የተያያዙ ጥያቄዎች		
201	ለምግብ የሚውል ሰብል ከየት ነው ምንጭ ?	1. የጓሮ ምርት (የራስ ማሳ)
		2. ከገበያ ተገዝቶ
		3. ከራስ ምርትና ከገበያ ተገዝቶ
		4. የምግብ እርዳታ
		5. ስጦታ
		6. ብድር
202	በቀን ስንት ጊዜ ትመገባለህ/ሽ?	1. አንድ ጊዜ
		2. ሁለት
		3. ሶስት
		4. አራትና ከዛም በላይ
203	በቀን ምን ያህል ጊዜ አታክልት ተመገብክ ?	1. አልመገብም
		2. አንዴ
		3. ሁለት
		4. ሶስት ወይም ከዛ በላይ
204	ፍራፍሬ በቀን ምን ያህል ጊዜ ትመገባለህ?	1. አልመገብም
		2. አንድ ጊዜ
		3. ሁለት ወይም ከዛ በላይ
205	በሳምንት ምን ያህል ጊዜ ስጋ ትበላለህ?	1. አልበላም

		2. አንድ ግዜ
		3. ሁለት
		4. ሶስትና ከዛ በላይ
206	ባለፈው ወር ምን ያህል ግዜ ሳትመገብ ዋል? በምግብ እጦት?	1. ምንም ቀን ሳልበላ አልቀረውም
		2. አንዴ
		3. ሁለት
		4. ሶስት
		5. አራት
		6. ከአራት በላይ
207	ቤተሰብ የምግብ እጥረት ሲገጥመው ምን ያረጋሉ?	1. እርዳታ ጠይቃለሁ
		2. ንብረት ሸጣለው
		3. ለምናለው
		4. እሰደዳለው
208	የተመጣጠነ ምግብ ጠቀሜታውን ያውቃሉ?	1. አዎ
		2. አላቅም
209	ተጨማሪ ምግብ ለምሳሌ አይረንና ፎሊክ አሲድ ተሰቶህ/ሽ ያውቃል?	1. አዎ
		2. አያቅም

የቤተሰብ ምግብዋስትና ሁኔታለመዳሰስ የተዘጋጀ መጠይቅ

ተ.ቁ	ጥያቄ	አማራጭ መልስ
301	ባለፈው አንድ ወር ውስጥ በቤትዎ ውስጥ የምግብ እጥረት እንዳያጋጥሞት ተጨንቀው ያውቃሉ	0 አላውቅም(አላውቅም ካሉ ወደ ጥያቄ 2.2 ይዘለሉ) 1 አዎ
301U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከስቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ)
302	ባለፈው አንድ ወር ውስጥ እርሶ ወይም ሌላ የቤተሰብ አባል በምግብ እጥረት ምክንያት የሚፈልጉትን ምግብ ሳይመገቡ ቀርተው ያውቃሉ	0 አላውቅም(አላውቅም ካሉ ወደ ጥያቄ 2.3 ይዘለሉ) 1 አዎ
302U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ)
303	ባለፈው አንድ ወር ውስጥ እርሶ ወይም ሌላ የቤተሰብ አባል በምግብ አቅርቦት ምክንያት የሚመገቧቸው የምግብ አይነቶችን ቀንሰዋል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ) 3.3 ባለፈው አንድ ወር ውስጥ እርሶ ወይም ሌላ የቤተሰብ አባል በምግብ አቅርቦት ምክንያት የሚመገቧቸው የምግብ አይነቶችን ቀንሰዋል 0

		አላውቅም(አላውቅም ካሉ ወደ ጥያቄ 2.4 ይዘለሉ) 1 አዎ
303U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከስቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ)
304	ባለፈው አንድ ወር ውስጥ እርሶ ወይም ሌላ የቤተሰብ አባል በምግብ አቅርቦት ምክንያት የማይፈልጉትን የምግብ አይነት ተመግቦው ያ	0 አላውቅም(አላውቅም ካሉ ወደ 2.5 ጥያቄ ይዘለሉ) 1 አዎ
304U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከስቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ 3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ)
305	ባለፈው አንድ ወር ውስጥ እርሶ ወይም ሌላ የቤተሰብ አባል በምግብ እጥረት ምክንያት የሚመገቡትን የምግብ መጠን ቀንሰዋል	0 አላውቅም(አላውቅም ካሉ ወደ 2.6 ጥያቄ ይዘለሉ) 1 አዎ
305U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ)
306	ባለፈው አንድ ወር ውስጥ እርሶ ወይም ሌላ የቤተሰብ አባል በምግብ እጥረት ምክንያት በቀን ምግብ የሚመገቧቸውን ጊዜዎች ቀንሰዋል	0 አላውቅም(አላውቅም ካሉ ወደ 2.7 ጥያቄ ይዘለሉ) 1 አዎ
306U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከስቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ)
307	ባለፈው አንድ ወር ውስጥ በምግብ እጥረት ምክንያት ማንኛውም የሚበላ ምግብ ከቤት ጠፍቶ ያውቃል	0 አላውቅም(አላውቅም ካሉ ወደ 2.8 ጥያቄ ይዘለሉ) 1 አዎ
307U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከስቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ)
308	ባለፈው አንድ ወር ውስጥ እርሶ ወይም ሌላ የቤተሰብ አባል በምግብ እጥረት ምክንያት እየተራቡ ምግብ ሳይበሉ ተኝተው ያውቃሉ	0 አላውቅም(አላውቅም ካሉ ወደ 2.9 ጥያቄ ይዘለሉ) 1 አዎ
308U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከስቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2 የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ (ከ10 ጊዜ በላይ)
309	ባለፈው አንድ ወር ውስጥ ማንኛውም የቤተሰብ አባል በምግብ እጥረት ምክንያት እየተራቡ ቀንና ሌሊት ሙሉ ሳይበሉ ቀርተው ያውቃሉ	0 አላውቅም 1 አዎ
309U	መልስዎ አዎ ከሆነ ይህ ለምን ያህል ጊዜ ተከስቷል	1 አልፎ- አልፎ(አንዴ ወይም ሁለት) 2

			የተወሰነ ጊዜ (ከ3 እስከ 10 ጊዜ) 3. ብዙ ጊዜ(ከ10 ጊዜ በላይ)
የቤተሰብ መዕዳዊ ንጥረ ምግብ የተመለከቱ ጥያቄዎች			
ተ.ቁ	የምግብ ምድብ	ዝርዝሮች	ከተመገቡ አዎ/አይደለም
401	እህል እና የእህል ዘሮች	ጤፍ፣ ስንዴ፣ ገብስ፣ ማሽላ፣ በቆሎ፣ ሩዝ፣ ማስላ፣ ዳጉሳ፣ ድነች፣ እና ከእነዚህ የሚሰሩ ምግቦች በሙሉ(ገንፎ፣ ዳቦ፣ ፓስታ፣ መኮረኒ፣ እንጀራ፣ ቂጣ፣ ንፍሮ እና ወዘተ ምግቦች	
402	ጥራጥሬ	የበሰላ ባቄላ፣ አተር፣ ምስር፣ እና ከእነዚህ የሚሰሩ ምግቦች በሙሉ(ንፍሮ ፣ ቆሎ ፣ ክክ ወጥ እና የመሳሰሉት)	
403	ለዉዝና የቅባት አህሎ	ኑግ፣ ተልባ፣ ሰሊጥ፣ ሱፍ፣ ዱባ፣ ኦቶ ሎኒ	
404	ወተትና የወተት ተዋጽዎች	ወተት፣ አይብ፣ ዕርጎ፣ አሬራ፣ አጉዋት፣ ወይም ልላ የወተት ተዋጽ	
405	ስጋ አሳ እና የሚበሉ አእዋፋት	የሰዉነት ክፍሎች (ጉበት፣ ኩላሊት፣ ልብ፣ ደም ወይም ልላ አካል) የበሬ ፣ የአሳማ ፣ የበግ ፣ የፍየል ፣ የግማል ፣ የዶሮ፣ የቆቅ ፣ የጅግራ ስጋ እና ከእነዚህ የሚሰሩ ማናቸውም ምግቦች በሙሉ(ወጥ፣ ጥብስ፣ ቅቅል፣ ወዘተ ምግቦች ትኩስ (ፍረሽ) አሳ ወይም የደረቀ ወይም የባህር አሳ	
406	እንቁላል	የዶሮ ፣ የቆቅ እና የጅግራ እንቁላል(የተቀቀለ፣ ፍርፍር፣ ወይም እንቁላል ከልሎች ምግቦች ጋር የተሰራ	
407	የዶሮ ፣ የቆቅ እና የጅግራ እንቁላል(የተቀቀለ፣ ፍርፍር፣ ወይም እንቁላል ከልሎች ምግቦች ጋር የተሰራ	ጎመን፣ ሰላጣ፣ ቆስታ፣ ሳማ፣ ጥቅል ጎመን	
408	በሻይታሚን ኤ የበለጸጉ ፍራፍሬ	የበሰላ ማንጎ	

	እና የጓጉሮ አትክልቶች	፣ፓፓያ፣ካሮት፣ቀይሰር፣ዱባ እና ግሽጣ	
409	ልሎች አትክልቶች	ቲማቲም፣ሽንኩርት፣ ቃሪያ፣ የበቆሎ ፣የአተር ፣የምስር እና የባቄላ እሽት፣ ወዘተ እሽቶች	
410	ልሎች ስኳር ወይም የማር-ነክ ምግቦች	ስኳር፣ማር፣ሽንኩራ አገዳ፣ማርማላታ....	
411	ልሎች የእንሰሳት ተዋፅኦ ምግቦች	ቂቤ፣ኤይብ፣እርጎ፣አጓት፣ወተት እና የወተት ውጤቶች	
412	ልሎች መጠጦች እና ቅመሞች	ሻይ፣ቡና፣የጁስ/ጭማቂ መጠጦች	
ባህሪ/ፀባይን የተመለከቱ ጥያቄዎች			
501	ባለፉት 7 ቀናት ምን ያህል ቀን ቢያንስ የ30 ደቂቃ የአካል ብቃት እንቅስቃሴ አረክ?	1. ምንም ቀን	
		2. አንድ ቀን	
		3. ሁለት ቀን	
		4. ሶስት ቀን	
		5. ከ3 ቀን በላይ	
502	ሲጋራ ታጫሳለህ?	1. አዎ	
		2. አላጫስም	
503	የአልኮል መጠጥ ትጠጣለህ?	1. አዎ	
		2. አልጠጣም	
504	ባለፉት 30 ቀናት ምን ያህል ቀን ቢያንስ 1 ብርጫቆ የአልኮል መጠጥ ጠጣህ?		
የግል ጤና አጠባበቅ			
602	የመፀዳጃ ቤት አላቸ?	1. አዎ	
		2. የለንም	
603	ካላቸ ከየትኛው አይነት የመፀዳጃ ቤት ነው ?	1. ባህላዊ መፀዳጃ ቤት 2. ሽታ አልባ መፀዳጃ ቤት	
604	ዋና የውሃ ምንጭ ከየት ታገኛለህ?	1. የቡዋንቡዋ ዉሃ 2. የተገደበ ኩሬ 3. ያልተገደበ ኩሬ 4. የምንጭ ዉሃ 5. ወንዝ 6. ሌላ ከሆነ ይግለፅ 6. ሌላ ከሆነ ይጥቀሱ	
605	ውሃ ለመቅዳት ምን ያህል ግዜ ይወስድብሁል/ሻል ?	1. ከ 5 ደቂቃ ያነሰ 2.5-10 ደቂቃ	

		3. 15-30 ደቂቃ 4. 30ደቂቃ-1 ሰዐት 5. ከ1 ሰዐት በላይ	
606	እንስሳት በመኖሪያ ቤት ይኖራሉን	1. አዎ 2. አይኖሩም	
607	የቤቱ ሁኔታ		
608	የቤቱ ክፍሎች	1 2 3 4 5	
609	የመስኮች ቁጥር	0 1 2 3 4	
610	የወለሉ አይነት	የጭቃ፣ የሲሚንቶ ሌላ ከሆነ ይጥቀሱ	
611	ከምግብ በፊት እጅዎን ሁሌም ይታጠባሉን?	1. አዎ 2. አልፎ አልፎ 3. አልታጠብም	
612	ከመጣጣም ቤት መልስ ምን ያህል ጊዜ እጅዎን ይታጠባሉ?	1. ሁሌ 2. አልፎ አልፎ 3. አልታጠብም	
613	ስትታጠብ/ቢ ምን ያህል ጊዜ ሳሙና ትጠቀማሉ/ሽ?	1. ሁል ጊዜ 2. አብዛኛውን ጊዜ 3 አልፎ አልፎ 4 አልጠቀምም	
ጠቅላላ የጤና ሁኔታ			
701	በቤተሰብህ/ሽ ሌላ የሳንባ ነቀርሳ ታማሚ አለ	አዎ የለም	
702	በህክምናው ወቅት የተጨማሪ ምግብ እርዳታ ተደርጎልሁል	1. አዎ 2. አልተደረገም	
703	የአመጋገብ ምክር /ትምህርት ተሰቶሁል/ሽ	1. አዎ 2. አልተሰጠኝም	
704	በአመጋገብ የገጠመህ/ሽ ችግር አለ	1. አዎ 2. የለም	
705	ከሳንባ ነቀርሳ ውጭ ሌላ ህመም በለፈው 2 ሳምንት ገጥሞሁል	1. አዎ 2. አልገጠመኝም	
706	ከገጠመህ/ሽ ምን አይነት የህመም ምልክት ነበር	1. ትኩሳት 2. የሆድ ህመም 3. ተቅማጥ 4. ትውከት 5. ደም ግፊት፣ 6. ሌላ ከሆነ ይጥቀሱ	
707	የታካሚው ሁኔታ	1. በስራ ላይ ያለ	

		2. ስራ ያቆመ ግን ያልተኛ 3. ተኝቶ ታካሚ	
--	--	---------------------------------	--

ከጤና ተቋማት መዝገብ/ ካርድ ሚሞላ፤

801	ምን አይነት የሰንባ ነቀርሳ ነው	1 የሰንባ 2. ከሰንባ ውጪ የሌለ
802	የሰንባ ነቀርሳ ህክምና ሁኔታ	1. አዲስ ታካሚ 2. በፊት ታካሚ የነበረ
803	የHIV/AIDS ምርመራ ውጤት	1 ፖዘቲቭ 2 ኔጌቲቭ/ ነፃ
804	በህክምና ላይ የቆዩበት ጊዜ	1. ≤ 4 ሳምንት 2. > 4 ሳምንት
805	የዐክታ ምርመራ ሁኔታ/ ውጤት	1. 'ስሚር ፖዘቲቭ' 2. 'ስሚር ኔጌቲቭ'

የክብደት የቁመት መጠን ልኬት

	ልኬት	ውጤት
901	የቁመት መጠን በ ሴንቲ ሜትር	
902	የክብደት መጠን በ ኪሎ ግራም	

አመሰግናለሁ!