# Addis Ababa University, College of Health Sciences, School of Public Health

## Ethiopian Field Epidemiology Training Program (EFETP)

### Compiled Body of Works in Field Epidemiology

**By**
**(ATSIKE BELAY)**

Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment for the degree of Master of Public Health in Field Epidemiology

**Addis Abeba, Ethiopia**
**November 1, 2025**

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**ADDIS ABABA UNIVERSITY**

**School of Graduate Studies**

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## *Table of Contents*

Tables ..... 8

Figures ..... 9

List of abbreviations and acronyms ..... 11

Executive Summary ..... 13

Chapter 1: Outbreak/Epidemic Investigations ..... 14

1.1. Cholera Outbreak Investigation in Afar Region of Ethiopia, 2024; A Case-Control Study ..... 15

1.1.1. Abstract ..... 15

1.1.2. Introduction ..... 16

1.1.3. Objectives ..... 19

1.1.4. Methods ..... 22

1.1.5. Results ..... 27

1.1.6. Discussion ..... 39

1.1.7. Conclusion and Recommendations ..... 42

1.1.8. Reference ..... 44

Chapter 2: Surveillance Data Analysis Report ..... 46

2.1. Distribution and Temporal Trends of Colorectal Cancer Incidence in Addis Ababa, Ethiopia: A Five-Year Retrospective Study (2018-2022) ..... 47

2.1.1. Abstract ..... 47

2.1.2. Introduction ..... 48

2.1.3. Objectives ..... 51

2.1.4. Methods and Materials ..... 54

2.1.5. Result ..... 58

2.1.6. Discussion ..... 67

2.1.7. Conclusion ..... 70

2.1.8. Recommendations ..... 70

2.1.9. References ..... 72

Chapter 3: Evaluation of Surveillance System ..... 76

3.1. Surveillance system evaluation of non-communicable disease in the government health system of Nifas Silk-Lafto Sub-city, Addis Ababa, Ethiopia, 2025 ..... 77
3.1.1. Abstract ..... 77
3.1.2. Introduction ..... 78
3.1.3. Objectives ..... 81
3.1.4. Methods and Materials ..... 84
3.1.5. Result ..... 90
3.1.6. Discussion ..... 99
3.1.7. Conclusions and Recommendations ..... 105
3.1.8. Reference ..... 107
Chapter 4: Health Profile Description Report ..... 111
4.1. Health Profile Assessment Report of Daleti Woreda, Glela-Guda Sub-City, Oromia Region, Ethiopia (2023-2024) ..... 112
4.1.1. Abstract ..... 112
4.1.2. Introduction ..... 113
4.1.3. Objectives ..... 115
4.1.4. Methods and Materials ..... 116
4.1.5. Result ..... 117
4.1.6. Discussion ..... 131
4.1.7. Conclusion ..... 132
4.1.8. Recommendation ..... 132
4.1.9. Reference ..... 134
Chapter 5: Disaster Situation Assessment ..... 135
5.1. Humanitarian and Health Impacts of Landslide in the Gofa Zone, Southern Region, Ethiopia, 2024: A Rapid Cross-Sectional Study. ..... 136
5.1.1. Abstract ..... 136
5.1.2. Introduction ..... 137
5.1.3. Objective ..... 140
5.1.4. Method And Material ..... 141

5.1.5. Result ..... 143
5.1.6. Discussion ..... 151
5.1.7. Conclusion ..... 152
5.1.8. Recommendations ..... 153
5.1.9. Reference ..... 154
Chapter 6: Scientific Manuscript for Peer-reviewed Journals ..... 156
6.1. Distribution and Temporal Trends of Colorectal Cancer Incidence in Addis Ababa, Ethiopia: A Five-Year Retrospective Study (2018-2022) ..... 158
6.1.1. Abstract ..... 158
6.1.2. Introduction ..... 159
6.1.3. Methods and Materials ..... 161
6.1.4. Result ..... 165
6.1.5. Discussion ..... 174
6.1.6. Conclusion ..... 177
6.1.7. Recommendations ..... 177
6.1.8. References ..... 179
Chapter 7: Abstract for Scientific Presentation ..... 181
7.2. Cholera Outbreak Investigation in Afar Region of Ethiopia, 2024; A Case-Control Study 183
7.2.1. Abstract ..... 183
Chapter 8: Thesis research ..... 184
8.1. Determinants of hypertension among military patients with type 2 diabetes mellitus on follow-up at Armed Force Comprehensive Specialized Hospital, Addis Ababa, Ethiopia, 2024: A case-control study ..... 185
8.1.1. Abstract ..... 185
8.1.2. Introduction ..... 186
8.1.3. Objectives ..... 192
8.1.4. Methods And Materials ..... 193
8.1.5. Results ..... 200

8.1.6. Discussion ..... 207
8.1.7. Conclusion and Recommendations ..... 217
8.1.8. Reference ..... 220
Annexes ..... 228
1. Questionnaires for AWD Outbreak Investigation in Afar region, Ethiopia ..... 228
2. Questionnaire of NCD surveillance system evaluation in NifasSilk Lafto Sub-city, Addis Ababa, Ethiopia ..... 232
3. Questionnaire for Health profile description in Daltie Woreda, Oromia region ..... 236
4. Questionnaire for Determinants of hypertension among military patients with type 2 diabetes mellitus on follow-up at Armed Force Comprehensive Specialized Hospital, Addis Ababa, Ethiopia, 2024: A case-control study ..... 244
***A. English version*** ..... 244
**B.** የአማርኛ መጠይቅ ..... 254

## Tables

**Table 1: Socio-demographic characteristics of cholera cases in Afar region, Ethiopia, 2024** ..... 27
**Table 2: Distribution of cholera cases by district, in Afar region, Ethiopia, April 2024** ..... 28
**Table 3: Specimen testing result of cholera cases in Afar Region, Ethiopia, April 2024** ..... 30
**Table 4: Clinical factors of cholera cases in Afar Region, Ethiopia, April 2024** ..... 31
**Table 5: Distribution of cholera cases by treatment Center and dehydration status in Afar region, Ethiopia** ..... 32
**Table 6: Distribution of cholera cases by source of water and occupation in Afar region, Ethiopia, 2024** ..... 33
**Table 7: distribution of cholera cases by latrine access and occupation in Afar region, Ethiopia,2024** ..... 34
**Table 8: Distribution of study participants in the case-control study by Zone and District in Afar Region, Ethiopia,2024** ..... 35
***Table 9: Sociodemographic characteristics of the study population in Afar Region, April 2024*** ..... 36
**Table 10: Bivariate and multivariable logistic regression analyses of determinants of cholera infection, Afar, Ethiopia, 2024 (Case–Control Study)** ..... 37
**Table 11: Crude and age-adjusted standardized incidence rate for age distribution colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 58
**Table 12: Crude and age adjusted standardized incidence rate for sex distribution colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 59
**Table 13: Colorectal cancer trend over five years (2018-2022) in Addis Ababa, Ethiopia** ..... 60
**Table 14: Colorectal Cancer Cases distribution by Morphology in Addis Ababa, Ethiopia** ..... 65
**Table 15: Colorectal Cancer Cases distribution by treatment type in Addis Ababa, Ethiopia** ..... 66
**Table 16: Governance in Nifas Silk Lafto Sub-city, Addis Ababa, Ethiopia** ..... 91
**Table 17: Availability of Key Resources Across Facilities (%)** ..... 93
**Table 18: Synthesis of Findings and Comparison with Literature** ..... 103
**Table 19: Population of Daleti Woreda by kebele** ..... 119
**Table 20: Number of health professionals to population ratio in Daleti woreda** ..... 124
**Table 21: Immunization coverage in Daleti Woreda 2015** ..... 126
**Table 22: Distribution of the affected population by landslide in Gofa zone, southern Region, Ethiopia, 2024** ..... 143
**Table 23: Distribution of landslide-affected population by woredas and kebeles in Gofa zone, southern Region, Ethiopia, 2024** ..... 144
**Table 24: Distribution of landslide-affected population by Sex in Gofa zone, southern Region, Ethiopia, 2024** ..... 144
**Table 25: Distribution of the established IDP sites for Gofa zone landslide, southern Region, Ethiopia, 2024** ..... 146
**Table 26: Surveillance activities in landslide affected IDP sites in Gofa zone, southern region, Ethiopia** ..... 147
**Table 27: case management in landslide affected IDPs in Gofa Zone, Southern region, Ethiopia** ..... 147
**Table 28: Nutritional activities in IDP sites in Gofa zone, Southern region, Ethiopia** ..... 148
**Table 29: Water, Sanitation, and Hygiene Activities (WASH) in IDP Sites in Gofa Zone, Southern Region, Ethiopia** ..... 148
**Table 30: Gofa Zone Landslide Response Risk Communication and Community Engagement Activities (RCCE) as of Sep 19, 2024** ..... 148
**Table 31: Gofa Zone Landslide Response Mental Health and Psychosocial Support Activities (MHPSS) as of Sep 19, 2024.** ..... 149
**Table 32: Crude and age-adjusted standardized incidence rate for age distribution colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 165

**Table 33: Crude and age-adjusted standardized incidence rate for sex distribution of colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 166
**Table 34: Colorectal cancer trend over five years (2018-2022) in Addis Ababa, Ethiopia** ..... 167
**Table 35: Colorectal Cancer Cases distribution by Morphology in Addis Ababa, Ethiopia** ..... 172
**Table 36: Colorectal Cancer Cases distribution by treatment type in Addis Ababa, Ethiopia** ..... 173
**Table 37: Sample size determination for the study** ..... 195
***Table 38: Socio-demographic characteristics of respondents (n = 356)*** ..... 200
***Table 39: Military-related characteristics of respondents (n = 356)*** ..... 201
***Table 40: Behavioral characteristics of respondents (n = 356)*** ..... 202
**Table 41: Clinical Factors characteristics of respondents (n = 356)** ..... 203
***Table 43: Bivariable and Multivariable Logistic Regression Analysis of Determinants of Hypertension Among Military Patients with Type 2 Diabetes Mellitus*** ..... 205

## Figures

**Figure 1: Map of Afar region, Ethiopia** ..... 22
**Figure 2: Distribution of cholera cases by sex in Afar region, Ethiopia,2024** ..... 27
**Figure 3: Distribution of cholera cases by Zone and district, in Afar region, Ethiopia, April 2024** ..... 28
**Figure 4: Spot map of cholera cases in Afar region, Ethiopia, April 2024** ..... 29
**Figure 5: Trend of cholera cases by date of onset in Afar region of Ethiopia, April 2024** ..... 30
**Figure 6: distribution of cholera cases by case identification in afar region, Ethiopia, 2024** ..... 31
**Figure 7: Distribution of cholera cases by treatment Center and in Afar region, Ethiopia** ..... 32
**Figure 8: Distribution of cholera cases by Occupation in the Afar region, Ethiopia,2024** ..... 33
**Figure 9: Distribution of cholera cases by Larine access in Afar region, Ethiopia, 2024** ..... 34
**Figure 10: Conceptual framework of colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 53
**Figure 11: Map of Addis Ababa, Ethiopia** ..... 54
**Figure 12: Sex incidence rate of colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 59
**Figure 13: trend line of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia** ..... 60
**Figure 14: trend of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia** 61
**Figure 15: Geographical distribution of colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 61
**Figure 16: Spot map of colorectal cancer distribution in Addis Ababa, Ethiopia** ..... 62
**Figure 17: Colorectal Cancer Cases distribution by Anatomical Topography in Addis Ababa, Ethiopia** ..... 63
**Figure 18: Colorectal Cancer Cases distribution by health facility in Addis Ababa, Ethiopia** ..... 64
**Figure 19: Colorectal Cancer Cases distribution by basis of diagnosis in Addis Ababa, Ethiopia** ..... 64
**Figure 20: Sampling procedure of NCD surveillance system evaluation in Nifas Silk-Lafto sub-city, Addis Ababa (W**=Woreda, **HC**=Health center**)** ..... 86
**Figure 21: Structure and workflow of Nifas Silk Lafto sub-city health Bureau, Addis Ababa, Ethiopia** ..... 91
**Figure 22: Case Detection (January 2024–May 2025)** ..... 93
**figure 23: Detected Hypertension cases in Nifasilk Lafto Sub-city, Addis Ababa (January 2024–May 2025)** ..... 94
**Figure 24: Detected Diabetes Mellitus cases in Nifasilk Lafto Sub-city, Addis Ababa (January 2024–May 2025)** ..... 94
**Figure 25: Training, Feedback, and Supervision Coverage** ..... 95
**Figure 26: Performance of NCD Surveillance System Attributes in Nifas Silk Lafto Sub-city, Addis Ababa, Ethiopia** ..... 98
**Figure 27: Map of Daleti Woreda** ..... 117
**Figure 28: Population age distribution of Daleti Woreda, Sheger City** ..... 119

**Figure 29: Number and types of educational institutions** ..... 121
**Figure 30: Number of health facilities by type in Daleti woreda** ..... 123
**Figure 31: Top ten morbidities in adults in 2015** ..... 127
**Figure 32: Top ten morbidities in >5 years** ..... 127
**Figure 33: Distribution of the Landslide Affected Population by Sex in Gofa zone, southern Region, Ethiopia, 2024** ..... 144
**Figure 34: Distribution of the Landslide Affected Population by Age Group in Gofa zone, southern Region, Ethiopia, 2024** ..... 145
**Figure 35: Major Reported Diseases in IDPs Temporary Clinics in Gofa Zone, Southern Region, Ethiopia.** ..... 147
**Figure 36: Map of Addis Abeba, Ethiopia** ..... 161
**Figure 37: Sex incidence rate of colorectal cancer in Addis Ababa, Ethiopia** ..... 166
**figure 38: trend line of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia** ..... 167
**Figure 39: Trend of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia** ..... 168
**Figure 40: Geographical distribution of colorectal cancer incidence in Addis Ababa, Ethiopia** ..... 168
**Figure 41: Spot map of colorectal cancer distribution in Addis Ababa, Ethiopia** ..... 169
**Figure 42: Colorectal Cancer Cases distribution by Anatomical Topography in Addis Ababa, Ethiopia** ..... 170
**figure 43: Colorectal Cancer Cases distribution by health facility in Addis Ababa, Ethiopia** ..... 171
**Figure 44: Colorectal Cancer Cases distribution by basis of diagnosis in Addis Ababa, Ethiopia** ..... 171
**Figure 45:Conceptual framework of the study** ..... 191
**Figure 46: Knowledge Level of the study participants about hypertension and diabetes** ..... 204

## List of abbreviations and acronyms

AAPBCR – Addis Ababa Population-Based Cancer Registry

AAR – After Action Review

AARHB – Afar Regional Health Bureau

AOR – Adjusted Odds Ratio

AWD – Acute Watery Diarrhea

CDC – Centers for Disease Control and Prevention

CI – Confidence Interval

CRC – Colorectal Cancer

EBS – Event-Based Surveillance

ECDC – European Centre for Disease Prevention and Control

EFDRE – Ethiopian Federal Democratic Republic

EFETP – Ethiopian Field Epidemiology Training Program

EHNRI – Ethiopian Health and Nutrition Research Institute

FMoH – Federal Ministry of Health

GLOBOCAN – Global Cancer Observatory

HC – Health Center

HDP – Health Development Partner

HIS – Health Information System

HP – Health Post

KII – Key Informant Interview

NCCP – National Cancer Control Plan

NCD – Non-Communicable Disease

NCDS – Non-Communicable Disease Surveillance

NGO – Non-Governmental Organization

OR – Odds Ratio

PHEM – Public Health Emergency Management

PHCU – Primary Health Care Unit

RHB – Regional Health Bureau

SPSS – Statistical Package for the Social Sciences

TASH – Tikur Anbessa Specialized Hospital

UNICEF – United Nations International Children's Emergency Fund

WASH – Water, Sanitation and Hygiene

WHO – World Health Organization

Woreda – District (Local Administrative Unit in Ethiopia)

## Executive Summary

This Document presents the comprehensive body of work completed during my two-year residency in the Ethiopian Field Epidemiology Training Program (FETP). It includes a range of applied epidemiology outputs such as outbreak investigations, surveillance data analyses, surveillance system evaluations, health profile assessments, scientific writing, and the development of tools to support public health action.

**Chapter One** documents a 2024 cholera outbreak investigation in the Afar Region conducted using a case–control design. The investigation identified significant risk factors, quantified the outbreak's magnitude, and formulated recommendations to strengthen prevention and response efforts.

**Chapter Two** provides a five-year (2018–2022) surveillance data analysis of colorectal cancer incidence in Addis Ababa, revealing a rising disease burden and emphasizing the urgent need for improved cancer surveillance and early detection strategies.

**Chapter Three** evaluates the non-communicable disease surveillance system in Nifas Silk Lafto Sub-City, Addis Ababa (2025). The assessment examined system attributes including usefulness, timeliness, data quality, and stability highlighting gaps in resources and feedback mechanisms and offering recommendations for system enhancement.

**Chapter Four** presents a health profile of Daleti Woreda, Oromia Region (2023–2024). It summarizes demographic characteristics, health service availability, and patterns of morbidity and mortality, identifying key challenges in maternal and child health, communicable diseases, and healthcare infrastructure.

**Chapter Five** examines the humanitarian and health impacts of a 2024 landslide in Gofa Zone, Southern Region, Ethiopia, based on a rapid cross-sectional study.

**Chapter Six** includes a scientific manuscript prepared from the colorectal cancer surveillance analysis for submission to peer-reviewed journals.

**Chapter Seven** presents a scientific abstract generated from the cholera outbreak investigation for conference presentation.

**Chapter Eight** investigates determinants of hypertension among military patients with type 2 diabetes mellitus at the Armed Force Comprehensive Specialized Hospital in Addis Ababa (2024) using a case–control study design.

The **Annexes** provide tools used during fieldwork—such as outbreak investigation forms and surveillance evaluation questionnaires—which serve as practical references for future epidemiologic activities.

Overall, this document demonstrates the core competencies of an FETP resident in applying epidemiologic principles to investigate outbreaks, analyze surveillance data, evaluate public health systems, and effectively communicate findings. The outputs contribute actionable evidence to strengthen Ethiopia's public health preparedness, surveillance, and response capacities.

# Chapter 1: Outbreak/Epidemic Investigations

## 1.1. Cholera Outbreak Investigation in Afar Region of Ethiopia, 2024; A Case-Control Study

### 1.1.1. Abstract

**Background:** On March 6, 2024, a patient with acute watery diarrhea and vomiting arrived at Dubti General Hospital in Afar Region, Ethiopia, suspecting cholera infection. Stool samples were collected and confirmed with Vibrio cholerae positive. As of April 15, 2024, 410 cholera cases in 2 zones were reported. We described the epidemiology, identified the determinants, and responded to the outbreak accordingly.

**Method:** We conducted a descriptive study followed by an unmatched case-control study, with a 1:2 ratio, conducted from March to April 2024. 410 cases from the line list were used for the descriptive study, and 45 cases and 90 controls for the unmatched case-control study. A structured interviewer-administered questionnaire was used for the data collection, with a Simple random sampling method for the sampling. ArcGIS was used to show disease distribution in a Map, and Data were entered into Epi Info software and analyzed using SPSS version 20 software. Logistic regression was used to compute the crude and adjusted odds ratios for the factors associated with cholera infection.

**Results:** The study identified 410 cases (0.93/1000 Attack Rate) with no deaths registered. Of the total cases, 76.6% were severely dehydrated, 87.3% cases used river water sources, and 76% of the cases were in zone 1, The median age was 23 years (interquartile range:18-30 years) with a male-to-female ratio of 4:1, and 64.6% cases were daily laborers. knowledge of cholera infection [AOR=6.06, 95% CI=1.10-33.33], unimproved water sources [AOR=3.28, 95% CI=1.20-8.95], without latrine access [AOR=4.56, 95% CI=1.23-17.00], Contact with suspected cases [AOR=3.28, 95% CI=1.24-8.69], and traveled to active outbreak area [AOR=2.79, 95% CI=1.08-7.22] were the significant determinants of the outbreak.

**Conclusions:** The study highlights that knowledge, unimproved water, and a lack of latrines were the causes of cholera transmission. We recommended that Strengthening WASH services and giving health education are essential to mitigating the outbreak.

**Keywords:** Cholera, Outbreak, Case-Control, Afar, Ethiopia

## 1.1.2. Introduction

### Background

Cholera is an acute diarrheal illness caused by infection of the intestine by food or water contaminated with the bacterium Vibrio cholerae serogroup O1 or O139 that is lethal within hours if left untreated[1-3]. It is characterized by the rapid onset of copious painless watery diarrhea or rice-water diarrhea, often accompanied by vomiting, that can lead quickly to severe dehydration and cardiovascular collapse[4, 5]. Though cholera may be treated with rehydration, the case-fatality rate of untreated cases can be as high as 30–50% if not treated within time. The case-fatality rate can be brought down to under 1% if treatment is applied appropriately [5].

Cholera is primarily spread through the fecal-oral route through fecal contamination of food and water. As the incubation period of cholera is very short 2 hours to 5 days in between Humans are the main reservoir of Vibrio cholerae[5, 6].

Cholera outbreaks have classically affected regions like Sub-Saharan Africa, Haiti, West Asia, and South Asia due to unsanitary habits[7]. The 7th cholera pandemic has also shown the challenges of controlling cholera, with multiple outbreaks, high mortality, and spread to cholera-free regions previously[8, 9].

Globally, the cholera case fatality rate (CFR) has been trending at a frightening rate of 1.9% in 2021, and for Africa, the CFR was at 2.9%. however, Underreporting could conceal the true cholera burden, which is estimated at 2.9 million cases and 95,000 deaths annually[8, 9]. In Africa alone, significant cases of cholera have been reported, with Cameroon, DRC, Malawi, Mozambique, and Nigeria accounting for the majority of cases[10].

Although appropriately organized cholera data at the national level in Ethiopia only became available after 2015, evidence of the last 2 decades (2001–2023) reported a total number of 21,5205 cases of acute watery diarrhea/cholera and 2355 deaths nationwide. During the recent 9 years (2015–2023), Ethiopia continuously had cholera outbreaks, which reported a total of 99,945 and 1030 deaths according to the Ethiopia Public Health Institute (EPHI) national cholera line-list[11].

Afar zone is one of the regions of the country that, has experienced recurrent outbreaks of cholera with high morbidity and mortality. In the years 2006-2009, 8,109 cases and 194 deaths were reported from three districts of the Afar zone with an overall case fatality rate of 2.4%.[12]. Despite efforts such as the National Cholera Elimination Plan (2021-2028), intended to eradicate cases of cholera in 2028, there continue to be outbreaks, as seen in recent 2024 outbreaks across different regions of the country, including Afar[13].

## Cholera outbreak situation

One patient with acute watery diarrhea and vomiting was presented to Dubti General Hospital in Dubti District, afar region, on 6th March 2024. Under suspected cholera, the health workers directly collected Specimens for laboratory testing and reported to the regional public health institute on the same day.

The outbreak was confirmed on 8th and 9th March 2024, and the formation of the cholera task force, RRT, and PHEOC was created and activated.

On April 5/2024, a 5-member team was deployed by the national public health institute to find the source of the outbreak and respond. The national deployed team and the regional health authorities team quickly moved into a protective response mode to the most vulnerable areas and have been involved in developing planned interventions to contain the outbreak and strengthen institutions and health workforce capacity. Four Cholera treatment centres (CTCs) were opened (Semera Logia, Asayita, and Dubti, Semera city) and two cholera treatment Units (CTUs). As of the 15th of April, 2024, two zones (Awsi Rasu-Zone 1, and Gabi Rasu-Zone 3) with 6 districts (Asayita-District, Dubti-District, Afambo-District, Amibara-District, Gewane-District, Haruka District) and 4 city administrations (Asayita-Town, Dubti-Town, Semera logia-Town, Werer Adebtoli-Town) were affected, and a total of 410 cholera cases were reported in the two zones of Afar.

## Statement of the problem

There have been recurring cholera outbreaks in the Afar region of Ethiopia that point to ongoing problems in public health management despite recurring interventions.

The implementation of the National Cholera Elimination Plan (NCP) in 2021 aimed at the elimination of cholera through improved sanitation, hygienic behavior, and access to clean water.

But the emergence of a fresh outbreak in March 2024, which incorporates various zones, districts, and city administrations, points to frailties in the current strategies.

As of 15 April 2024, 410 cases had been reported, revealing the need to understand and react to the causes propelling the outbreak. While the NCP provides an overall picture, the particular mechanisms of the 2024 outbreak remain not fully understood. Determinants such as environmental environments, population mobility, and behavioral habits potentially underlying transmission must be addressed by research. This knowledge deficit limits the creation of and application of tailored interventions for controlling the current outbreak and preventing future ones. Control measures such as increased sanitation and availability of water are significant, but other determinants specific to the 2024 outbreak in the Afar region were Unknown.

This study aims to describe the epidemiology of the 2024 cholera outbreak in Afar and identify significant risk factors for cholera cases. By the identification of the factors, this study will offer important insights to inform evidence-based interventions and strengthen the prevention and control of cholera within the region.

## Significance/rationale of the study

Cholera epidemics continue to be a significant public health burden in the Afar region of Ethiopia, in spite of ongoing control activities. This case-control study is of enormous significance considering that it has the potential to contribute significant insights and evidence to inform public health interventions for the prevention and control of cholera epidemics in the Afar region and similar settings.

By employing a case-control study design, the study will successfully identify important risk factors of cholera infection during the outbreak. This rigorous review of the epidemiological dynamics, contextual factors, and risk factors can also pinpoint gaps in response, preparedness, and sanitation infrastructure, which will inform targeted interventions to mitigate the impact of the current outbreak and prevent future occurrences.

Moreover, the findings of the research can enlighten regarding the socio-economic determinants and community perceptions related to cholera. Such information can guide the development of tailored prevention interventions that target vulnerabilities and promote sustainable shifts in WASH practices.

The study's contribution is not restricted to the Afar region. It has the potential to contribute to the current body of knowledge regarding cholera epidemiology and outbreak response, offering lessons that could inform the development of policies, the allocation of resources, and capacity building at the local, national, and global levels.

Ultimately, the worth of the study is in its potential to safeguard public health, reduce morbidity and mortality due to cholera, and facilitate the acceleration of progress toward the achievement of Sustainable Development Goals for health and well-being.

### 1.1.3. Objectives

#### General Objective

To control and investigate the underlying determinants of the cholera infection outbreak in 2024 in the Afar region of Ethiopia.

#### Specific Objectives

- To control and prevent the cholera outbreak in Afar through appropriate intervention measures.
- To describe cholera cases epidemiologically by place, person, and time in the Afar region.
- To identify the source and underlying determinants of the cholera infection outbreak in the Afar region.

## Literature Review

Cholera, an acute diarrheal illness caused by Vibrio cholerae, remains a public health menace globally [1]. The fecal-oral route is typically the primary transmission through contaminated food or water sources [2]. Inadequate hygiene behavior (particularly hand hygiene), poor sanitation facilities, and poor living conditions in congested environments also contribute importantly in very favorable settings for cholera outbreaks [3]. Flooding as a result of natural disasters also increases transmission through contaminated water and sanitation system disruption [4].

In spite of treatment advances using oral rehydration therapy (ORT) and vaccines, cholera continues to be a major global burden. The World Health Organization (WHO) estimates 2.9 million cases and 95,000 deaths each year from cholera, with most of these reports coming from areas with poor sanitation and poor hygiene [5]. Sub-Saharan Africa is disproportionately affected by the disease. These countries, namely Democratic Republic of the Congo, Nigeria, and Cameroon, also experience recurrent outbreaks owing to a set of factors: inadequate access to safe water and sanitation, displacement of the population typically because of conflict or natural calamity, and food insecurity that can weaken immune systems [6].

Ethiopia has a history of repeated cholera outbreaks, and some areas like Oromia and Somali carry an disproportional burden [7]. As a result of the frequent public health emergencies, the Ethiopian government launched the National Cholera Elimination Plan (NCP) in 2021 with a goal of zero cholera incidence by 2028 [8]. The current Afar outbreak in 2024 is a painful reminder of the enormous task to achieve the ambitious target.

There are numerous reasons why the Afar region is particularly susceptible to outbreaks of cholera. Limited access to clean water by way of drought or infrastructure allows populations to resort to unclean sources. Unsanitary conditions, often a result of limited resources and inadequate facilities, also have a role in the exposure to fecal-oral transmission [9]. Alongside these physical susceptibilities, socio-economic weaknesses are also a primary driver. Poverty can limit access to healthy food and health care, and population displacement because of conflict or drought can destabilize sanitation facilities and hygiene practices that are established, creating an ideal setting for outbreak [10].

Although extensive literature on cholera epidemiology and control measures in general has been available, there are critical knowledge gaps specific to the 2024 outbreak in the Afar region.

The limited data on the specific risk factors for the current epidemic. While socio-economic and environmental determinants are suspected to play a role, further description of the specific exposures and behaviors with which cholera infection in this epidemic is associated is required.

We require a more insightful understanding of the socio-economic determinants of vulnerability. For designing targeted interventions, It is important to understand how poverty, food insecurity, and access to health care affect susceptibility to cholera in the Afar region of Ethiopia. It is also vital to assess the effectiveness of current control strategies such as the NCP in the Afar region to evaluate the strengths and limitations of the applied measures and provide insights into future control activities and areas of improvement.

### 1.1.4. Methods

#### Study area and period

The Afar region is located in the northeaster part of Ethiopia, and it is located 653.1 km from the national capital of Addis Ababa. "Afar" means "The Best" or "First" in the Afaric language. It has an estimated population of 2,119,000, of which 1,149,000 are males and 970,000 are females according to the Ethiopian Central Statistics Agency [14]. It is divided into five administrative zones, 37 Districts, and five city administrations. Its capital is the planned city of Semera, which lies on the tarmac Awash – Assab road. It is surrounded by Eritrea in the north and Djibouti in the northeast, and regionally it is bordered by the Tigray, Amhara, Oromo, and Somali regions. The Afar people are mainly pastoralists and subsist on their cattle for food and livelihood. The region is mostly inhabited by Muslim pastoralists or agropastoral.

The study was conducted from March 6 to April 15, 2024.

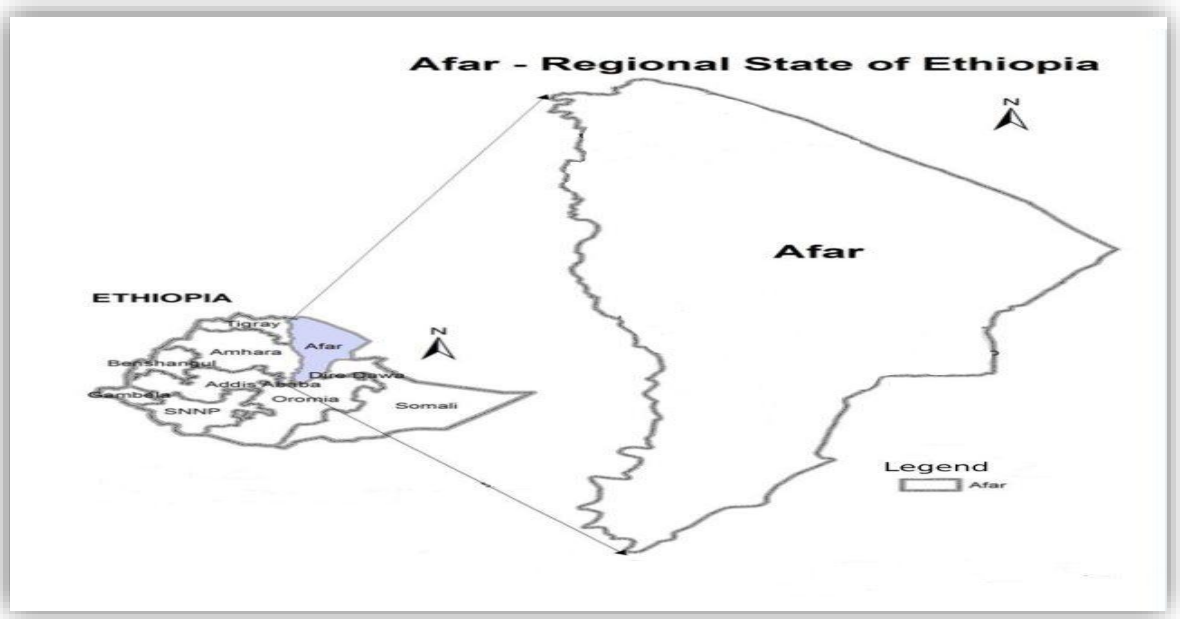


**Figure 1: Map of Afar region, Ethiopia**

## Study Design

The retrospective descriptive cross-sectional study design was conducted, followed by an unmatched case-control study.

## Study population

**Cases:** A 2-year-old or above person residing in afar cholera-affected District who had three or more loose/watery stools in 24 hours with/ without abdominal cramps, vomiting, and nausea two weeks before the study.

**Controls:** controls were all people in the affected Districts who didn't fulfill the case definition during the study period.

## Sample Size Determination and Sampling Technique

### Sample Size Determination

We used a descriptive cross-sectional study to describe the magnitude of the Cholera outbreak and a 1:2 unmatched case-control study design to identify the risk factors associated with cholera infection. All confirmed and epidemiologically linked cholera cases recorded on the line list were included in the descriptive study. The case-control study included 135 samples (45 cases and 90 controls). We selected and interviewed cases from cholera treatment centers (CTCs), and two controls from neighbors of cases who reside in the same districts were recruited for each selected case. We used Epi-info version 7.0 statistical software for sample size calculation, based on the assumptions of a 55.9% expected prevalence of no adequate access to clean water sources among controls, a desired power of 80%, 99.9% confidence intervals (CIs), and an estimated odds ratio (OR) of 5.9[15], a sample size of 135 was calculated.

### Sampling Technique

For the descriptive study line list and medical records from March 8 to April 15, 2024, were collected from the Afar Public Health Institute (APHI) and cholera treatment centers (CTCs) and described by place, person, and time. We identified study subjects (Both cases and controls) from health facilities' cholera treatment centers (CTCs) while seeking care, and, being an attendant simple random sampling technique was employed with 45 cases and 90 controls.

### Data collection method

The data were collected using an interviewer-administered structured questionnaire adapted and designed from different literature to identify possible exposures to acute watery diarrhea. Data was collected through face-to-face interviews with cholera cases, by reviewing their medical records, and Discussions with clinicians in cholera treatment centers. meanwhile line list of 410 cases was collected

from Afar Public Health Institute to describe cases by place, person, and time. The questionnaire comprises socio-demographic, knowledge about cholera infection, occupation of cases, water (source, treatment), feeding habits (unwashed fruits, raw vegetables, raw meat, eating food outside home), availability of latrine, history of contact with suspected cases of cholera and travel history were collected using the questionnaire.

Then the questionnaire was pre-tested in 5% of the study population in the Dubti district who were not involved in this study. During the pre-test, the questionnaire was assessed for its understandability, reliability, the time needed to complete the interview, and cultural acceptability in the area. Finally, the questionnaire was translated from English to the local Afaric language and translated back to English to check for consistency.

## Data analysis and quality assurance method

### Data analysis method

The collected data were entered into Epi Info version 7 and checked for data completeness, clarity, and coding. Then the data were transferred to SPSS version 20 for statistical analysis. Descriptive statistics were used to describe the outbreak by time, place, and person, and a calculation of the attack rate was done. In Bivariate conditional regression analysis, a crude odds ratio with 95% confidence intervals was calculated to see the association between explanatory variables and vaccine dropout. Variables with a p-value ≤0.25 in bivariate analysis with well-known risk factors for vaccination dropout were included in the final model of multivariable analysis. Finally, conditional logistic regression was employed to see the relationship between dependent and independent variables by controlling for confounder variables. All reports with a P-value ≤0.05 were considered statistically significant.

### Data quality control

The quality of data was ensured by pre-testing the questionnaires in the Dubti district on 5% of the study participants. Appropriate modifications were made after reviewing the pre-test results by the principal investigator. Every day after data collection, questionnaires were reviewed and checked for completeness, accuracy, and clarity by the principal investigator, and the necessary feedback was provided. Responses were then carefully coded, with verification, and checked for consistency.

## Variables

Socio-demographic variables like age, sex, residence, symptoms and signs for cases, source of drinking, adequate access to water, any travel to other areas, having a latrine, and utilization of it were the independent variables. The dependent variable is either being a patient or a control.

## Inclusion and Exclusion Criteria

**Inclusion criteria:** Cases and controls residing in cholera-affected districts in afar region during the study period who gave informed consent to participate in the study were included.

**Exclusion criteria:** Severely ill patients who can't provide information were also excluded. In addition, cases that have recently recovered from the disease can't be considered for controls.

## Case definition

**Suspected case of cholera:** In an area where a cholera outbreak has not been declared, a patient aged 5 years or more develops severe dehydration or dies from acute watery diarrhea. In an area where there is a cholera epidemic, a patient aged 2 years or more develops acute watery diarrhea with or without vomiting.

**Confirmed case of cholera:** A case of cholera is confirmed when either Vibrio cholera O1 or O139 is isolated from the patient's stool.

## Operational definitions

**Diarrhea:** The passage of three or more loose/watery stools per day or increased frequency of stool in the past 2 weeks prior to data collection, as perceived by the patient, mother/caregiver.

A Cholera Treatment Center (CTC) is a designated facility for managing moderate to severe cholera cases during outbreaks. It provides rehydration, supportive care, and infection prevention services. CTCs help reduce mortality and limit disease transmission.

**Hand washing at all 5 critical times**: If a mother/caregiver practiced simple hand washing before eating, before food preparation, before child feeding, after child cleaning, and after latrine visiting, if all five actions were done, these were considered all practiced, if not, it was considered as "partially practiced".

**Proper solid waste disposal**: is a way of disposal of ordinary domestic waste which includes burning, burying in a pit, or storing in a container, compost was considered as proper disposal whereas disposing in an open field was considered improper disposal.

**Unimproved water source:** when people use water for drinking from a river, pond, well, unprotected spring, or untreated with water treatment chemicals.

**Basic water supply:** access to safe drinking water sources including household connection, public standpipe, borehole, protected dug well, protected spring, or rainwater collection within a 30-minute round trip, plus household disinfection.

**Basic sanitation:** access to improved sanitation facilities, including connection to a public sewer or to a septic system, or a pour-flush, simple pit, or ventilated improved pit latrine.

## Ethical Considerations

Ethical clearance for the study was provided by the Afar Public Health Institution Ethical Review Committee. The descriptive phase involved analysis of accessible surveillance data (line lists for cholera) without direct contact with patients. All personal identifiers were removed and the data anonymized to ensure confidentiality and the protection of participant privacy. For the case-control section, informed consent was obtained from all subjects upon explaining the purpose, methods, and voluntary nature of study participation in unambiguous terms. Confidentiality was assured to participants, and no individual information was disclosed. Data were securely stored and made available only to the research team.

## 1.1.5. Results

### Descriptive study

### Description by person

The population of this study was the entirety of 410 cases retrieved from the cholera line list report. Out of these cases, 325 (79.3%) were males. For age distribution, the highest number of cases were in the 15–25 age group with 162(39.5%) cases from the total, followed by the 25–35 and 5–15 age groups. The lowest percentages were in the <2, 55–65, and >65 age groups, each having fewer than 2% of the total cases. The estimated Median age was approximately 23 years with an interquartile range of 18-30 years. The male-to-female ratio was approximately 4:1 (Table 1).

**Table 1: Socio-demographic characteristics of cholera cases in Afar region, Ethiopia, 2024**

| Variables | Categories | Female (%) | Male (%) | Total (%) |
|---|---|---|---|---|
| Age | >2 | 0(0.0%) | 1(100.0%) | 1(0.2%) |
| | 2-5 | 4(33.3%) | 8(66.7%) | 12(2.9%) |
| | 5-15 | 27(37.0%) | 46(63.0%) | 73(17.8%) |
| | 15-25 | 21(13.0%) | 141(87.0%) | 162(39.5%) |
| | 25-35 | 17(16.5%) | 86(83.5%) | 103(25.1%) |
| | 35-45 | 7(23.3%) | 23(76.7%) | 30(7.3%) |
| | 45-55 | 6(31.6%) | 13(68.4%) | 19(4.6%) |
| | 55-65 | 3(37.5%) | 5(62.5%) | 8(2.0%) |
| | >65 | 0(0.0%) | 2((100.0%)) | 2(0.5%) |
| | **Total** | **85(20.7%)** | **325(79.3%)** | **410(100.0%)** |

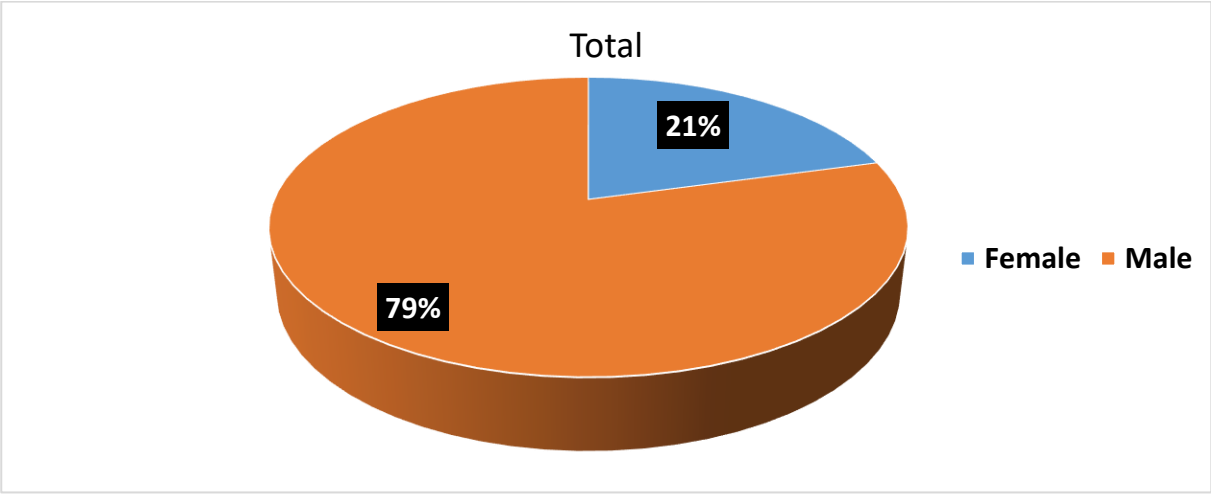


**Figure 2: Distribution of cholera cases by sex in Afar region, Ethiopia,2024**

### Description by place

The study found that cholera cases in Afar were highly concentrated in Zone 1, with 311 cases (76%) with attack rate (AR) of 1.36 per 1,000 population. Within Zone 1, Dubti Town had the highest attack rate of 2.38 per 1,000 people, followed by Dubti District at 1.96 per 1,000 and Ayssaita District at 1.48

per 1,000 people. Zone 3, however, had fewer cases at 99 (24%) with an attack rate of 0.47 per 1,000 population. In Zone 3, Werer Adetboli recorded the highest attack rate at 0.93 per 1,000, while Gelealu had an attack rate of 0.66 per 1,000. Notably, there were no reported facility or community deaths in both zones, which resulted in a case fatality rate (CFR) of 0% (Table 2, Figure 1).

**Table 2: Distribution of cholera cases by district, in Afar region, Ethiopia, April 2024**

| Zones/Districts | Cholera cases (%) | Population | AR/1000 |
|---|---|---|---|
| Zone 1 | 311(75.9%) | 228,288 | 1.36 |
| Afambo | 9 (2.9%) | 32269 | 0.28 |
| Ayssaita Town | 27 (8.7%) | 23,242 | 1.16 |
| Ayssaita District | 59 (19.0%) | 39,895 | 1.48 |
| Dubti Town | 81 (26.0%) | 34,065 | 2.38 |
| Dubti District | 105 (33.8%) | 53,439 | 1.96 |
| Semera- Logiya | 30 (9.6%) | 45,378 | 0.66 |
| Zone 3 | 99 (24.1%) | 211,620 | 0.47 |
| Amibara | 20 (20.2%) | 84,874 | 0.24 |
| Gelealu | 28 (28.3%) | 42,634 | 0.66 |
| Hanruka | 18 (18.2%) | 48,462 | 0.37 |
| Werer Adebtoli | 33 (33.3%) | 35,650 | 0.93 |
| Grand Total | 410(100%) | 439,908 | 0.93 |

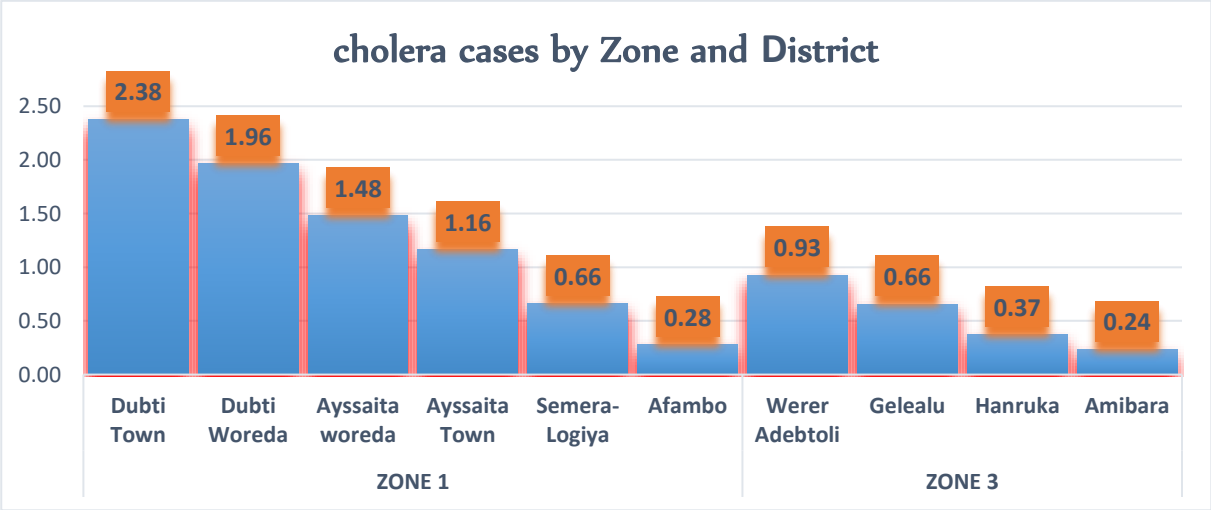


**Figure 3: Distribution of cholera cases by Zone and district, in Afar region, Ethiopia, April 2024**

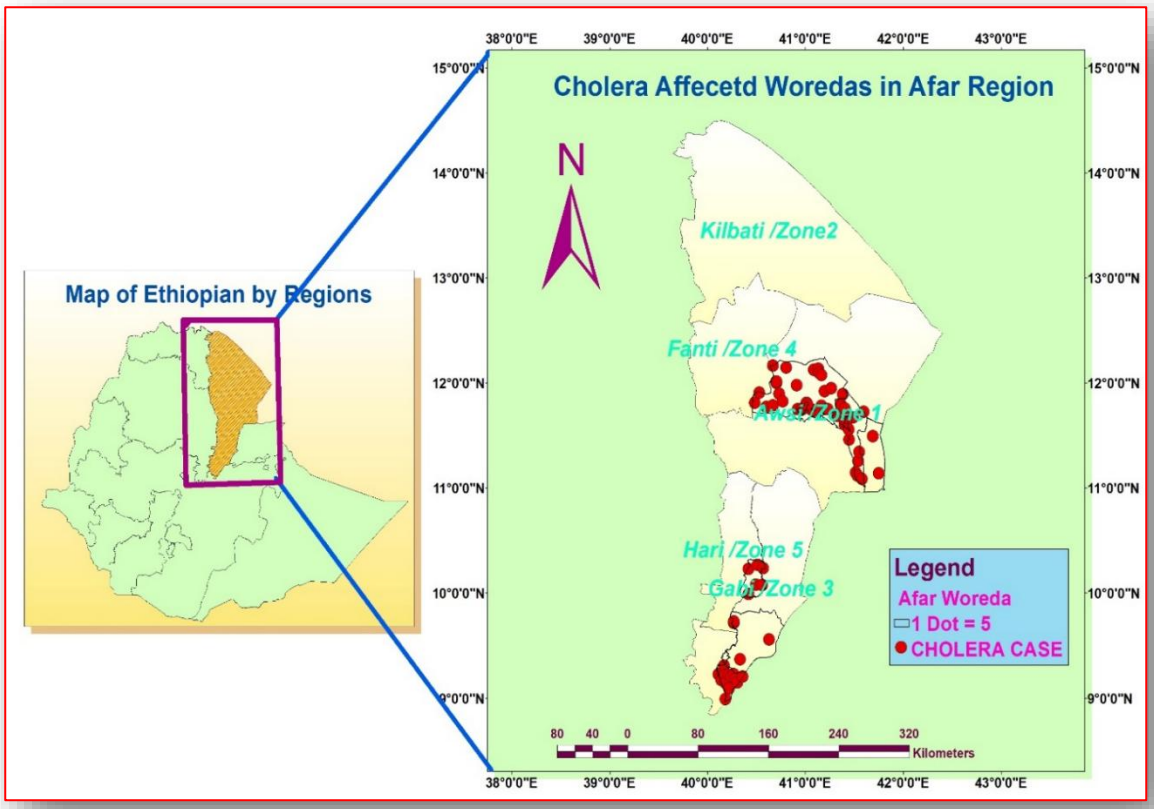


**Figure 4: Spot map of cholera cases in Afar region, Ethiopia, April 2024**

## Description by time

The epidemic curve reveals a propagated cholera outbreak with the onset of the index case on March 3, 2024. The case was reported to Dubti General Hospital on March 6, and a stool sample was collected and reported to the Afar Regional Public Health Institute in the same day. An initial public health response was started on March 7, aiming at case management and infection prevention and control activities. The outbreak was laboratory-confirmed by both culture and rapid diagnostic test (RDT) on March 8. Despite the timely interventions, the cases continued to fluctuate with successive peaks. The peak was highest at 33 cases on April 13, which suggested a possible second wave, indicated the continuity of the outbreak. There is a rising trend gradually over the period, reflecting the need for more aggressive interventions. Investigative activities were initiated on April 5, 2024, to identify the cause of transmission and enhance containment procedures since the outbreak is still active (Figure 2).

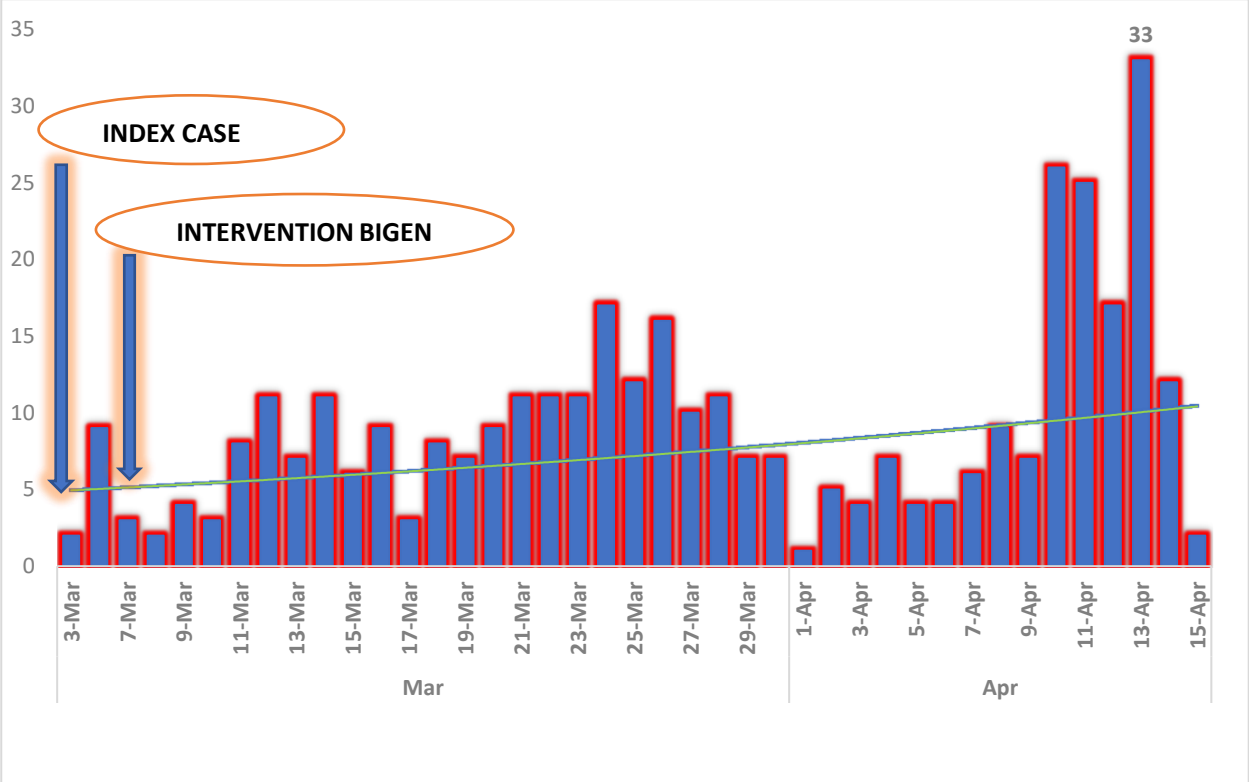


**Figure 5: Trend of cholera cases by date of onset in Afar region of Ethiopia, April 2024**

## Specimen Testing Result and Clinical Factors

### Specimen Testing Result

63 specimens were examined out of 410 cholera cases. Among these, 12 samples were tested with both Culture and Rapid Diagnostic Test (RDT) and found to be positive (100%). 15 samples were tested with Culture alone and found 12 positive (80%). 48 samples were tested with RDT alone and found 32 positive (66.7). 44/63 specimens (69.8%) were positive by all the tests. Notably, the combination of Culture + RDT showed the highest diagnostic sensitivity. Meanwhile, A total of 216 cases (53%) were epidemiologically linked, followed by 150 suspected cases (37%) and 44 confirmed cases (10%).

**Table 3: Specimen testing result of cholera cases in Afar Region, Ethiopia, April 2024**

| Variable | | Cases (%) | |
|---|---|---|---|
| **Diagnostic test (RDT or Culture)** | **Total tested** | **Positive** | **Negative** |
| Culture + RDT | 12(19%) | 12(100.0%) | 0(0.0%) |
| Culture | 15(23.8%) | 12(80.0%) | 3(20.0%) |
| RDT | 48(76.2%) | 32(66.7%) | 16(33.3%) |
| Total | 63(100%) | 44(69.8%) | 19(30.2%) |

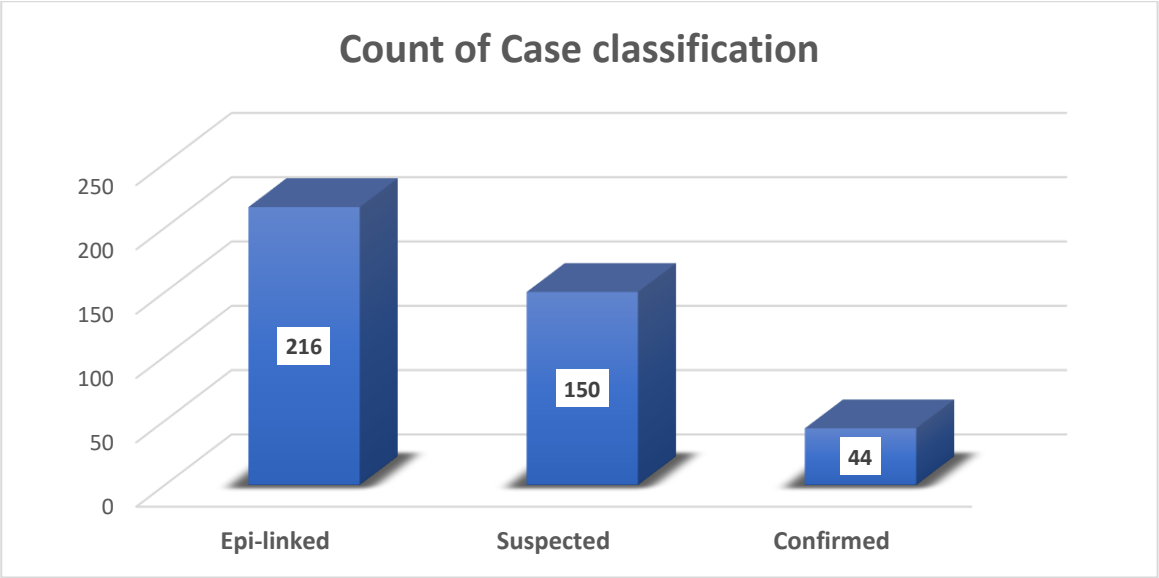


**Figure 6: distribution of cholera cases by case identification in afar region, Ethiopia, 2024**

## Clinical Factors

The study analyzed the clinical presentations and dehydration status in 410 reported cases of cholera. watery diarrhea was a consistently presented clinical feature among all the individuals (100%). Vomiting was also an extremely prevalent symptom, occurring in 383 cases (93.4%). Regarding dehydration status, the majority of the cases, 314 (76.6%), were severely dehydrated, followed by some dehydration in 69 cases (16.8%), and 27 cases (6.6%) showed no dehydrated sign.

**Table 4: Clinical factors of cholera cases in Afar Region, Ethiopia, April 2024**

| Variable | Category | Cases |
|---|---|---|
| **Watery Diarrhea** | Yes | 410(100.0%) |
| | No | 0(0.0%) |
| **Vomiting** | Yes | 383(93.4%) |
| | No | 27(6.6%) |
| **Dehydration Status** | No DHN | 27(6.6%) |
| | Severe DHN | 314(76.6%) |
| | Some DHN | 69(16.8%) |
| Grand Total | | 410 |

## Cholera cases by Treatment Center (CTC)

The study indicated that cholera cases in the Afar region were distributed in many Cholera Treatment Centers (CTCs) across the region, with a majority of cases presenting with severe dehydration. MSF CTC recorded the largest number of cases, 32% of total, with 75 in severe dehydration, 32 in some dehydration, and 24 with no dehydration. Assayita Hospital CTC also reported a high number of 23.2% of total cases, most of which were under the severe dehydration category (89 cases). Dubti Hospital CTC treated 78 cases, 19% of the total, with the largest number being severe dehydration cases. Werer CTC treated 15.9% of cases, with severe (32 cases) and some dehydration (30 cases).

Other centers, such as Debel HC CTC, Semera HC CTC, and MAMGH CTC, saw lower case numbers, with proportions between 6.8% - 1.5%, with the majority being severe or no dehydration cases. In all, the study determined that out of 410 cases, 314 (76.6%) were severe dehydration, indicating the pressing need for immediate hydration therapy and the severity of the disease's effect being particularly severe in this region. The prevalence of severe dehydration also indicates the strain on some facilities, particularly MSF and Ayssaita CTCs, necessitating targeted resource mobilization to ensure maximization of management of severe cases.

Meanwhile, for severe and some dehydration, the maximum length of stay of admission was 9 days, and a minimum length of stay was 0, which is the same day of admission, with a mean and median day of 3 and 3.1 for all CTCs.

**Table 5: Distribution of cholera cases by treatment Center and dehydration status in Afar region, Ethiopia**

| Health Facility (CTC) | Dehydration status | | | | |
|---|---|---|---|---|---|
| | No DHN | Severe DHN | Some DHN | Grand Total | Percentage% |
| **MSF CTC** | 24 | 75 | 32 | 131 | 32.0% |
| **Ayssaita Hospital CTC** | 0 | 89 | 6 | 95 | 23.2% |
| **Dubti Hospital CTC** | 0 | 77 | 1 | 78 | 19.0% |
| **Werer CTC** | 3 | 32 | 30 | 65 | 15.9% |
| **Debel HC CTC** | 0 | 28 | 0 | 28 | 6.8% |
| **Semera HC CTC** | 0 | 7 | 0 | 7 | 1.7% |
| **MAMGH CTC** | 0 | 6 | 0 | 6 | 1.5% |
| **Grand Total** | 27 | 314 | 69 | 410 | 100.0% |

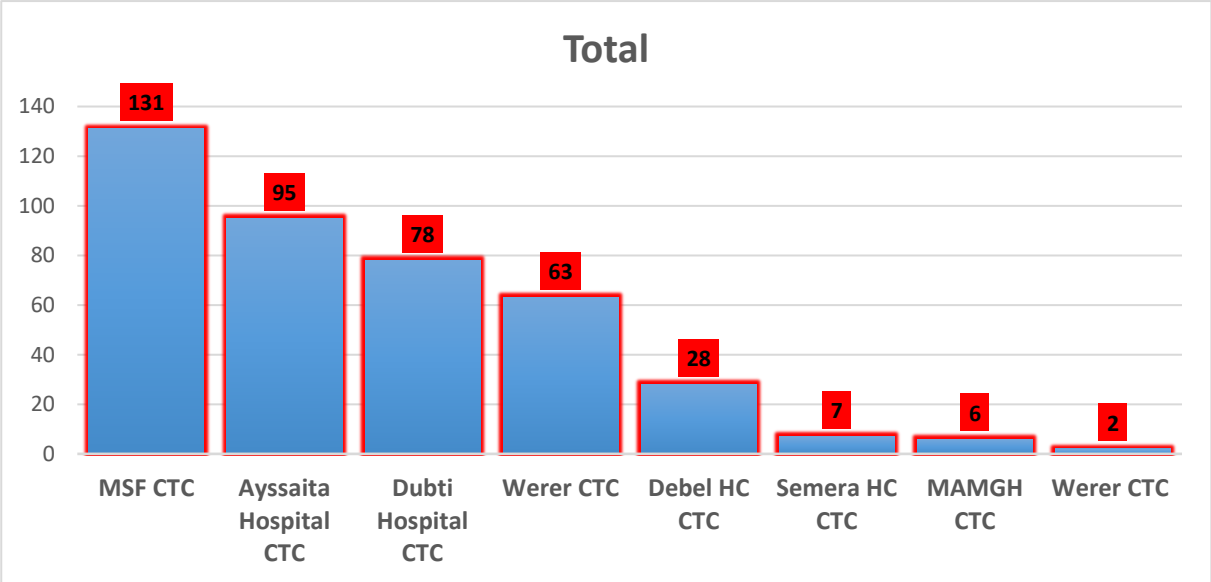


**Figure 7: Distribution of cholera cases by treatment Center and in Afar region, Ethiopia**

## Cholera Cases by Occupation and Water Source

This study found a strong correlation between river water use and cholera incidence among different occupational groups. The most affected population was daily workers, 255(62.2%) out of the total number, of which 242(62.2%) cases are attributed to river water, in contrast, lower cases were traced back to tap Water (12 cases) and pump water (1 case) among them. The trend suggests that it is the daily workers affected, possibly due to occupational exposure to regions surrounding infected river sources. Students and children are the second most affected, making up 52(12.7%) and 37(9%) cases, related to river water. Merchants and militia have the lowest case, with 4(1%) and 1(0.2%). As such, tap and pump water are associated with substantially fewer cases of cholera across all occupations, reflecting the fact that these sources are a safer option, respectively, even though it might be less available.

**Table 6: Distribution of cholera cases by source of water and occupation in Afar region, Ethiopia, 2024**

| Occupation | Source of Water | | | Total (%) | |
|---|---|---|---|---|---|
| | River | Tap water | Pump water | Grand Total | percentage% |
| Daily laborer | 242 | 12 | 1 | 255 | 62.2% |
| Student | 47 | 5 | 0 | 52 | 12.7% |
| Child | 23 | 14 | 0 | 37 | 9.0% |
| Housewife | 29 | 2 | 0 | 31 | 7.6% |
| Not mentioned | 13 | 2 | 0 | 15 | 3.7% |
| Pastoralist | 1 | 0 | 14 | 15 | 3.7% |
| Merchant | 2 | 2 | 0 | 4 | 1.0% |
| Militia | 1 | 0 | 0 | 1 | 0.2% |
| Grand Total | **358** | **37** | **15** | **410** | **100.0%** |

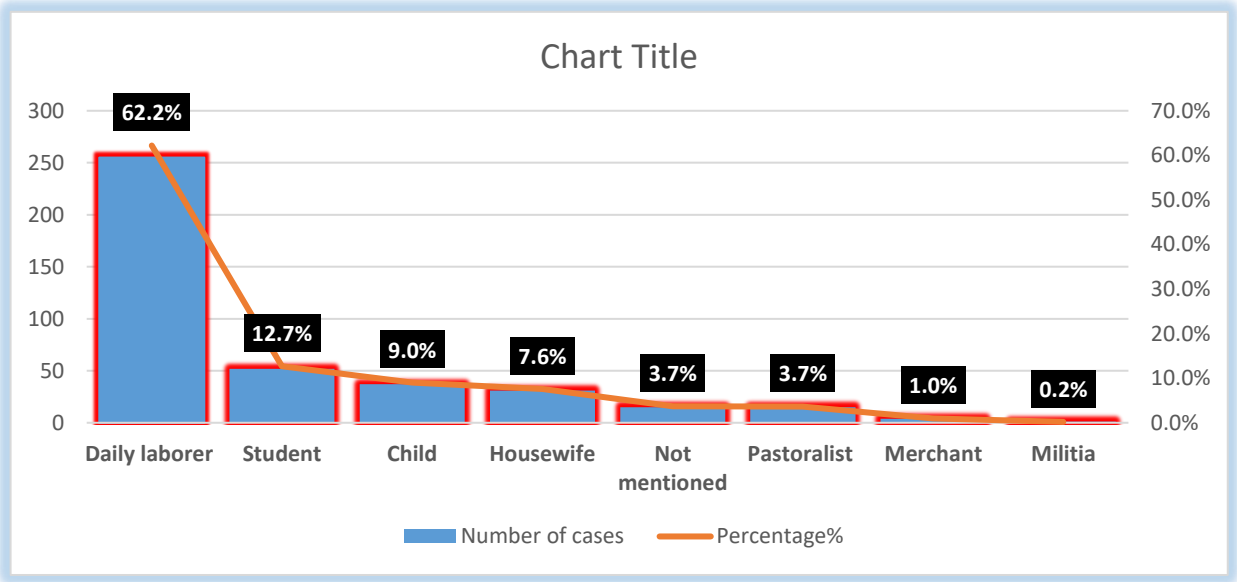


**Figure 8: Distribution of cholera cases by Occupation in the Afar region, Ethiopia,2024**

## Cholera cases by latrine access and Occupation

The research revealed that latrine access by cholera cases in the Afar region was highly limited, with a mere 5% of cases having access to latrines. Among the population with latrine access, students were the most prevalent.

However, the majority of all occupational classes did not have latrine access, mainly daily laborers, who accounted for 63.5%, followed by students (11.9%), children (8.6%), and housewives (7.1%). Limited access to latrines was uniformly affecting all occupational classes but disproportionately affecting daily laborers and students.

**Table 7: distribution of cholera cases by latrine access and occupation in Afar region, Ethiopia,2024**

| Occupation | Latrine Access | | Total |
|---|---|---|---|
| | **No** | **Yes** | **total** |
| Daily laborer | 251(63.5%) | 4(1.0%) | 255(64.6%) |
| Child | 34(8.6%) | 3(0.8%) | 37(9.4%) |
| Housewife | 28(7.1%) | 3(0.8%) | 31(7.8%) |
| Merchant | 2(0.5%) | 2(0.5%) | 4(1.0%) |
| Pastoralist | 14(3.5%) | 1(0.3%) | 15(3.8%) |
| Student | 47(11.9%) | 5(1.3%) | 52(13.2%) |
| Militia | 1(0.3%) | 0(0%) | 1(0.3%) |
| Total | 377(95.4%) | 18(4.6%) | 395(100%) |

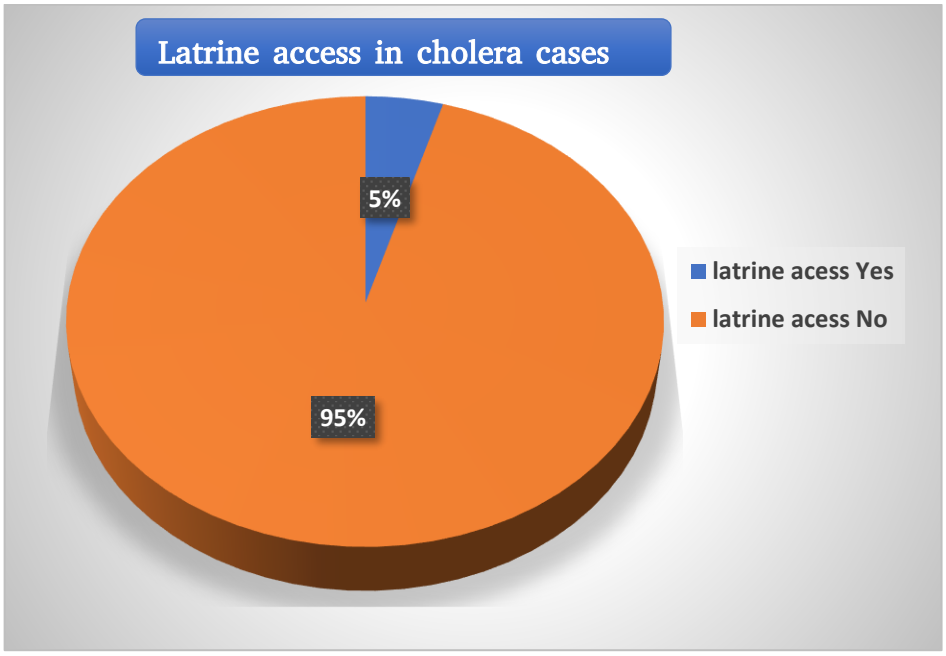


**Figure 9: Distribution of cholera cases by Larine access in Afar region, Ethiopia, 2024**

## Case-Control study

### Geographical distribution of study participants

This study, with 45 cases and 90 controls, categorized participants into cases and controls across two zones and their respective Districts. Zone 1 accounted for the majority of participants, comprising 102 individuals (75.6%), with Dubti District contributing the highest number of participants (33, 24.4%) followed by Dubti Town (27, 20.0%), Ayssaita District (18, 13.3%), Ayssaita Town (9, 6.7%), and Afambo (6, 4.4%). Zone 3 included 33 participants (24.4%) distributed across Werer Adebtoli (12, 8.9%), Gelealu (9, 6.7%), and both Amibara and Hanruka, each with 6 participants (4.4%).

**Table 8: Distribution of study participants in the case-control study by Zone and District in Afar Region, Ethiopia,2024**

| Zones/Districts | Case | Control | Grand Total (%) |
|---|---|---|---|
| Zone 1 | 34 | 68 | 102(75.6%) |
| Afambo | 2 | 4 | 6(4.4%) |
| Ayssaita Town | 3 | 6 | 9(6.7%) |
| Ayssaita District | 6 | 12 | 18(13.3%) |
| Dubti Town | 9 | 18 | 27(20.0%) |
| Dubti District | 11 | 22 | 33(24.4%) |
| Semera- Logiya | 3 | 6 | 9(6.7%) |
| Zone 3 | 11 | 22 | 33(24.4%) |
| Amibara | 2 | 4 | 6(4.4%) |
| Gelealu | 3 | 6 | 9(6.7%) |
| Hanruka | 2 | 4 | 6(4.4%) |
| Werer Adebtoli | 4 | 8 | 12(8.9%) |
| Grand Total | 45 | 90 | 135(100%) |

### Socio-demographic distribution of study participants

The Sociodemographic Characteristics of the study participants when comparing cases and controls. Males constituted the majority (77%), with most cases (82.2%) also being male. The age group 15–35 years was predominant (41.5%), followed by 5–15 years (26.7%). Occupation data revealed that daily laborers (40%) and housewives (31.1%) were the most represented. (Table 9)

*Table 9: Sociodemographic characteristics of the study population in Afar Region, April 2024*

| Variables | | Controls (%) | Cases (%) | Total (%) |
|---|---|---|---|---|
| Sex | Male | 67(74.4) | 37(82.2%) | 104(77.0%) |
| | Female | 23(25.6%) | 8(17.8%) | 31(23%) |
| Age | 2-5 | 5(5.6%) | 3(6.7%) | 8(5.9) |
| | 5-15 | 7(7.8%) | 5(11.1%) | 12(8.9%) |
| | 15-25 | 40(44.4%) | 16(35.6%) | 56(41.5%) |
| | 25-35 | 28(31.1%) | 14(31.1%) | 42(31.1%) |
| | 35-45 | 5(5.6%) | 5(11.1%) | 10(7.4%) |
| | >45 | 5(5.6%) | 2(4.4%) | 7(5.2%) |
| Occupation | Daily laborer | 76(84.4%) | 31(68.9%) | 107(79.3%) |
| | Housewife | 2(2.2%) | 4(8.9%) | 6(4.4%) |
| | Merchant | 4(4.4%) | 3(6.7%) | 7(5.2%) |
| | Student | 3(3.3%) | 4(8.9%) | 7(5.2%) |
| | Child | 0(0%) | 3(6.7%) | 3(2.2%) |
| | Pastoralist | 5(5.6%) | 0(0%) | 5(3.7%) |

## Determinants of Cholera Infection

In the bivariate logistic regression, several factors showed significant associations with cholera infection. Variables with a p-value less than .25 were considered candidates for inclusion in the multivariable model, following the recommended purposeful selection strategy for logistic regression. After adjusting for potential confounders, five factors remained independently associated with cholera infection. The results of the multivariable logistic regression analysis revealed that Participants with poor knowledge about cholera prevention and transmission were six times more likely to contract cholera compared to those with good knowledge (AOR = 6.06; 95% CI: 1.10–33.33; p = 0.039). Those using unimproved water sources had approximately threefold higher odds of infection compared to individuals using improved sources (AOR = 3.28; 95% CI: 1.20–8.95; p = 0.020). Similarly, individuals lacking access to a latrine were 4.6 times more likely to be infected than those with access (AOR = 4.56; 95% CI: 1.23–16.99; p = 0.024). Contact with a suspected AWD patient increased the likelihood of infection by over threefold (AOR = 3.28; 95% CI: 1.24–8.69; p = 0.017), while individuals who had recently traveled to areas with an active cholera outbreak were nearly three times more likely to become infected (AOR = 2.79; 95% CI: 1.08–7.22; p = 0.034).

**Table 10: Bivariate and multivariable logistic regression analyses of determinants of cholera infection, Afar, Ethiopia, 2024 (Case–Control Study)**

| Variables | | Cases n (%) | Controls n (%) | Bivariate Analysis | | Multivariable Analysis | |
|---|---|---|---|---|---|---|---|
| | | | | COR (95% CI) | P-value | AOR (95% CI) | P-value |
| Knowledge about cholera | Good | 2 (4.4) | 21 (23.3) | 1 | 1 | 1 | |
| | Poor | 43 (95.6) | 69 (76.7) | 6.54 (1.46–29.31) | 0.014 | 6.06 (1.10–33.33) | 0.039 |
| Water source | Improved | 7 (15.6) | 45 (50.0) | 1 | 1 | 1 | |
| | Unimproved | 38 (84.4) | 45 (50.0) | 5.43 (2.19–13.43) | <0.001 | 3.28 (1.20–8.95) | 0.020 |
| Latrine access | Yes | 3 (6.7) | 35 (38.9) | 1 | 1 | 1 | |
| | No | 42 (93.3) | 55 (61.1) | 8.91 (2.56–30.96) | 0.001 | 4.56 (1.23–16.99) | 0.024 |
| Contact with a suspected AWD patient | No | 27 (60.0) | 72 (80.0) | 1 | 1 | 1 | |
| | Yes | 18 (40.0) | 18 (20.0) | 2.67 (1.21–5.87) | 0.015 | 3.28 (1.24–8.69) | 0.017 |
| Travel history to an active cholera outbreak | No | 27 (60.0) | 77 (85.6) | 1 | 1 | 1 | |
| | Yes | 18 (40.0) | 13 (14.4) | 3.95 (1.71–9.12) | 0.001 | 2.79 (1.08–7.22) | 0.034 |

**Note. COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval. *Significant at p < .05.**

## Interventions and Surge Team Deployment

A five-member team from the Ethiopian Public Health Institute (EPHI) was deployed to the Afar region to coordinate, support, and investigate the cholera outbreak. The team initiated their efforts by holding a meeting with the Afar Public Health Institute to collect baseline information on the outbreak situation. The team actively participated in task force meetings, Emergency Operations Center (EOC) sessions, and cluster meetings to guide partners on areas requiring support. The team facilitated the establishment of Oral Rehydration Points (ORPs) and Cholera Treatment Centers (CTCs) in various Districts and kebeles. Additionally, they mobilized health extension workers to conduct disinfection campaigns, distribute water treatment chemicals, and educate communities about cholera prevention. Religious leaders were engaged to disseminate information about the outbreak to the community.

## Field Observation

Field Observations and Recommendations During field visits, the team identified that most cholera cases originated from agricultural sites in Zone 1, which hosted a large number of migrant workers from the Amhara region. Many of these workers were unvaccinated and lacked access to clean dr inking water, relying instead on unimproved water from the Awash River agricultural canals for drinking and food preparation. The team reported these findings to the district administration,

recommending that agricultural investors be required to provide water tankers at their sites to ensure access to safe drinking water.

### Comprehensive Response Activities

Comprehensive response activities were implemented across the region, focusing on coordination, s usurveillance, community-level interventions, WASH improvements, and case management. Coordination efforts were led by the Regional Public Health Institute, which collaborated with health professionals and stakeholders to revitalize Rapid Response Teams (RRTs) and establish outbreak response pillars at regional, zonal, and District levels. Daily task force meetings at the zonal level, weekly EOC sessions, and regular cluster meetings strengthened collaboration between governmental and non-governmental partners. Field visits to affected areas, including CTCs, and discussions with local coordinators reinforced intervention strategies, with particular attention to RCCE (Risk Communication and Community Engagement), WASH, and surveillance at the community level. Surveillance activities included active case finding, contact tracing, and rumor verification in were done in newly affected Districts. Data collection systems were enhanced through continuous line lists, regular data analysis, and the dissemination of standardized case definition formats to ensure efficient reporting and monitoring. Case management was carried out at three functional CTCs in Semera Logia, Asayita, and Dubti, as well as two ORPs in the affected Districts. An additional CTC was seated in Zone 3. These centers adhered to standard guidelines for site selection and setup, particularly those supported by Médecins Sans Frontières (MSF) in Asayita and Dubti districts. Case management involved strict disinfection procedures at arrival, during treatment, and at discharge. Facilities were equipped with separate latrines and showers to maintain hygiene and prevent cross-contamination.

### Partner Contributions

Partner Contributions Various partners contributed significantly to the response. WHO Ethiopia deployed eight officers in Zones 1 and 3, focusing on coordination, RCCE, IPC/WASH, case management, and surveillance. WHO also distributed two tins of 55% HTH to Semera CTC and mobilized six cholera central modules, capable of treating 600 cases, valued at over 1.1 million Ethiopian birr. These were distributed to key locations, including Dubti Hospital and Werer. UNICEF supported RCCE activities in Dubti District by providing a vehicle and two experts. MSF continued its role in case management and support for CTCs in Dubti. Mercy Corps provided a vehicle, while Amref and APDA briefly contributed to RCCE and surveillance in Ayssaita and Dubti. Other organizations also made critical contributions. GOAL provided a vehicle for surveillance activities, transported WASH materials from Semera to Ayssaita, and trained health workers in Dubti. Alight supported IPC/WASH teams by providing a vehicle. Emory University deployed an expert to Ayssaita for technical assistance. Save the Children International (SCI) provided 160 liters of fuel and a vehicle

for 10 days. REACH supported cholera response activities in Zone 3 with vehicle support, while Mothers and Children Multisectoral Development Organization (MCMDO) continues to supply personnel and cover per diem costs in Amibara and Werer Town. Médecins du Monde (MDM) provided two vehicles to support transportation between Semera and Gewane. Although organizations like World Vision and others have concluded their support, their contributions were vital in delivering WASH materials, conducting training, and ensuring transportation for response teams. Despite signif icant progress, the cholera outbreak in the Afar region highlights the need for sustained collaboration, logistical aid, and capacity-building measures to prevent future outbreaks.

### 1.1.6. Discussion

The 2024 cholera outbreak in the Afar region of Ethiopia, centered primarily in Zone 1, represents a critical episode within the country's protracted and complex cholera epidemic. This broader public health crisis, which has been ongoing since August 2022, has affected multiple regions and resulted in tens of thousands of cases and hundreds of deaths nationwide[16]. The persistence of cholera in Ethiopia, as in many other sub-Saharan African countries, is driven by a complex interplay of inadequate water, sanitation, and hygiene (WASH) infrastructure, population movements, and socio-economic vulnerabilities[17]. This study was designed to provide a detailed epidemiological and etio logical investigation of the Afar outbreak. The descriptive component of the study outlined the demographic, geographical, and temporal characteristics of the outbreak, while the case-control anal ysis identified and quantified the key determinants of infection. The findings reveal a compelling narrative of how population mobility, occupational risk, and environmental factors converged to fuel the epidemic, while a robust public health response successfully mitigated its impact on human life.
The descriptive analysis revealed a notable demographic profile, with a strong male predominance (79.3%) and a high concentration of cases among young to middle-aged adults, specifically the 15–25 age group (39.5%). The overall male-to-female ratio was approximately 4:1. This pattern is consistent with other recent cholera outbreak investigations in Africa and within Ethiopia. For instance, a study in Ethiopia's Dollo Ado district found a similar male predominance, with males accounting for 71.7% of cases, and a majority of the affected population falling into the 15–44 age group[18]. This is not merely a statistical observation but a direct reflection of the socio-economic and occupational context of the region. The study data indicate that daily laborers constitute the most affected occupational group, accounting for 62.2% of all cases. Field observations further confirmed that many of these cases were among migrant agricultural workers from the Amhara region. The high prevalence of cholera among males in the 15-35 age group is a direct consequence of their over representation in this daily labor workforce, where their occupational activities expose them to the primary environmental determinants of the disease. This causal link between a specific demographic

group, their occupation, and their vulnerability to infection provides a crucial public health target for future interventions. The spatial distribution of cases was highly concentrated, with Zone 1 accounting for 76% of all cases and the highest attack rates observed in Dubti Town (2.38 per 1,000 people) and Dubti District (1.96 per 1,000). This geographical pattern aligns with reports from other outbreaks, which frequently concentrate in densely populated areas or those with specific environmental risk factors, such as proximity to major water bodiess[19]. The outbreak's epi-curve, with its rapid initial rise and subsequent successive peaks, is characteristic of a propagated outbreak. This indicates ongoing transmission sustained by either person-to-person spread or persistent environmental contamination, rather than a single, resolved point-source event. This temporal dynamic is also consistent with the broader, protracted nature of the current cholera epidemic in Ethiopia, which has continued to recur and spread to new areas since its initial declaration in 2022[20].

A particularly significant finding of this study is the remarkable 0% case fatality rate, with no community or facility deaths recorded. This stands in stark contrast to the typically high CFRs ass ociated with cholera outbreaks in Africa. The World Health Organization (WHO) has set a target of keeping CFRs below 1% in treatment centers, yet many countries on the continent struggle to meet this goal[21]. For example, Africa reported a regional average CFR of 1.9% between 2014 and 2023[22]. More specifically, previous studies in the Afar region have reported a much higher CFR of 4.4%[18]. This study's achievement of a 0% CFR, despite the fact that a large proportion of patients (76.6%) presented with severe dehydration, underscores the profound impact of the rapid and coordinated public health response. The swift establishment of Cholera Treatment Centers (CTCs) and Oral Rehydration Points (ORPs), supported by multiple national and international partners such as the Ethiopian Public Health Institute (EPHI), WHO, and Médecins Sans Frontières (MSF), ensured that critically ill patients received immediate and effective rehydration and treatment. This success story is a powerful testament to the efficacy of a well-resourced and collaborative response model in a resource-limited setting. The multivariable logistic regression analysis identified five key independent predictors of cholera infection.

The study found that individuals with poor knowledge of cholera prevention and transmission were 6 times more likely to be infected than those with good knowledge (AOR: 6.055, 95% CI: 1.100, 33.333). This finding is strongly corroborated by research from other parts of Ethiopia, such as a study in the Dollo Ado district, which found a similar significant association with an AOR of 4.2 [18].The high odds ratio in both studies underscores that a lack of accurate information about transmission and prevention is a fundamental vulnerability, on par with infrastructural deficiencies. With 95.6% of cases in the Afar study reporting poor knowledge, it is clear that targeted public health education is a critical, and often neglected, component of an effective cholera response. The use of unimproved water sources was a significant risk factor, increasing the odds of infection by approximately 3.3 times

(AOR: 3.278, 95% CI: 1.201, 8.947). The descriptive data from the study provided further evidence for this, showing that 358 out of 410 cases were associated with river water use. This is a globally consistent finding, as contaminated water sources are the main vehicle for cholera transmission[17]. However, a comparison with other Ethiopian studies reveals an interesting nuance. While the odds ratio is significant, it is lower than the AOR of 20 (95% CI: 5.2, 73.2) reported for drinking untreated river water in the Dollo Ado outbreak[23]. This discrepancy can be attributed to the categorization of water sources in the present study. The "unimproved" category encompasses both river water and pump water. Since pump water may be less heavily contaminated than direct river water, its inclusion in the same category likely diluted the overall risk estimate, a point that is crucial for interpreting the findings. Nevertheless, the evidence overwhelmingly points to the Awash River, as corroborated by the field observations, as the primary source of contamination. Individuals without access to a latrine were found to be 4.563 times more likely to be infected with cholera (AOR: 4.563, 95% CI: 1.225, 16.996). This finding is a cornerstone of cholera epidemiology and is supported by a wealth of literat ure. A systematic review of cholera determinants in the WHO African region identified a lack of basic sanitation, open defecation, and limited hygiene facilities as key predisposing factors[24]. A study in Ethiopia’s Somali region reported a comparable odds ratio of 3.25 for not having a household latrine[25]. The Afar study's descriptive data, which indicates that 95.4% of cases lacked latrine access, provides a direct and powerful illustration of this statistical association. This demonstrates how open defecation facilitates the fecal-oral route of transmission, particularly when combined with the reliance on contaminated river water for drinking and daily activities. The case-control study found that contact with a suspected patient with acute watery diarrhea (AWD) increased the odds of infection by 3.277 times (AOR: 3.277, 95% CI: 1.236, 8.691). Similarly, a history of recent travel to an active cholera outbreak area made individuals 2.8 times more likely to be infected (AOR: 2.790, 95% CI: 1.078, 7.220). These findings are consistent with the well-documented role of population movement in the spread of infectious diseases[20]. This is where the analytical and descriptive findings of the Afar study converge most powerfully. The field observations identified migrant agricultural workers from the Amhara region as the primary group of origin for many cases. The Amhara region itself had experienced a resurgence of cholera in February 2025[16]. This establishes a logical sequence of events: mobile populations, potentially carrying the pathogen, travel to new areas for work, and upon arrival, an environment with poor sanitation and contaminated water sources allows for the rapid amplification and spread of the disease. The odds ratios for travel and contact with patients quantify this crucial chain of transmission. The broader global context further highlights this dynamic, as seen in the 2025 European autochthonous cases linked to contaminated holy water brought back from a pilgrimage site in Ethiopia[16].

The findings from this study are not a collection of isolated risk factors but rather a synthesis of interconnected vulnerabilities that form a vicious cycle of transmission. The outbreak was fundamentally driven by the nexus of occupation, water, and mobility. Migrant agricultural workers, a highly mobile and vulnerable population, traveled from a region with an active cholera outbreak (Amhara) to the agricultural sites in Afar. Their occupational and living conditions—characterized by a reliance on the untreated Awash River for water and a widespread lack of latrine access—created an environment perfectly suited for the transmission of Vibrio cholerae. This exposure was further compounded by a pervasive lack of knowledge about cholera prevention, which likely resulted in risky behaviors and delays in seeking care. The high odds ratios for unimproved water, lack of sanitation, travel history, and contact with patients all point to a single, powerful conclusion: the cholera outbre ak in Afar was a classic example of how socio-economic factors and population movement can in tersect with environmental and behavioral risks to create a perfect storm for infectious disease transmission

### Study Strengths and Limitations

This study's strengths include its robust case-control design, which allowed for the quantification of risk factors using odds ratios, and the inclusion of detailed descriptive and clinical data. The study's focus on a single, specific outbreak also provides valuable localized data that complements national-level surveillance reports. However, the study has several limitations. The small sample size of the case-control component (45 cases, 90 controls) is a notable limitation, as evidenced by the wide confidence intervals for some of the odds ratios (e.g., knowledge AOR: 6.055, 95% CI: 1.100, 33.333). This may impact the precision of the risk estimates. Additionally, like all case-control studies, it is susceptible to recall bias, where participants' ability to accurately remember their exposures may be limited. The reliance on a case-line list extracted from health facilities means that milder, unrecorded cases and transmission dynamics in the community may be underestimated[20].

## 1.1.7. Conclusion and Recommendations

The cholera outbreak in the Afar region in 2024 was a propagated epidemic driven by a combination of a lack of access to safe WASH infrastructure, poor community knowledge, and population mobility, particularly among agricultural migrant workers. The high odds ratios for unimproved water sources and lack of latrine access, in tandem with the descriptive data linking daily laborers to river water use, paint a clear picture of the primary transmission pathways. The high odds ratios for contact with suspected patients and travel to active areas highlight the critical role of population movement in the introduction and sustained spread of the disease. Despite these challenges, the rapid and coordinated public health response from national and international partners was highly effective, as evidenced by the remarkable 0% case fatality rate. This success is a powerful example of what is possible when

timely and well-resourced interventions are deployed. Based on these findings, the following recommendations are put forth for future public health action and outbreak prevention in the Afar region and similar contexts:

1. Prioritize Targeted WASH Interventions: Immediate efforts should focus on providing safe, chlorinated water and improved sanitation facilities at agricultural sites and in communities with high populations of daily laborers. The provision of these basic services should be a mandatory requirement for agricultural investors.

2. Enhance Risk Communication and Community Engagement (RCCE): Tailored health education campaigns are needed for mobile populations and young adults, focusing on the importance of water treatment, handwashing, and the immediate recognition and reporting of cholera symptoms.

3. Strengthen Surveillance for Mobile Populations: Establish active surveillance and early warning systems at points of entry and in agricultural hubs to proactively monitor for disease introduction by mobile populations and to facilitate timely reactive vaccination campaigns.

4. Sustain Inter-Agency Collaboration: The success of the response demonstrates the value of a coordinated, multi-sectoral approach. It is crucial to institutionalize these collaborative frameworks and ensure continued investment from partners like EPHI, WHO, and MSF to strengthen long-term outbreak preparedness and response capacity.

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# Chapter 2: Surveillance Data Analysis Report

## 2.1.Distribution and Temporal Trends of Colorectal Cancer Incidence in Addis Ababa, Ethiopia: A Five-Year Retrospective Study (2018-2022)

### 2.1.1. Abstract

**Background:** Colorectal cancer (CRC) is a significant public health issue globally, with increasing incidence rates in many regions. Addis Ababa, Ethiopia, has shown rising colorectal cancer cases, yet comprehensive studies on its incidence trends and demographic distributions remain limited. Understa nding these trends is crucial for developing effective public health strategies.

**Methods:** This study conducted a five-year retrospective analysis (2018–2022) using data from the Addis Ababa Population-Based Cancer Registry. We examined annual incidence rates of colorectal cancer, demographic characteristics (age and sex), anatomical tumor site, and basis of diagnosis. Statistical analyses were performed to assess temporal trends and identify significant patterns using Microsoft Excel 2016. Age-standardized incidence rates (ASIR) were calculated to facilitate comparisons across years and between sexes.

**Results**: A total of 1,222 CRC cases were analyzed, with nearly equal incidence among males (ASIR: 8.93 per 100,000) and females (ASIR: 8.77 per 100,000). Age-specific incidence peaked in the 60–69-year age group, while 22% of cases occurred in individuals under 50, indicating a notable early-onset CRC burden. Temporal trends fluctuated over the study period, rising from 6.85 per 100,000 in 2018 to 8.05 in 2019, declining to 5.94 in 2021, and modestly rebounding to 6.24 in 2022. Anatomically, the rectum, NOS (519 cases), and sigmoid colon (436 cases) were the most frequently affected sites, with left-sided tumors predominating, consistent with global epidemiologic patterns. Most cases were managed at Black Lion Specialized Hospital (698 cases), and Saint Paul's Hospital (225 cases), reflecting tertiary center referral patterns. Histological confirmation accounted for the majority of diagnoses (1,058 cases), underscoring robust diagnostic capacity.

**Conclusion:** Colorectal cancer in Addis Ababa demonstrates a significant burden, with notable early-onset cases and left-sided predominance.Temporal fluctuations in incidence may reflect healthcare service disruptions and population growth, highlighting the need for continuous surveillance and high-quality data collection. Strengthened screening programs, clinical vigilance for younger populations, and sustained histopathological diagnostic capacity are essential for effective CRC control.

**Keywords:** Colorectal cancer, incidence, Addis Ababa, early-onset, histopathology, temporal trends

## 2.1.2. Introduction

### Background

Cancer is defined as the rapid proliferation of aberrant cells that surpass their normal limits, invade nearby tissues of the body, and spread to other organs[1]. Colorectal cancer (CRC) is a prevalent malignancy that begins in the large intestine or rectum, posing a serious worldwide health threat and contributing to cancer-related fatalities[2]. It is one of the top three frequently diagnosed cancer types and the second leading cause of death worldwide, with significant morbidity and mortality rates[3]. In 2022, there were approximately 1.9 million new cases and more than 900,000 deaths due to CRC globally according to GLOBOCAN [4]. espite regional differences, more developed countries such as North America and Europe have greater incidence and mortality rates, but less developed places such as Africa are now experiencing a significant increase in CRC cases[5, 6]. In Africa, CRC is the fifth most frequent cancer in both men and women, following breast, prostate, cervical, and liver cancers r espectively[7]. CRC is the third most common cancer in Ethiopia's adult population in both sexes, with males leading the way and females coming in third[8]. Patients frequently present with late stages of cancer[9, 10]. Although population-based data are confined to Addis Abeba, the country is expected to have an annual incidence of roughly 6,551 CRC cases and a fatality of more than 4,863 according to Globocan 2022[11].

The exact reason of colorectal cancer is unknown, but it is thought to be complex. Unhealthy eating habits, tobacco use, a high BMI, and inactivity are all risk factors[12, 13]. Screening for colorectal cancer is critical for early detection and can be accomplished through faecal blood testing and colonoscopy[14-16]. Colorectal cancer treatment choices depend on the stage of the tumor and patient characteristics, and may include surgery, chemotherapy, radiation, molecular targeted therapy, immu notherapy, and other programs[17-19]. To battle cancer, Ethiopia has revised a The National Cancer Control Plan (2016-2020) intends to promote palliative care, early detection, more accurate diagnosis and treatment, research, monitoring, and registration efforts[20].

Despite the increasing incidence of CRC in Ethiopia, there is a lack of comprehensive and up-to-date studies focusing on its distribution and temporal trends. The Addis Ababa Population-Based Cancer Registry (AAPBCR), established in September 2011 at the Radiotherapy Center of Tikur Anbessa Specialized Hospital, School of Medicine, and Addis Ababa University, serves as a valuable resource for cancer data within the region[21]. However, this resource remains underutilized despite its poten tial to inform evidence-based interventions. This study aims to bridge this gap by examining the distribution and temporal trends of colorectal cancer incidence in Addis Ababa using five-year data (2018–2022) from the Addis Ababa Population-Based Cancer Registry. This research effort seeks to

provide critical insight into the epidemiology of CRC in the city, thereby enabling targeted interventions and improved health strategies for CRC management and prevention.

## Statement of the Problem

Colorectal cancer (CRC) is a major global health concern, accounting for the third most prevalent malignancy and the second highest cause of cancer-related deaths globally. In 2022, there were a predicted 1.9 million new cases and more than 900,000 fatalities, with a worrying rise in low- and middle-income nations attributed to lifestyle changes[4]. Africa is also experiencing an increase in CRC cases, which presents issues for healthcare systems that have traditionally focused on infectious diseases[22]. In Ethiopia, restricted access to healthcare, a lack of screening programs, and low public awareness all contribute to delayed diagnoses and poor results for CRC patients[22]. The absence of comprehensive population-based studies on CRC in Ethiopia impedes public health measures and patient care improvement[9].

The incidence of CRC in Ethiopia is on the rise, with estimated rates of 8.5 and 6.3 per 100,000 for men and women, respectively[23]. In Addis Ababa specifically, CRC is the most common cancer among men, accounting for 12.4% of all cancers, and the fourth most common cancer among women, representing 5.4% of all cancers[24]. CRC also contributes significantly to cancer cases at Tikur Anbessa Specialized Hospital (TASH), where it accounts for 12% of cancer cases at the oncology ward and 7.7% of all cancer cases in Addis Ababa[25]. The available data suggests that colorectal cancer incidence rates in Addis Ababa may be higher than those reported for the rest of the country due to urbanization and lifestyle changes associated with economic growth. However, there is no comprehensive analysis of colorectal cancer incidence patterns in Addis Ababa, which limits our understanding of the disease burden and hampers efforts to address it effectively.

The Addis Ababa Population-Based Cancer Registry (AAPBCR) offers a valuable resource for understanding cancer patterns in the city. However, detailed analyses of CRC data to inform policy and practice are lacking[26]. Preliminary reports suggest an increasing trend of CRC cases, mirroring global and regional patterns, but without a detailed examination of distribution by geographical area, gender, and age, and temporal trends, the full extent of the problem remains unclear[27].

There is a paucity of literature on colorectal cancer incidence trends in Ethiopia, especially in Addis Ababa. Previous studies have focused mainly on the overall cancer burden without providing specific details about individual types of cancer or their geographical distribution. Moreover, these studies relied on hospital records rather than population-based registries, limiting their generalizability and accuracy[9, 26, 27].

To address this gap, this study proposes to use the Addis Ababa population-based cancer registry, which provides reliable and up-to-date data on cancer rates in the city. This study focuses specifically on colorectal cancer and seeks to contribute new insights into the distribution and temporal trends of this disease in Addis Ababa, thereby informing policy decisions related to cancer control and treatm ent.

## Significance of the Study

The significance of this study lies in its potential to offer fundamental insight into the distribution and temporal trends of colorectal cancer (CRC) incidence in Addis Ababa, Ethiopia, over a five-year per iod from 2018 to 2022. CRC is a major global health problem and a leading cause of morbidity and mortality worldwide, with cancer. By examining CRC patterns specifically in Addis Ababa, this study can provide valuable data to public health officials, healthcare providers, policymakers, and researchers. Understanding the geographic distribution of CRC cases in different administrative zones or districts of Addis Ababa can help target interventions, resource allocation, and health care planning.Additionally, analysis of gender-specific differences, age-specific patterns, and time trends in CRC incidence rates can inform strategies for early detection, screening programs, treatment protocols, and ultimately improve patient outcomes and survival rates. This study aims to fill a critical knowledge gap regarding the epidemiology of CRC in Addis Ababa and contribute to broader efforts to reduce the burden of CRC and improve public health in the region.

### 2.1.3. Objectives

#### General Objective

To investigate the distribution and temporal trends of colorectal cancer (CRC) incidence among residents of Addis Ababa, Ethiopia, using data from the Addis Ababa Population-Based Cancer Registry (AAPBCR), 2018–2022.

#### Specific Objectives

1. To determine the annual crude and age-standardized incidence rates of colorectal cancer in Addis Ababa.
2. To describe colorectal cancer incidence by person, place, and time.
3. To examine temporal trends in colorectal cancer incidence from 2018 to 2022.
4. To assess incidence patterns by anatomical subsite and histologic type.

## Literature Review

Colorectal cancer (CRC) is a major public health concern worldwide, with high morbidity and mortality rates. According to the World Health Organization's Global Cancer Observatory (GLOBOCAN), an estimated 1.9 million new cases of CRC will be detected worldwide in 2022, making it the third most often diagnosed cancer. CRC is also the second greatest cause of cancer death, accounting for approximately 935,000 deaths in 2022[4]. Globally, men have a higher age-standardized incidence rate (23.6 per 100,000) than women (16.3 per 100,000), and the disease is 3-4 times more common in industrialized nations than in developing ones[28]. Despite significant progress in lowering mortality rates, certain nations have seen a worrying trend of increased incidence rates among young adults (aged 20 to 49 years) [29, 30]. Research indicates that younger individuals diagnosed with colorectal cancer often display more aggressive histopathologic characteristics and are typically diagnosed at more advanced stages[31]. Genetic mutations play a role in causing hereditary colorectal cancer in young individuals, however, cases of early-onset colorectal cancer not related to genetics are on the rise as well[32]. This increase is due to a variety of variables, including lifestyle changes, food choices, and increased screening adherence in younger groups [33]. Various factors like population growth, aging populations, and economic progress are anticipated to contribute to the escalating global burden of colorectal cancer (CRC) in the future. It is estimated that there will be 3 million new cases of CRC annually by 2040, which is a 56% rise from 2020 [34].

n sub-Saharan Africa, CRC is the fifth most common cancer but has a lower prevalence rate (5.9 per 100,000 per year) than in more developed regions. However, CRC mortality is significantly higher (17.7 per 100,000 per year) due to limited screening, low public awareness, and insufficient diagnostic resources, which lead to late-stage diagnosis and poorer treatment outcomes[30, 31].

CRC is the third most common cancer in Ethiopia, after breast and cervical cancer. The incidence of CRC in Ethiopia is estimated to be 8 per 100,000 person-years, with a 15.3% prevalence of advanced disease at the time of diagnosis[26]. According to studies, most CRC cases in Ethiopia are detected at an advanced stage, with more than 75% being stage III or IV cancer[9]. In addition, awareness of C RC among the general Ethiopian population is minimal, with more than half of survey respondents having lower awareness of CRC[35].

According to the Addis Ababa Cancer Registry, CRC is the first most common cancer in men and the fourth most common in women in Ethiopia [26]. CRC accounts for approximately 12.2% of all cancer-related deaths in men and 4.8% in women[36]. The incidence of CRC in Ethiopia is rising, with an estimated rate of 8.5 and 6.3 per 100,000 in men and 6.3 per 100,000 in men and women, respectively[23].

In Addis Ababa, CRC is the most common malignancy in men, accounting for 12.4% of all malignancies, and the fourth most common malignancy in women, accounting for 5.4% of all malig nancies[24]. CRC also accounts for 12% of cancer cases in the Oncology Department of Tikur Anbessa Specialized Hospital (TASH) and 7.7% of all cancer cases in Addis Ababa[25, 37].

## Conceptual Framework

This study utilizes data from the Addis Ababa Population-Based Cancer Registry to analyze the incidence of colorectal cancer from 2018 to 2022. The framework incorporates key variables such as demographic characteristics, year of diagnosis, morphology, basis of diagnosis, treatment type, anat omical site, health facility, and population size or residency to assess the distribution and temporal trends. It quantifies proportions, crude and age-standardized incidence rates, and examines the distribution of colorectal cancer by age, sex, tumor site, and diagnostic category. This framework provides a comprehensive understanding of colorectal cancer patterns and trends in Addis Ababa over the study period.

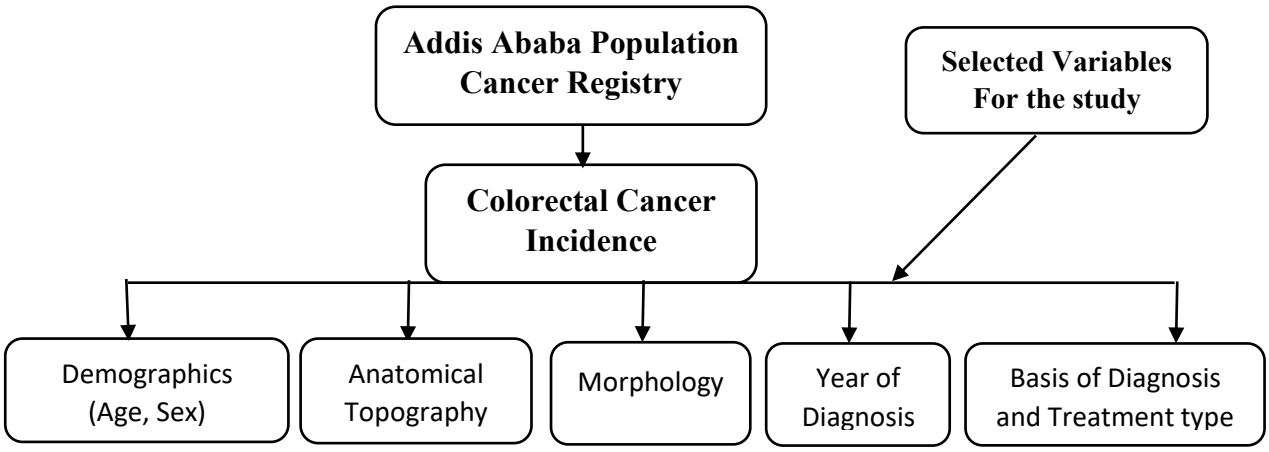


**Figure 10: Conceptual framework of colorectal cancer incidence in Addis Ababa, Ethiopia**

## 2.1.4. Methods and Materials

### Study area and period

The study was conducted in Addis Ababa, the capital city of Ethiopia, located in the central part of Ethiopia. Addis Abeba has an estimated population of 4,030,000, comprising 1,900,000 males and 2,130,000 females. The population of Addis Abeba is considered an urban population; the city has 96 hospitals (government and private), providing healthcare services[38]. Administratively, the city is divided into 11 sub-cities[39].

The study was conducted from February to March 2024, using the Addis Ababa Cancer Registry data from 2018-2022.

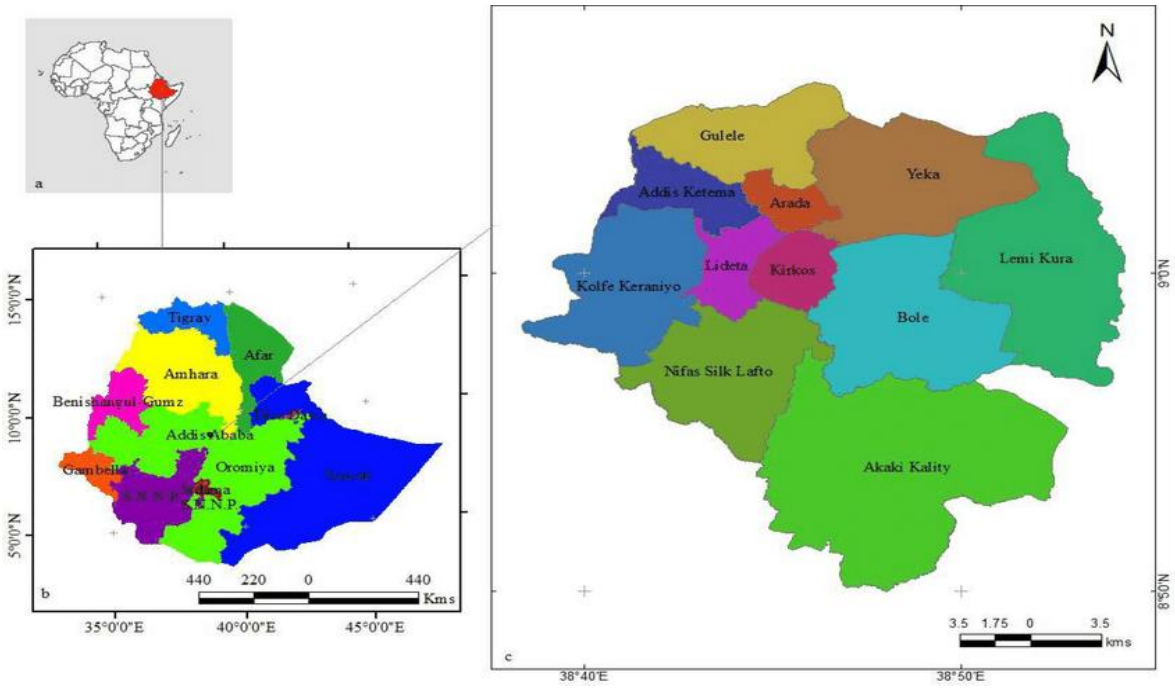


**Figure 11: Map of Addis Ababa, Ethiopia**

### Study Design

The study uses a retrospective descriptive study design to investigate the distribution and temporal trends of colorectal cancer (CRC) incidence among patients diagnosed and treated in Addis Ababa, Ethiopia, over five years (2018-2022). This design involves analyzing existing cancer Registry data to assess past occurrences and outcomes of CRC cases. Retrospective studies are well-suited for exa mining disease trends and incidence over time, making them ideal for this research objective. By reviewing cancer Registry data from the designated timeframe, the study captured a comprehensive overview of CRC cases at the city administration and identified patterns or changes in incidence rates in Addis Abeba, Ethiopia from 2018 to 2022.

**Source Population**

The source population was all individuals residing in Addis Ababa during the study period (2018–2022) who had the potential to develop colorectal cancer. This includes all residents of Addis Ababa, particularly those eligible for screening and diagnosis within healthcare facilities.

**Study Population**

The study population consists of individuals with a confirmed diagnosis of colorectal cancer during the specified period (2018–2022) who were residing at least a 6-month duration of stay as residents of Addis Ababa City and registered in the Addis Abeba cancer registry.

## Inclusion and exclusion criteria

**Inclusion Criteria**

**Time Frame:** Patients diagnosed with CRC between January 1, 2018, and December 31, 2022, were included in the study to capture data over five years.

**Diagnosis:** Individuals with confirmed diagnoses of CRC based on standardized diagnostic criteria were included.

**Age:** Patients of all ages were included in the study to provide a comprehensive assessment of CRC burden across different age groups.

**Cases**: CRC cases registered in the Addis Abeba City cancer registry, between January 1, 2018, and December 31, 2022, were included.

**Exclusion criteria**

**Duplicate Entries:** Duplicate entries of the same patient (same id num) within the Cancer registry were excluded to avoid double counting and ensure data accuracy.

**Incomplete Data:** CRC cases with missing or incomplete information regarding patient demogr aphics, and diagnosis were excluded from the analysis to maintain data quality and integrity.

**Suspected causes**: Patients with Suspected causes or unconfirmed diagnosis of colorectal cancer based on clinical presentation alone, without histological confirmation.

**Non-Oncological Conditions:** Patients diagnosed with benign tumors, non-neoplastic conditions, or other non-cancerous diseases were excluded from the study to focus specifically on CRC diseases

## Sample Size and Sampling Technique

Since this is a retrospective review encompassing the entire population of eligible CRC patients during the designated period, a complete enumeration of cases was conducted. This eliminates the need for sampling techniques and ensures the analysis captures all relevant data within the defined timeframe.

## Operational Definitions

**Colorectal Cancer Cases:** Refer to patients who have been diagnosed with cancer in the colon or rectum and surrounding area based by histopathological examination of tissue samples or clinical diagnosis confirmed by medical records at Addis Abeba.

**Patients Treated in Addis Abeba:** Refer to patients who are a resident of addis Abeba at list 6 months duration of stay in Addis Ababa City and received medical care, including diagnostic evaluations, surgeries, chemotherapy, or other interventions related to colorectal cancer, at the hospital within a specified timeframe.

**Incidence:** Incidence refers to the number of new cases of colorectal cancer that occur at each year of the 2018 to 2022 duration among patients treated in Addis Abeba, Ethiopia.

**Prevalence**: Prevalence refers to the total number of cases of colorectal cancer among patients treated in addis abeba, Ethiopia from 2018 to 2022, regardless of when the diagnosis was made.

**Trends:** Trends refer to the patterns or changes observed in the incidence or prevalence of colorectal cancer cases over time among patients treated in addis abeba, Ethiopia.

**ICD-10 (International Classification of Diseases, 10th Revision):** A WHO-developed system for coding and classifying diseases and health conditions using alphanumeric codes. It standardizes health data for global reporting and comparison.

**Morphology:** refers to the histological classification of colorectal cancer cells, such as adenoc arcinoma or mucinous carcinoma, based on the ICD-10 system. it captures the microscopic structure and cellular characteristics of the tumor.

**Anatomical Topography:** classifies the specific site of cancer origin within the colon or rectum, i.e., the sigmoid colon or rectum, based on ICD-10 codes. it classifies the location of the tumor for clinic and research purposes.

## Data Collection Procedures, Quality Assurance, and Analysis

The primary data source was the Addis Ababa City Cancer Registry, managed by Tikur Anbesa Specialized Hospital Cancer Treatment Center, containing CRC case details such as age, sex, residency, morphology, diagnosis, and anatomical topography. Extracted data were cleaned and

validated to address missing values, outliers, and inconsistencies, ensuring accuracy and reliability. Data quality assurance involved addressing missing or inconsistent entries through consultation with original sources, data cleaning to remove duplicates, and resolving errors to ensure a reliable dataset. The data were analyzed using Microsoft Excel 2016, employing descriptive statistics to summarize demographic characteristics, including frequencies, percentages, means, and medians. Incidence rates, age-standardized rates were calculated, with subgroup analyses exploring variations by demographic and clinical factors. GIS mapping visualized the geographic distribution of CRC cases across Addis Ababa, while trend analysis identified significant changes in CRC burden over time. These combined efforts ensured a high-quality dataset, offering robust insights into CRC prevalence and trends.

## Ethical Considerations

The principles of confidentiality, privacy, and informed consent were strictly adhered to during data collection and analysis. Patient identifiers were anonymized and kept confidential to ensure the pri vacy of participants. Informed consent was waived since the study involves the analysis of the existing cancer registry, and no direct contact with patients was made. The study complied with the ethical guidelines and regulations set forth by the institution and national regulations.

## 2.1.5. Result

### Distribution by Demographics

#### Age Distribution of Colorectal Cancer Cases

Between 2018 and 2022, a total of 1,222 colorectal cancer (CRC) cases were reported in Addis Ab abaEthiopia. The highest proportions were recorded in the 50–59 and 60–69 age groups, with 286 (23.4%) and 284 (23.2%) cases, respectively, while the lowest proportion was observed among individuals aged over 70, accounting for 161 cases (13.2%). The mean age at diagnosis was 52.3 years (SD ±14.4), with a median age of 52 years and an interquartile range (IQR) of 40–64 years, indicating that CRC primarily affects middle-aged adults. Age-standardized incidence rates (ASIR) further support this pattern, with the highest ASIR observed in the 60–69 age group (2.80 per 100,000), followed by the 50–59 age group (2.31 per 100,000), indicating a consistent age-related gradient in incidence.

**Table 11: Crude and age-adjusted standardized incidence rate for age distribution colorectal cancer incidence in Addis Ababa, Ethiopia**

| Years | Variables | <40 | 40-49 | 50-59 | 60-69 | ≥70 | total |
|---|---|---|---|---|---|---|---|
| 2018 | CRC Case | 35(14.9%) | 39(16.6%) | 63(26.8%) | 59(25.1%) | 39(16.6%) | 235(19.2%) |
| | population | 2,696,311.00 | 418,884.00 | 211,519.00 | 119,470.00 | 72,816.00 | 3,519,000.00 |
| | ASIR | 0.85 | 1.18 | 2.95 | 3.30 | 2.83 | 11.11 |
| 2019 | CRC Case | 70(24.1%) | 48(16.6%) | 66(22.8%) | 62(21.4%) | 44(15.2%) | 290(23.7%) |
| | population | 2,760,701.00 | 428,865.00 | 216,561.00 | 122,320.00 | 74,553.00 | 3,603,000.00 |
| | ASIR | 1.66 | 1.41 | 3.02 | 3.39 | 3.12 | 12.60 |
| 2020 | CRC Case | 49(21.1%) | 39(16.8%) | 58(25.0%) | 59(25.4%) | 27(11.6%) | 232(19.0%) |
| | population | 2,625,090.00 | 564,821.00 | 273,134.00 | 146,151.00 | 79,809.00 | 3,689,005.00 |
| | ASIR | 1.22 | 0.87 | 2.11 | 2.70 | 1.79 | 8.68 |
| 2021 | CRC Case | 50(22.3%) | 43(19.2%) | 44(19.6%) | 57(25.4%) | 30(13.4%) | 224(18.3%) |
| | population | 2,685,616.00 | 577,814.00 | 279,410.00 | 149,516.00 | 81,645.00 | 3,774,001.00 |
| | ASIR | 1.22 | 0.94 | 1.56 | 2.55 | 1.94 | 8.21 |
| 2022 | CRC Case | 61(25.3%) | 57(23.7%) | 55(22.8%) | 47(19.5%) | 21(8.7%) | 241(19.7%) |
| | population | 2,746,265.00 | 590,909.00 | 285,753.00 | 152,896.00 | 83,817.00 | 3,859,640.00 |
| | ASIR | 1.46 | 1.22 | 1.91 | 2.05 | 1.32 | 7.96 |
| Total | CRC Cases | 265(21.7%) | 226(18.5%) | 286(23.4%) | 284(23.2%) | 161(13.2%) | 1222(100%) |
| | ASIR | 1.28 | 1.12 | 2.31 | 2.80 | 2.20 | 9.71 |

## Sex Distribution of Colorectal Cancer Cases

Over the five-year period from 2018 to 2022, colorectal cancer (CRC) in Addis Ababa showed a relatively balanced gender distribution, with males accounting for 602 (49%) and females for 620 (51%) of the total 1,222 cases. Incidence rates fluctuated annually, with the highest recorded in 2019 for both sexes—7.75 per 100,000 in males and 8.32 per 100,000 in females. Despite annual variations, males consistently exhibited higher average incidence rates (6.91 per 100,000) compared to females (6.37 per 100,000). The age-standardized incidence rate (ASIR) demonstrated a declining trend in both sexes, dropping from 12.7 to 8.34 per 100,000 in males and from 9.69 to 7.67 per 100,000 in females over the study period. On average, males had a slightly higher ASIR (8.93) than females (8 .77), indicating a modest but consistent gender disparity in CRC burden.

**Table 12: Crude and age adjusted standardized incidence rate for sex distribution colorectal cancer incidence in Addis Ababa, Ethiopia**

| Year | Male Incidence | Female Incidence | Male Population | Female Population | Male ASIR | Female ASIR |
|---|---|---|---|---|---|---|
| 2018 | **124(20.6%)** | **111(17.9%)** | 1,664,001 | 1,854,999 | **12.70** | **9.69** |
| 2019 | **132(21.9%)** | **158(25.5%)** | 1,703,001 | 1,899,999 | **9.79** | **10.57** |
| 2020 | **107(17.8%)** | **125(20.2%)** | 1743003 | 1,946,002 | **8.59** | **8.88** |
| 2021 | **115(19.1%)** | **109(17.6%)** | 1782000 | 1,992,001 | **5.22** | **7.04** |
| 2022 | **124(20.6%)** | **117(18.9%)** | 1821691 | 2,037,623 | **8.34** | **7.67** |
| Total | **602(49.1)** | **620(50.9)** | **Average Incidence** | | 8.93 | 8.77 |

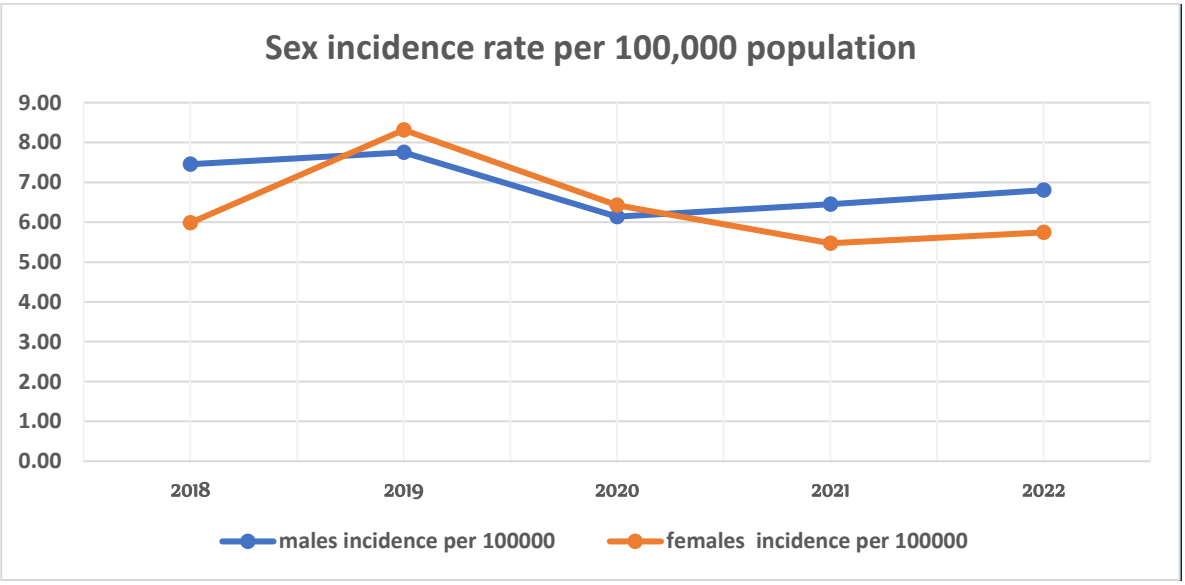


**Figure 12: Sex incidence rate of colorectal cancer incidence in Addis Ababa, Ethiopia**

## Temporal Trends of Colorectal Cancer Incidence (2018-2022)

Over the five years from 2018 to 2022, a total of 1,222 colorectal cancer (CRC) cases were reported in Addis Ababa, with an average annual incidence rate of 6.64 per 100,000 population. The number of cases peaked in 2019 at 290 (8.05 per 100,000) and reached its lowest in 2021 with 224 cases (5.94 per 100,000). Annual fluctuations were observed, including a rise in 2022 to 241 cases (6.24 per 100,000), following a dip in 2020 and 2021. These variations in incidence do not suggest a consistent upward or downward trend but may reflect changes in disease detection, reporting practices, or heal thcare access over time. Additionally, the population in Addis Ababa grew consistently from 3.5 millio n in 2018 to 3.86 million in 2022, which could affect the calculation of incidence rates

**Table 13: Colorectal cancer trend over five years (2018-2022) in Addis Ababa, Ethiopia**

| Year | Frequency (%) | Population | Incidence per 100,000 |
|---|---|---|---|
| 2018 | 2,35(19.2%) | 3,519,000 | 6.68 |
| 2019 | 2,90(23.7%) | 3,603,000 | 8.05 |
| 2020 | 2,32(19.0%) | 3,689,000 | 6.29 |
| 2021 | 2,24(18.3%) | 3,774,000 | 5.94 |
| 2022 | 2,41(19.7%) | 3,860,000 | 6.24 |
| Total | **1,222** | **Average Incidence** | **6.64** |

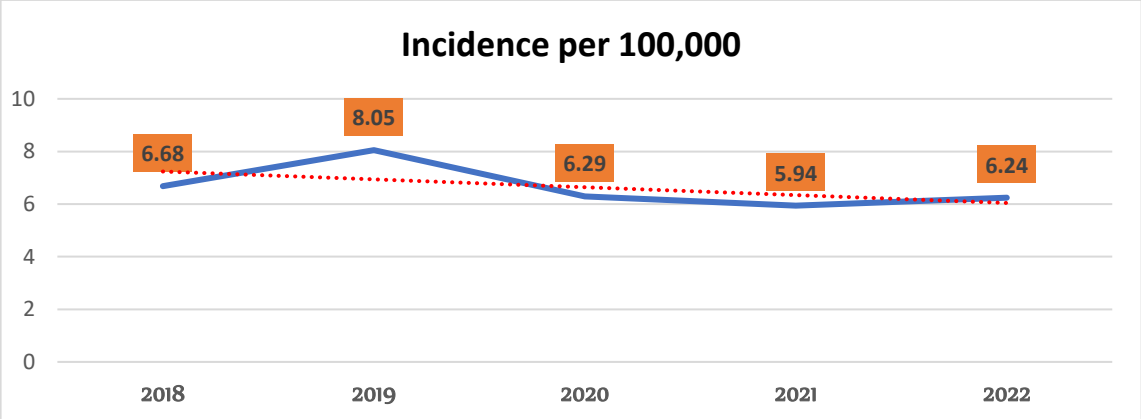


**Figure 13: trend line of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia**

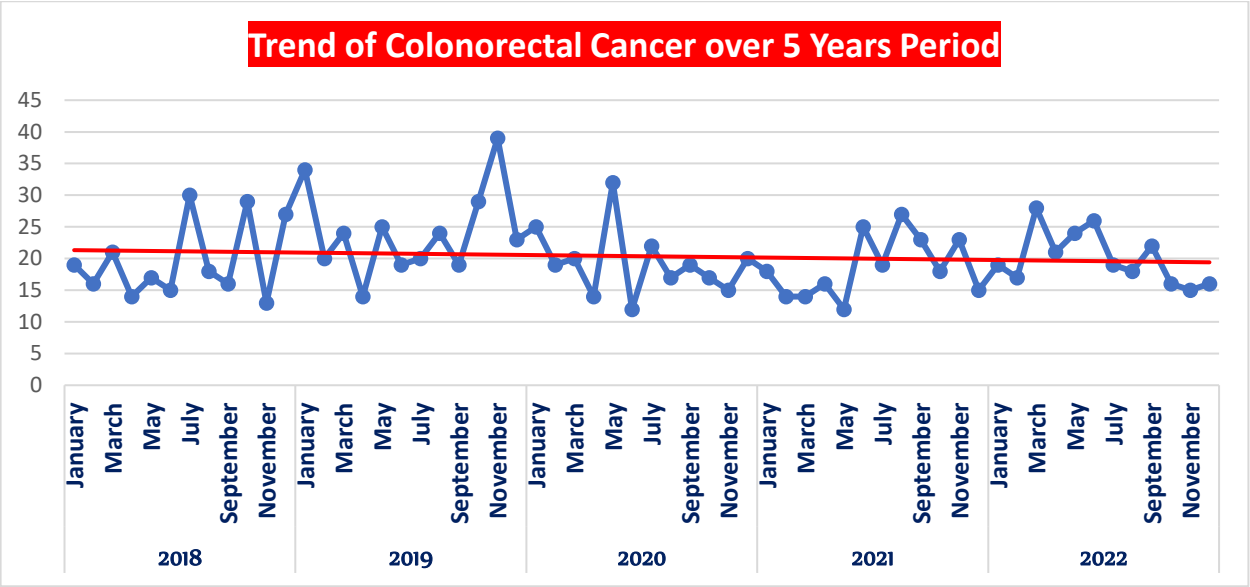


**Figure 14: trend of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia**

## Geographical Distribution of Colorectal Cancer Cases (2018-2022)

The geographical distribution of colorectal cancer cases across the sub-cities of Addis Ababa reveals marked disparities in incidence. Yeka sub-city reported the highest number of cases, with 182 cases representing 14.9% of the total, followed closely by Kolfe sub-city recorded 178 cases, accounting for 14.6% of the total incidence. Conversely, the lowest incidence was observed in Lideta sub-cities and Lemi Kura, with 59 and 8 cases, constituting 4.8% and 0.7% of the total cases, respectively. The notably low case count was registered in Lemi Kura sub-city.

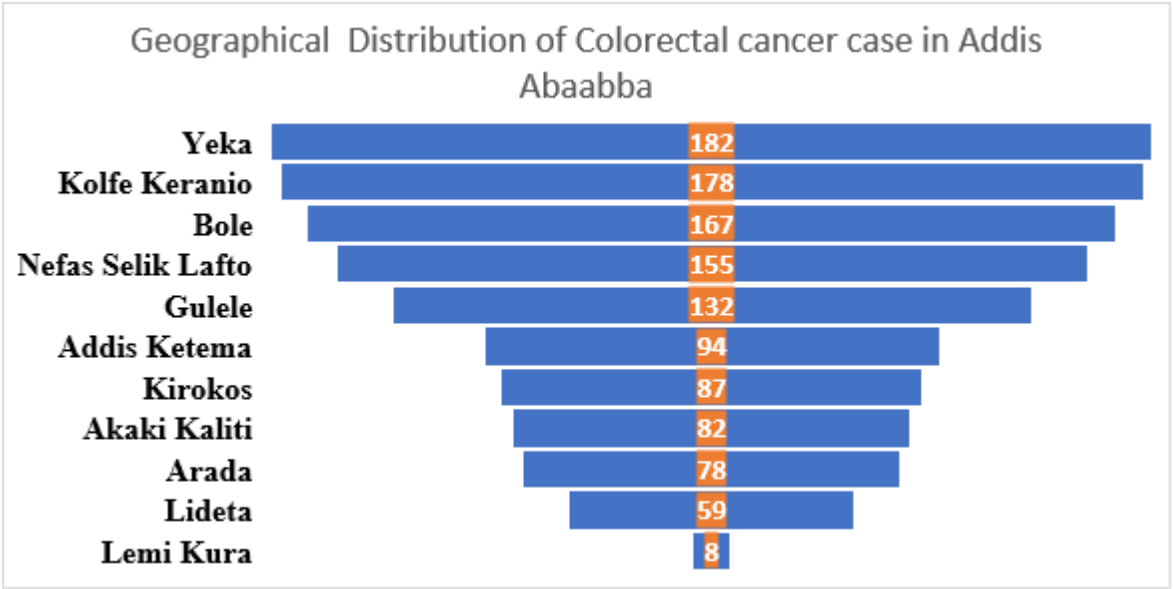


**Figure 15: Geographical distribution of colorectal cancer incidence in Addis Ababa, Ethiopia**

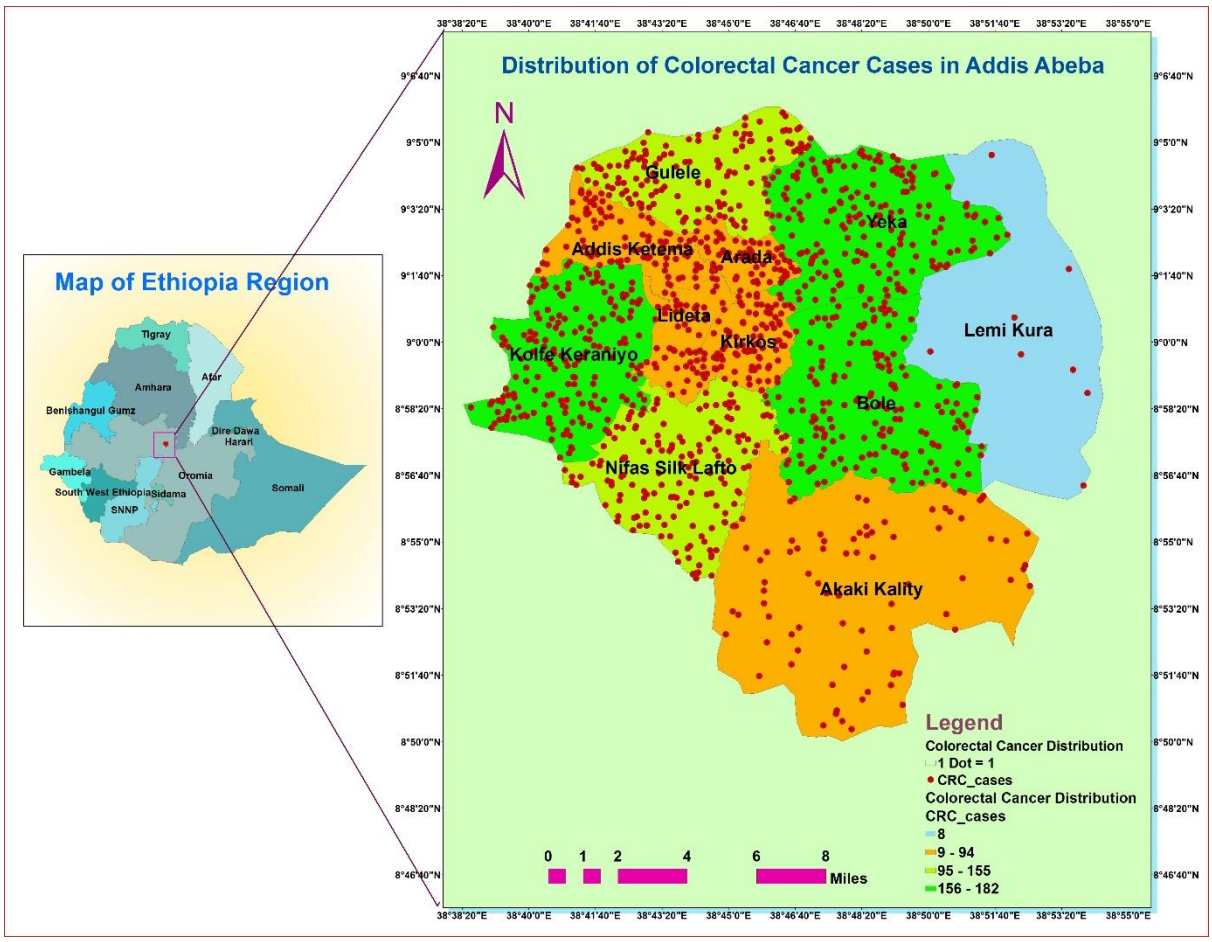


**Figure 16: Spot map of colorectal cancer distribution in Addis Ababa, Ethiopia**

## Distribution of Colorectal Cancer Cases by Anatomical Topography

The study described the distribution of colorectal cancer (CRC) cases by anatomical topography. The topography axis on the cancer registry uses the WHO-developed ICD-10 system for coding and cla ssifying the malignant neoplasms cases in Addis Ababa, based on 1222 cases recorded in the Addis Abeba cancer registry. The data reveal that the most common topographic site is the rectum, not otherwise specified (NOS), accounting for 42.5% (519 cases), followed by the colon, NOS, with 35.7% (436 cases). Other significant sites include the sigmoid colon (8.6% or 105 cases), the rectosigmoid junction (7.3% or 89 cases), and the cecum (3.3% or 40 cases). Less frequently affected regions include the splenic flexure of the colon (0.2% or 2 cases), overlapping lesions of the colon (0.2% or 2 cases), and hepatic flexure of the colon (0.1% or 1 case). These findings emphasize that CRC cases are predominantly concentrated in the rectum and colon regions, accounting for 78.2% of all cases.

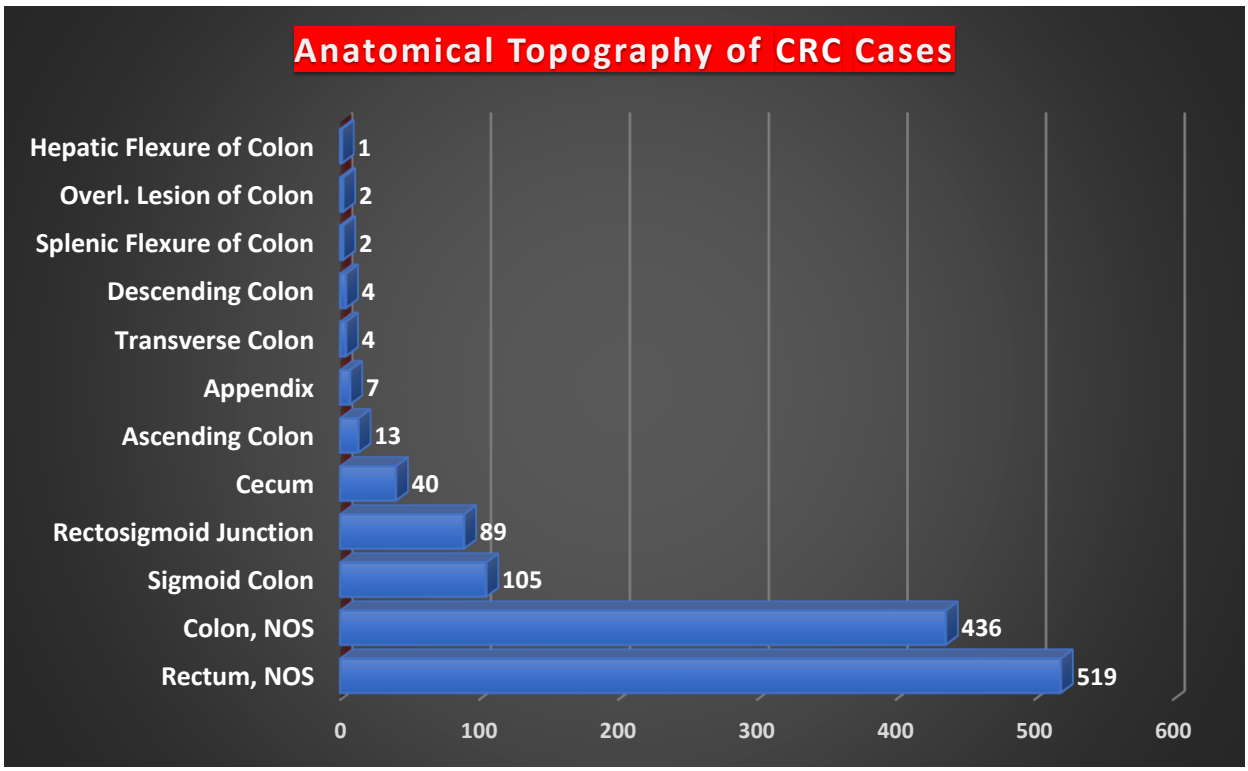


**Figure 17: Colorectal Cancer Cases distribution by Anatomical Topography in Addis Ababa, Ethiopia**

## Distribution Of Colorectal Cases by Health Facilities

The data reveal that the majority of cases were reported at Black Lion Specialized Hospital, accounting for 57.1% (698 cases), followed by Saint Paul's Hospital with 18.4% (225 cases). Other facilities include United Vision Higher Clinic (11.7% or 143 cases), Girum General Hospital (6.6% or 81 cas es), and Hallelujah General Hospital (2.4% or 29 cases). Facilities with smaller case shares include St. Gabriel General Hospital (1.3% or 16 cases), Lancet General Hospital (1.1% or 14 cases), MCM Specialized Hospital (0.7% or 9 cases), Legar General Hospital (0.2% or 3 cases), Arsho Medical Lab oratories (0.2% or 3 cases), and Betezata General Hospital (0.1% or 1 case).

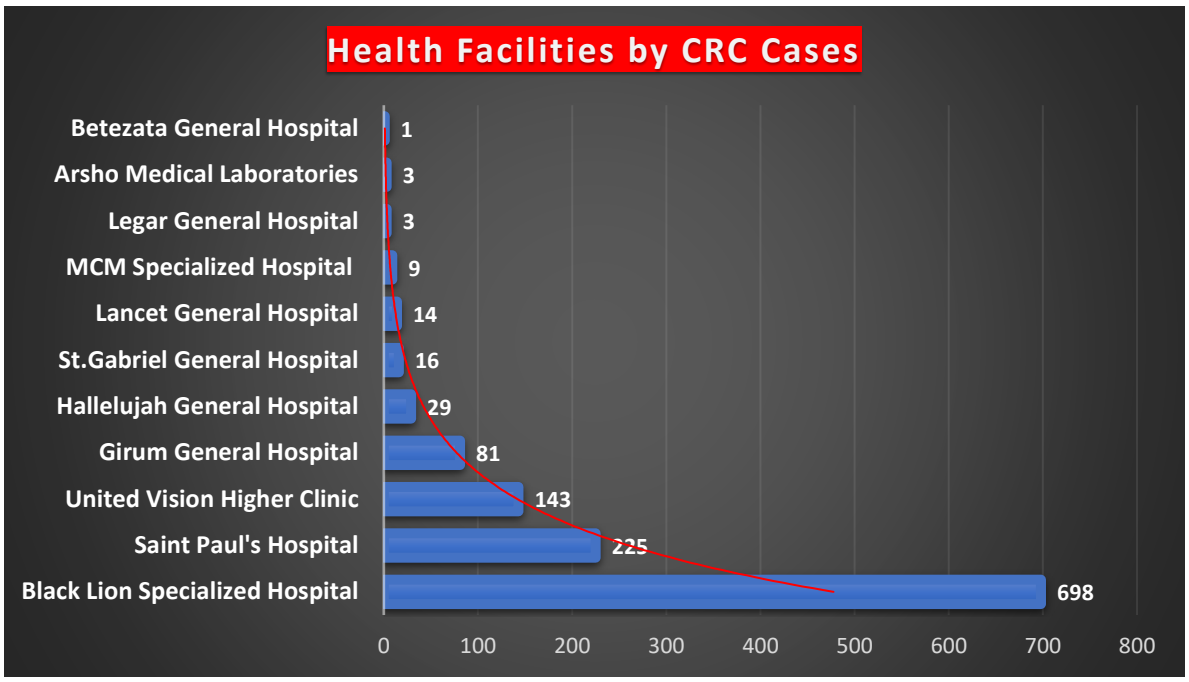


**Figure 18: Colorectal Cancer Cases distribution by health facility in Addis Ababa, Ethiopia**

## Distribution by Basis of Diagnosis

The study data on colorectal cancer based on diagnosis basis revealed most cases (1,058; 86.7%) were confirmed through "Histology of Primary," followed by 107 cases (8.8%) via "Cytology." "Clinical Investigation/Ultrasound" contributed to 47 cases (3.9%), while 5 cases (0.4%) were diagnosed clinically without additional testing. Laboratory tests and histology of metastases each accounted for 2 cases (0.2%), and only 1 case (0.1%) was diagnosed posthumously through autopsy or histology.

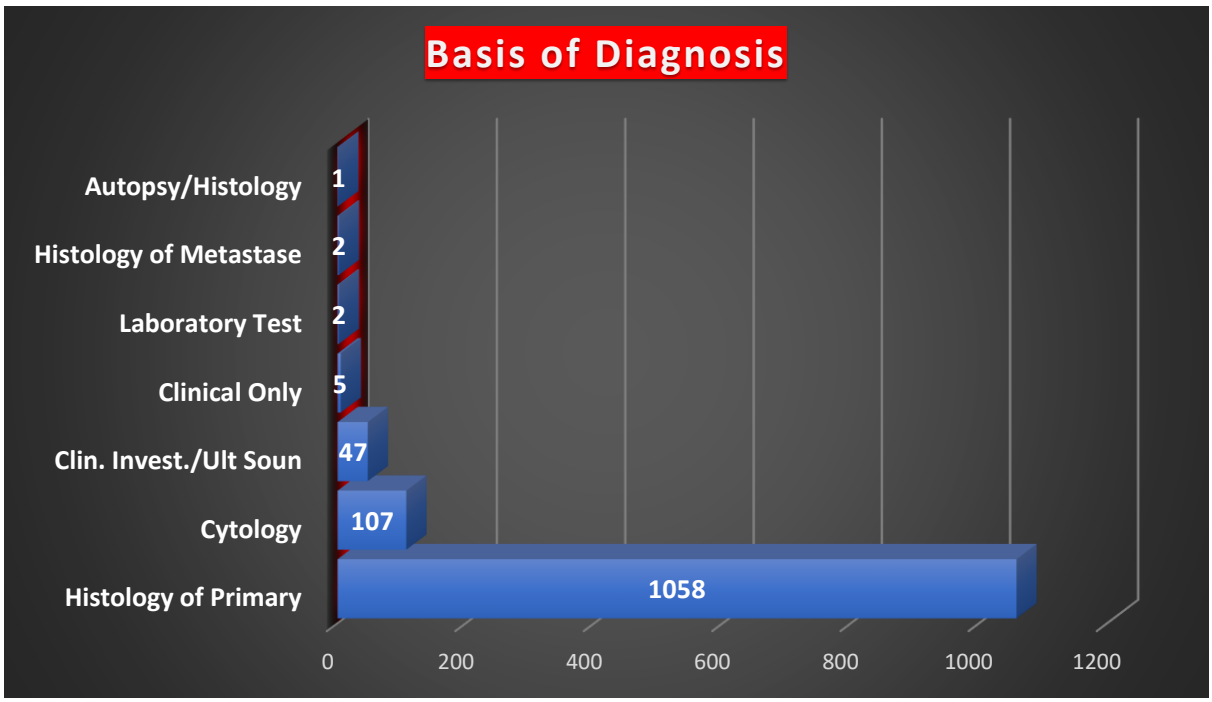


**Figure 19: Colorectal Cancer Cases distribution by basis of diagnosis in Addis Ababa, Ethiopia**

## Distribution of Colorectal Cancer Cases by Morphology

The study described the morphology of CRC cases from Addis Abeba city cancer registry which used the ICD 10 for coding and classifying the malignant neoplasms and, it identified the majority of cases were "Adenocarcinoma, NOS," accounting for 884 cases (72.3%). "Neoplasm, malignant" was the second most frequent type with 131 cases (10.7%), followed by "Carcinoma, NOS" with 69 cases (5.6%) and "Mucinous adenocarcinoma" with 65 cases (5.3%). Less common morphologies include "Signet ring cell carcinoma" (24 cases; 2.0%) and "Squamous cell carcinoma, NOS" (8 cases; 0.7%). Other rare morphologies such as "Neuroendocrine carcinoma" (7 cases; 0.6%) and "Carcinoid tumor, NOS" (5 cases; 0.4%) were reported in smaller numbers. Extremely rare morphologies, including "Sarcoma, NOS," and "Kaposi sarcoma," accounted for only 1 case each (0.1%).

**Table 14: Colorectal Cancer Cases distribution by Morphology in Addis Ababa, Ethiopia**

| Morphology of CRC Cases | Frequency | Percentage |
|---|---|---|
| Adenocarcinoma, NOS | 884 | 72.3% |
| Neoplasm, malignant | 131 | 10.7% |
| Carcinoma, NOS | 69 | 5.6% |
| Mucinous adenocarcinoma | 65 | 5.3% |
| Signet ring cell carcinoma | 24 | 2.0% |
| Squamous cell carcinoma, NOS | 8 | 0.7% |
| Neuroendocrine carcinoma, NOS | 7 | 0.6% |
| Carcinoid tumor, NOS | 5 | 0.4% |
| Squamous cell carcinoma, keratinizing, NOS | 3 | 0.2% |
| Cholangiocarcinoma | 2 | 0.2% |
| Medullary carcinoma, NOS | 2 | 0.2% |
| Malignant melanoma, NOS (except juvenile melan | 2 | 0.2% |
| Malignant lymphoma, NOS | 2 | 0.2% |
| Malignant lymphoma, large B-cell, diffuse, NOS | 2 | 0.2% |
| Large cell neuroendocrine carcinoma | 1 | 0.1% |
| Scirrhous adenocarcinoma | 1 | 0.1% |
| Carcinoma, diffuse type | 1 | 0.1% |
| A typical carcinoid tumor | 1 | 0.1% |
| Villous adenocarcinoma | 1 | 0.1% |
| Acidophil carcinoma | 1 | 0.1% |
| Mucinous adenocarcinoma, endocervical type | 1 | 0.1% |
| Infiltrating duct carcinoma, NOS | 1 | 0.1% |
| Intraductal papillary adenocarcinoma with inva | 1 | 0.1% |
| Infiltrating duct mixed with other types of ca | 1 | 0.1% |
| Polymorphous low-grade adenocarcinoma | 1 | 0.1% |
| Sarcoma, NOS | 1 | 0.1% |
| Undifferentiated sarcoma | 1 | 0.1% |
| Leiomyosarcoma, NOS | 1 | 0.1% |
| Kaposi sarcoma | 1 | 0.1% |
| Hodgkin lymphoma, NOS | 1 | 0.1% |
| Total | 1,222 | 100.0% |

## Distribution of Colorectal Cancer Cases by Treatment Types

The distribution of colorectal cancer cases by treatment type shows surgery was the most frequently administered treatment, accounting for 290 cases (23.7%) of all cases. Chemotherapy was followed in 211 cases (17.3%), while radiotherapy was utilized in 60 cases (4.9%). Hormone therapy was the least common treatment, used in only 2 cases (0.2%).

**Table 15: Colorectal Cancer Cases distribution by treatment type in Addis Ababa, Ethiopia**

| Treatment Types | Frequency | Percentage |
|---|---|---|
| Surgery | 290 | 23.7% |
| Chemotherapy | 211 | 17.3% |
| Radiotherapy | 60 | 4.9% |
| Hormone Therapy | 2 | 0.2% |

## 2.1.6. Discussion

The findings from this five-year retrospective study on colorectal cancer incidence in Addis Ababa reveal several critical insights into the distribution and temporal trends of the disease.

The age-specific incidence of CRC demonstrates a classic pattern: risk increases with age, peaking in the 60–69-year age group, with the lowest incidence observed among individuals under 40. Nonetheless, a substantial proportion (~22%) of total cases occurred in individuals younger than 50 years over the five years, underscoring a notable early-onset CRC (EOCRC) burden. This pattern aligns with global observations of rising EOCRC rates—projections estimate that by 2030, up to 11% of colon and 23% of rectal cancers will occur in individuals under 50 [40]. Regional studies from Ethiopia similarly report mean patient ages in the late 40s to early 50s, with a considerable fraction of patients younger than 60 [41, 42]. These findings have important implications for clinical vigilance and potential consideration of earlier diagnostic strategies.

Overall, the average age-standardized incidence rates (ASIR) were nearly equivalent: approximately 8.93 per 100,000 in males and 8.77 per 100,000 in females. While males had slightly higher rates in 2018 and 2019, this difference diminished between 2020 and 2022, and in some years, female rates exceeded male rates. Globally, CRC incidence is typically higher in men, often by 30–50% in high-SDI countries, attributed to greater exposure to risk factors such as red and processed meat, alcohol, smoking, and adiposity; women often present later and with biologically different tumor subtypes, such as right-sided, microsatellite-instable cancers[43, 44]. However, in lower-SDI regions, including sub-Saharan Africa, sex incidence disparities are less pronounced, consistent with our findings. Previous Ethiopian data report similar sex distributions, with males comprising about 54–57% of cases, and a near parity in incidence[41].

The temporal trend of CRC incidence in Addis Ababa did not follow a linear trajectory. Incidence rose from 6.85 per 100,000 in 2018 to a peak of 8.05 in 2019, before declining to 5.94 in 2021 and rebounding modestly to 6.24 in 2022. The overall average was approximately 6.64 per 100,000. These fluctuations may largely reflect external factors, such as service disruptions during the COVID-19 pandemic, which globally disrupted CRC screening and diagnosis with reductions in new diagnoses of up to 40%, rather than true changes in disease occurrence[45, 46]. Additionally, Addis Ababa's population grew steadily over this period (from ~3.3 million in 2018 to ~3.86 million in 2022), and this denominator expansion likely attenuated rate increases even when absolute case counts rose[47].

In the study, rectum, NOS (not otherwise specified), and sigmoid colon accounted for the majority of colorectal cancer (CRC) cases, with 519 and 436 cases, respectively. In contrast, the cecum, appendix , and descending colon were far less frequent sites. This pattern aligns with broader epidemiological

trends: CRCs arising in the left colon (sigmoid colon, descending colon, rectum) are generally more prevalent than those in proximal sites. For example, an analysis by MD Anderson Cancer Center notes that about 70% of CRCs are found on the left side, including the sigmoid colon and rectum, with left-sided tumors being both more common and easier to detect via colonoscopy[48]. Additionally, U.S. data show that distribution across the proximal colon, distal colon, and rectum is roughly 41%, 22%, and 28%, respectively, with a slightly higher rectal proportion in men[49].

Such predominance of left-sided tumors in our dataset may reflect both biological factors (e.g., symptom presentation such as bleeding) and diagnostic accessibility, since left-sided lesions are more readily detected during colonoscopic evaluation[48]. From a clinical standpoint, this distribution underlines the need for adequate screening and attention to left-sided CRC, especially in settings where colonoscopy is more commonly deployed.

The majority of CRC cases in the study were concentrated at Black Lion Specialized Hospital (698 cases), followed by Saint Paul's Hospital (225 cases), United Vision Higher Clinic (143), Girim General Hospital (81), Hallelujah General Hospital (29), and smaller numbers at other institutions. This uneven distribution likely reflects the role of tertiary centers in acting as referral hubs, particularly in resource-limited settings. For instance, Tikur Anbessa (Black Lion) is a leading referral and teaching hospital with comprehensive oncology, radiology, colorectal surgery, and pathology services[50]. The concentration of cases at this facility is consistent with its capacity for advanced diagnostics and treatment, while more peripheral hospitals see fewer referrals.

Furthermore, other studies in Ethiopia have similarly emphasized that advanced and specialized services are centralized in such tertiary hospitals, resulting in higher caseloads compared to general hospitals with limited infrastructure[51].

In the study, the overwhelming majority of diagnoses were histologically confirmed (Histology of primary: 1,058 cases), followed by Cytology (107), Clinical investigations/ultrasound (47), Clinical only (5), Laboratory test (2), Histology of metastasis (2), and Autopsy/histology (1). This preponderance of histopathological confirmation is consistent with standard oncologic diagnostic practice globally. Histology remains the gold standard for CRC diagnosis and staging, providing definitive tissue-based confirmation of malignancy. Non-histological methods (e.g., imaging, cyto logy, clinical signs alone) are generally adjuncts or used when biopsy is not feasible. Although I could not locate specific global percentages for diagnostic modality breakdowns, the dominance of histology here is consistent with clinical guidelines and established research protocols. Where histological diagnosis is limited by resource constraints, diagnostic accuracy and staging may be compromised.

Thus, the high rate of histological confirmation suggests robust diagnostic capacity in the institutions providing data.

## Implications for Public Health and Future Research

The findings of this study underscore the need for continuous, population-based surveillance of colorectal cancer (CRC) in Addis Ababa to monitor trends and emerging patterns, particularly the notable proportion of early-onset CRC cases among individuals under 50 years. The observed fluctuations in incidence over the five years, likely influenced by factors such as service disruptions during the COVID-19 pandemic and population growth, highlight the importance of interpreting trends cautiously and ensuring high-quality, consistent data collection. Strengthening cancer registry systems and maintaining robust histopathological diagnostic capacity are critical to ensure accurate and timely reporting, which in turn informs public health planning and resource allocation. Enhanced screening programs, particularly targeting middle-aged and older adults, should be prioritized, alongside clinical vigilance for early-onset cases. Public health strategies should integrate awareness campaigns, risk-based screening approaches, and adherence to standard diagnostic protocols to improve early detection and patient outcomes. Future research should focus on elucidating the determinants of the observed temporal trends, including lifestyle factors, genetic predispositions, and access to health care services

## .Strengths and Limitations of the Study

The study included all the necessary information to show the burden of CRC in Addis Abeba, Ethiopia, this may help in prevention, screening, policy-making, and interventions of colon-rectal cancer inc idence, this study includes incidence rate, prevalence, distribution by geographical location and trend of CRC incidences in Addis Abeba, Ethiopia over 5 years period (2018-2022), it also describes CRC incidence by place, person and time.

The limitation of the study is it only includes CRC disease incidence it does not include death incidences and risk factors of colon rectal cancer.

## 2.1.7. Conclusion

This five-year retrospective study of colorectal cancer incidence in Addis Ababa has provided valuable insights into the temporal trends, demographic distribution, and geographical disparities of the disease. The key findings reveal a modest but statistically significant increase in colorectal cancer incidence over the study period, with notable fluctuations in annual incidence, likely influenced by factors such as the COVID-19 pandemic.

The analysis identified a higher incidence of colorectal cancer in the 60-70 years age group, with a growing trend in cases among individuals aged 40-49 years. Gender-specific trends showed a slightly higher incidence among females, highlighting the need for gender-tailored prevention and screening strategies. Geographical variations in incidence underscore the necessity for targeted public health interventions in different sub-cities of Addis Ababa.

The results emphasize the importance of continuous monitoring of colorectal cancer trends and suggest that both evolving risk factors and changes in healthcare practices are influencing the incidence rates. This comprehensive understanding is essential for developing effective strategies to manage and reduce the burden of colorectal cancer in the city.

## 2.1.8. Recommendations

Based on the findings of this study, several key recommendations are proposed to address the rising incidence of colorectal cancer in Addis Ababa. Enhanced screening programs are essential, particularly with the observed increase in cases among individuals aged 40-49 years. It is recommended that the screening age be lowered to 45 years to facilitate earlier detection and intervention. Additionally, community-based screening programs should be expanded, particularly in high-incidence sub-cities, such as Yeka and Kolfe, to increase access to screening and reduce geographical disparities in early detection rates.

Gender-specific Interventions should be developed to address the differences in colorectal cancer incidence between males and females. Public health campaigns should be designed to consider gender-specific risk factors, with an emphasis on encouraging early screening, particularly for females who have shown a steady increase in incidence over the study period. These campaigns should also promote awareness about colorectal cancer symptoms and risk factors, particularly targeting the most affected age groups and genders. Enhancing health literacy through community outreach, workshops, and media campaigns will be crucial in encouraging regular screening and healthier lifestyle choices.

In terms of healthcare access, it is important to address disparities in sub-cities like Lemi Kura, where colorectal cancer incidence is low, possibly due to barriers in access to screening, diagnosis, and

treatment services. Strengthening healthcare infrastructure is necessary to support comprehensive cancer care, including better diagnostic services, treatment facilities, and patient support programs. Further research should be conducted to investigate the changing risk factors contributing to the inc reasing incidence of colorectal cancer in younger populations. Studies should also explore potential lifestyle or environmental factors that may be influencing these trends.

Geographical studies are recommended to better understand the regional disparities in colorectal cancer incidence, which could inform more targeted public health interventions. Additionally, suppor ting policy development that promotes colorectal cancer prevention, screening, and treatment is esse ntial. Collaborating with local and national health authorities to implement evidence-based public health policies will be crucial in mitigating the rising burden of colorectal cancer.

In conclusion, addressing the increasing incidence of colorectal cancer in Addis Ababa requires a comprehensive and multifaceted approach. By enhancing screening programs, developing gender-specific interventions, promoting public health education, improving healthcare access, conducting targeted research, and supporting policy initiatives, public health authorities can effectively manage and reduce the burden of colorectal cancer, ultimately improving outcomes for the population of Addis.

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# Chapter 3: Evaluation of Surveillance System

## 3.1. Surveillance system evaluation of non-communicable disease in the government health system of Nifas Silk-Lafto Sub-city, Addis Ababa, Ethiopia, 2025

### 3.1.1. Abstract

**Background:** Non-communicable diseases (NCDs) are the leading cause of death globally, accounting for over 74% of all deaths, with a disproportionate burden on low- and middle-income countries. In Ethiopia, NCDs contribute to up to 42% of all deaths, with urban areas like Addis Ababa facing an increasing prevalence. Despite the growing burden, the national health system remains primarily focused on infectious diseases, resulting in weak surveillance infrastructure, minimal integration of NCD data into health information systems, and limited resources for prevention and control. These challenges are also evident in sub-cities like Nifas Silk Lafto, where inadequate reporting mechanisms, the absence of standardized electronic medical records, and poor data quality hinder effective planning and intervention. Evaluating the existing NCD surveillance system in such settings is crucial to identifying operational gaps, strengthening data systems, and informing evidence-based strategies that align with Ethiopia's commitment to reduce premature NCD-related mortality by one-third by 2030.

**Methods:** A mixed-methods descriptive Cross-Sectional study was conducted in Nifas Silk Lafto Sub-City, Addis Ababa, from May 30 to June 20, 2025. Quantitative data were obtained from the Sub-City Health Office and five randomly selected health centers using KoboCollect with structured questionnaires, while qualitative data were collected through 12 purposively selected key informant interviews with NCD focal persons and PHEM officers. Data collection included document reviews and semi-structured interviews guided by a CDC-adapted tool. Quantitative data were analyzed usin g Microsoft Excel 2016, and qualitative data were thematically analyzed to complement and contextua lize the quantitative findings.

**Result:** The NCD surveillance system in Nifas Silk Lafto sub-city focuses on hypertension and diabetes in weekly PHEM reporting, with other major NCDs reported monthly. Reporting completeness and timeliness from January 2024 to May 2025 were 100%, but data disaggregation and integration across sources were inconsistent. A total of 3,036 new hypertension and 1,642 new diabetes cases were detected during the period. Preparedness, feedback, training, and dedicated funding were limited despite adequate infrastructure. The system showed high usefulness, acceptability, and stability but moderate flexibility, predictive value, and representativeness.

**Conclusion:** The NCD surveillance system in Nifas Silk Lafto Sub-City is functional and provides useful data, but is limited by its narrow scope, fragmented data management, and resource gaps. While completeness and usefulness are strengths, deficiencies in preparedness, training, and data diaggregation hinder effective response.

**Key Words:** Surveillance System Evaluation, Non-Communicable Disease, Nifas Silk-Lafto Sub-City
**Word Counts:** 378

## 3.1.2. Introduction

### Background

Non-communicable diseases are the leading cause of death and disability worldwide, being responsible for approximately 74% of all global deaths, which is over 43 million fatalities annually. Moreover, more than 80% of these premature deaths occur in low- and middle-income countries, striking these regions disproportionately[1-4]. The major NCDs include cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes, all of which collectively impose significant health and economic burdens globally[1, 5]. It is a fact that the prevalence of NCDs is increasing due to risk factors like an aging population, urbanization, and changes in lifestyle, such as unhealthy diets, physical inactivity, tobacco use, and harmful alcohol consumption. This increasing global health crisis has required comprehensive strategies that focus on the prevention, early detection, and effective management of NCDs[6-8]

Non-communicable diseases have become a great public health concern in Ethiopia, causing about 39% of all deaths across the country[9, 10]. Most particularly, the emerging burden is higher within urban settings such as Addis Ababa City, which is a result of rapid urbanization accompanied by changes in lifestyle that lead to increased prevalence of non-communicable diseases such as cardiovascular diseases, diabetes, cancer, and chronic respiratory conditions.[11, 12]. In spite of this growing challenge, the health system in Ethiopia has traditionally been set up to address infectious diseases, leaving limited infrastructure and commitment of resources to NCD surveillance and management[11-13]. Recent data show that 11.5% of adults in Addis Ababa reported having at least one NCD, while hypertension and diabetes have become the leading conditions. This calls for an urgent need to strengthen NCD surveillance, prevention, and care strategies within the health care system of Ethiopia.[14].

The Ethiopian Public Health Institute( EPHI) reports that the leading cause of death in the country has become non-communicable diseases(NCD) at an estimated mortality rate of 554 per 100,000 population. This means that about 25 Ethiopians die from NCDs every hour[10]. Most of these deaths are due to cardiovascular diseases and neoplasms. Due to this growing crisis in health, Ethiopia has committed to Sustainable Development Goal 3.4 with a pledge to reduce premature mortality due to NCDs by one-third until 2030[12].

Public health surveillance is the continuous and systematic collection, analysis, interpretation, and dissemination of data regarding diseases or health-related events that have significant public health importance, and is used in public health action. This information is used for planning, implementing,

and evaluating public health interventions and programs. The evaluation of a surveillance system ensures that systems are functional and encourages the optimum use of health resources.
NCD surveillance system evaluation is critical for monitoring and evaluating illness patterns and trends, which are necessary for better NCD prevention and management. In Ethiopia, the health management information systems lay more emphasis on acute and communicable health conditions, with minimal integration of data on NCDs. A deficit in this respect critically hampers the development of evidence-based policy and allocation of resources that would mitigate the NCD epidemic[13].

The case of Nifas Silk Lafto Subcity in Addis Ababa attests to the challenges characteristic of urban centers, where lifestyle changes contribute to an increased burden of NCDs. At the subcity level, evaluation of the current NCD surveillance system is a priority in order to identify its strengths and limitations and thus propose an informed strategy for improvement. In this regard, the evaluation will provide insight into the data collection processes, the mechanisms for reporting, and the general capacity of the system with respect to capturing accurate and timely information on NCDs. This research, therefore, attempts to assess the effectiveness of the NCD surveillance system in Nifas Silk Lafto Subcity, identifying the existing gaps and giving actionable recommendations to enhance its performance. In essence, the study is out to contribute to the broader goal of improving NCD prevention and control efforts in Addis Ababa and across Ethiopia.

## Statement of the problem

In Ethiopia, NCDs have emerged as one of the major public health concerns, accounting for between 28.6% and 42% of all deaths in the country. In 2019, the country reported 202 million new cases of NCDs, resulting in 219,000 deaths and 13 million DALYs [12, 13, 15].

The rapidly increasing burden is especially higher in urban cities like Addis Ababa because of rapid urbanization, accompanied by changes in lifestyles that increase the risk of non-communicable diseases such as cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases[16, 17]. Despite these growing effects of NCDs, historically, infectious diseases have been a priority in the health system of Ethiopia, leading to limited infrastructure and resources available for surveillance and management services of NCDs[18]. Weak surveillance structures, lack of comprehensive and standardized electronic medical records, and inadequate data sources hampered effective monitoring and subsequent responses to NCDs[13].

Effective surveillance systems help in monitoring the trends of NCDs, identifying risk factors, and assessing the impact of a public health intervention[19]. However, many existing health management information systems are oriented toward acute and communicable health conditions, with limited

integration of NCD data in Ethiopia. This gap limits evidence-based policy formulation and resource allocation for responding to the growing NCD epidemic.[13, 18].

The case of Nifas Silk Lafto Subcity in Addis Ababa indicates that urban settings face the challenge of lifestyle transitions, which have resulted in an increasing incidence of NCDs. Understanding the strengths and weaknesses of the current NCD surveillance system requires its evaluation, which in turn could provide information on how best to improve. Such an evaluation would identify gaps in data collection, reporting mechanisms, and the capacity of the system for accurate and timely capture of NCDs.

The purpose of this study is therefore to assess the functionality of the NCD surveillance system in Nifas Silk Lafto Sub-city, determine the gaps in its practice, and propose recommendations based on findings from the field to help improve performance. Strengthening surveillance at the sub-city level is expected to add value to efforts towards the expansion of NCD prevention and control in Addis Ababa and throughout Ethiopia.

## Significance of the Study

Evaluation of the NCD surveillance system in Nifas Silk Lafto Sub-city holds significant importance for public health planning and intervention. In fact, strong surveillance can monitor the prevalence and trend of NCDs accurately, allowing for the earlier identification of emerging health challenges and resource allocation to areas with higher need. This becomes important in the context of Ethiopia, which has a high and increasing prevalence of NCDs but does not have comprehensive, regular, and reliable surveillance data on the major NCDs; such evaluation is critical.

Moreover, assessing the current surveillance system can identify gaps in data collection, reporting, and analysis, which are necessary to develop targeted interventions. In most countries like Ethiopia, the health system has traditionally focused on infectious diseases, resulting in limited infrastructure and resources for NCD surveillance and management. By understanding such gaps, stakeholders can implement strategies to boost the system's effectiveness and lead to better health outcomes within the community.

This evaluation can further be used as a model to study similar pathologies in other subcities and regions. Sharing knowledge and experiences from Nifas Silk Lafto Subcity will enlighten national policies and inform the development of standardization of NCD surveillance across Ethiopia. This harmonization is critical for the progress toward Sustainable Development Goal 3.4, which aims to reduce premature mortality from NCDs by one-third until 2030. A well-functioning surveillance

system is fundamental to these efforts, providing the data necessary to monitor progress and adapt strategies as needed.

### 3.1.3. Objectives

#### General Objectives

The study aims to assess the functionality of the NCD surveillance system by identifying strengths, weaknesses, and areas of improvement to support and strengthen NCD prevention and control in Nifas Silk-Lafto Subcity, Addis Ababa, Ethiopia.

#### Specific Objectives

- To assess the Key attributes of the NCD surveillance system, including completeness, timeliness, usefulness, simplicity, flexibility, and accuracy in Nifas Silk-Lafto Sub-City, Addis Ababa, Ethiopia.
- To review the surveillance system's ability to detect and analyse trends in the incidence and prevalence of NCDs in Nifas Silk-Lafto Sub-City, Addis Ababa, Ethiopia.
- To identify challenges and barriers in the NCD surveillance system in Nifas Silk-Lafto Sub-City, Addis Ababa, Ethiopia.
- To give recommendations to improve the performance of the NCD surveillance system in Nifas Silk-Lafto Sub-City, Addis Ababa, Ethiopia.

# Literature review

## Introduction

It is estimated that NCDs are responsible for 74% of all deaths globally, which corresponds to 41.1 million deaths each year. Of these, cardiovascular diseases account for 17.9 million, cancers for 9.3 million, chronic respiratory diseases for 4.1 million, and diabetes for 1.5 million annually. Very alarmingly, 15 million deaths due to NCDs are recorded between the ages of 30-69 years, while 85% of the deaths due to these causes occur in low- and middle-income countries[20]. This disparity has been attributed to limited access to healthcare, lower awareness of risk factors, and inadequate public health infrastructure. Modifiable risk factors from key contributors to the NCD burden include tobacco use, unhealthy diets, physical inactivity, and harmful use of alcohol[21, 22].

## NCD Burden in Addis Ababa and Ethiopia

Non-communicable diseases have emerged as the major public health concern in Ethiopia, reflecting a significant epidemiological transition[23]. The Global Burden of Disease Study in 2019 estimated that in Ethiopia, there were about 219,000 deaths and 13 million DALYs due to NCDs, with an age-standardized DALY rate of 12,200 per 100,000 population[12]. This is a high increase compared to the previous decades; for example, the contribution of NCDs to total DALYs increased from 17% in 1990 to 33% in 2021, which means doubling over two decades. Cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes mellitus are the major contributors to this burden. The increasing trend of these conditions has been linked to urbanization, changes in lifestyles, and a lack of access to services for the prevention of these conditions. Prevention, early detection, and management of the diseases are comprehensive strategies needed in mitigating the impact of the diseases among Ethiopians.

In Addis Ababa, the burden of NCDs is very high, with about 63.2% of total cases from NCDs. This urban setting has a dual burden of both communicable and non-communicable diseases, which further overburdens the health system, hence calling for effective surveillance mechanisms. Assessing the NCD surveillance system in Addis Ababa at Nifas silk Lafto sub-city is thus essential in understanding its strengths and weaknesses to drive improvement. The evaluation may highlight some of the areas relating to data collection, its reporting system, and the ability of the system to gather timely and accurate information regarding NCDs.

## NCD Surveillance System in Addis Abeba and Ethiopia

Ethiopia has made efforts towards the establishment of non-communicable disease surveillance systems, but it faces challenges in attaining comprehensive and timely data. The World Health Organization's STEPwise approach was implemented for the surveillance of NCD risk factors, but the most recent national survey was in 2015, hence a significant gap in current surveillance data. In Addis

Ababa, the Addis Health and Demographic Surveillance System has provided estimates on the prevalence of chronic NCDs, showing that 11.5% of adults reported at least one NCD, with hypertension and diabetes being the most common. Despite these, the dearth of recent and comprehensive data prohibits effective tracking of the trend and targeted interventionsThe cornerstone of addressing the rising NCD burden in Ethiopia rests on strengthening surveillance systems, ensuring periodic data collection, and translating findings into public health strategies.

The case of the Nifas Silk Lafto Subcity represents an urban setting where lifestyle changes also contribute to the increasing burden of NCDs. The current assessment was, therefore, necessary to identify gaps in the current NCD surveillance system in this subcity and to proffer recommendations that are implementable to enhance performance. This evaluation can help ensure that improving NCD surveillance at the subcity levels leads to better prevention and control of NCDs both in Addis Ababa and the country as a whole.

In summary, the need for assessment of NCD surveillance systems in Ethiopia and urban areas such as Addis Ababa and Nifas Silk Lafto Subcity cannot be overemphasized in view of the current increasing burden the country is experiencing as a result of NCDs. Enhancement of these systems through regular assessment and capacity-building initiatives could subsequently achieve effective monitoring, early detection, and management, with further improvements in the public health outcome.

## 3.1.4. Methods and Materials

### Study Area and Study Period

This study was conducted in Nifas Silk Lafto Subcity, one of the 11th subcities within the Addis Ababa City Administration, Ethiopia. Nifas Silk Lafto Subcity is located in the southwestern part of Addis Ababa. It shares boundaries with the Oromia Special Zone to the south, Kolfe Keranio Subcity to the northwest, Bole and Akaki Kality subcities to the east, and Lideta and Kirkos subcities to the north. Geographically, the subcity spans an area of approximately 5,876.02 hectares and is administratively divided into 13 woredas. Meanwhile, it has 8 health centers and 137 private medium clinics, and 1 private general hospital.

According to the 2007 national census conducted by the Central Statistical Agency (CSA), the total population of Nifas Silk Lafto was 316,283, comprising 148,984 males and 167,299 females.

The study was conducted from May 30 to June 20, 2025, using 2024/25 as the base year.

### Study Design

We conduct a concurrent embedded mixed study approach of both quantitative and qualitative methods. A descriptive cross-sectional study design was carried out to determine the performance of a surveillance system in the Sub-City.

### Source and Study Population

#### Source Population

All health institutions involved in non-communicable disease (NCD) surveillance within Nifas Silk Lafto Subcity, including the sub-city health office, and health facilities operational during the 2024/25 Ethiopian fiscal year.

#### Study Population

The study population comprises 6 selected study units within Nifas Silk Lafto Sub-City, including the Sub-City Health Office, and five randomly selected health centers. For the qualitative component, the study population includes 12 key informants purposively selected from the sub-city and from 5 health centers, including NCD focal persons and health center PHEM officers based on their direct involvement in NCD surveillance and their depth of experience.

### Inclusion Criteria and Exclusion Criteria

#### Inclusion Criteria

- Selected Government Health facilities within Nifas Silk Lafto Sub-City for the study, which were contributing data to the NCD surveillance system for the baseline year 2024/25.

- The Sub-City Health Office, which is overseeing the NCD surveillance activities for the baseline year.
- Key informants who are actively involved in NCD surveillance, monitoring, and reporting based on data from the 2024/25 baseline year.
- Staff with at least six months of experience relevant to NCD surveillance as of the baseline year.

### Exclusion Criteria

- Key informants who are unavailable during the data collection period or decline to give informed consent.
- Newly established institutions with no NCD reporting history during the study period.

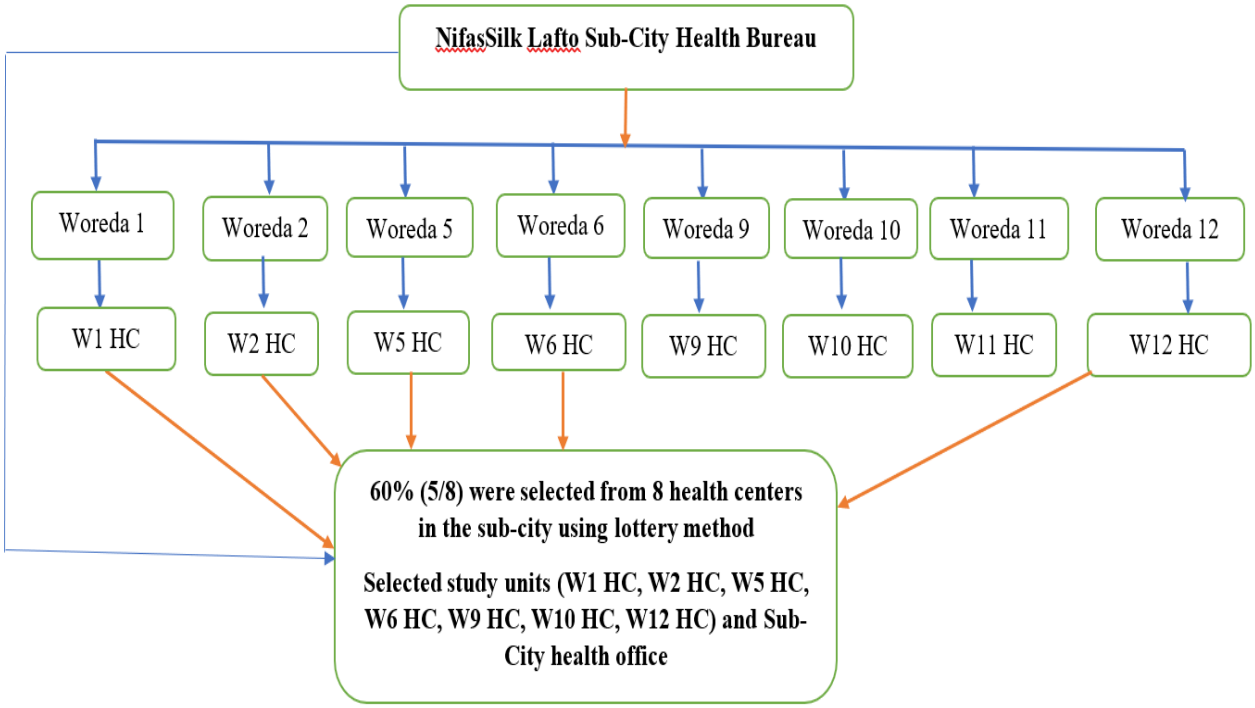
### Sample Size and Sampling Procedure

In total, 6 study units were selected for the comprehensive assessment of the NCD surveillance system in Nifas Silk Lafto Sub-City. The Sub-City Health Office was purposely selected because it coordinates and oversees the activities of surveillance. The sub-city has 13 Woredas and 8 health centers. of the eight health centers in the sub-city, 5 health centers (60%): Woreda 1 HC, Woreda 2 HC, Woreda 5 HC, Woreda 6 HC, Woreda 9 HC, Woreda 10 HC, and Woreda 12 HC were selected using a lottery method to ensure representativeness and reduce selection bias.

The qualitative component of the study targeted key informants using a purposive sampling technique. Key informants included those who were directly involved in the planning, implementation, and monitoring of NCD surveillance activities. Selected key informants included PHEM officers, NCD focal persons, or data managers from selected health centers and sub-city health offices. Accordingly, a total of 12 key informant interviews, with two drawn from each of the selected health centers and two from the Sub-City Health Office, were conducted. The respondents were selected based on their role, experience, and presumed depth of knowledge about the NCD Surveillance system, since they are considered valuable sources of information about the functioning of the NCD surveillance system.

## Sampling procedure diagram

**Figure 20: Sampling procedure of NCD surveillance system evaluation in Nifas Silk-Lafto sub-city, Addis Ababa (W=Woreda, HC=Health center)**




## Study Variables

### Dependent Variable

- Effectiveness of the Non-Communicable Disease (NCD) surveillance system

### Independent Variables

1. System Attributes:

   o Data completeness (percentage of reports fully filled) o Data timeliness (report submission within set deadlines)

   o Data accuracy (correctness and reliability of reported data) o Data quality (consistency and validity of surveillance data)

   o Data availability (ease of access to required data)

   o System simplicity (ease of use of the surveillance tools and forms)

   o Flexibility (ability to adapt to changes in case definitions or reporting requirements)

   o Acceptability (willingness of stakeholders to participate in the system)

   o Stability (system uptime and reliability)

2. Human Resource Factors:

   o Staff knowledge and training on NCD surveillance

   o Experience of key personnel in NCD reporting

- o Availability of skilled personnel for data collection and reporting

3. Organizational Factors:
   - o Availability of guidelines and standard operating procedures
   - o Supervision and feedback mechanisms
   - o Resources (financial, technical, and material support)
   - o Coordination between health offices and facilities
4. Contextual Variables:
   - o Type of health facility (health center or woreda health office)
   - o Geographic location within Nifas Silk Lafto Subcity
   - o Reporting period (2024/25 baseline year)

## Data Collection Tools and Techniques

Data for this study were collected through document review and semi-structured interviews to assess the performance of the NCD surveillance system in Nifas Silk Lafto Sub-City. Specifically, for the quantitative component, data were extracted from available surveillance reports, records, and documents from the Sub-City Health Office, selected health centers, and woreda health offices on the completeness, timeliness, and quality of reporting, as well as the availability and consistency of guidelines on surveillance, reporting formats, and case registration consistent with the WHO STEPwise approach to NCD risk factor surveillance.For the qualitative component, in-depth information was gathered through semi-structured interviews with purposively selected key informants, including PHEM officers at sub-city and health facility levels and NCD focal persons at selected health centers, guided by a questionnaire adapted from the CDC's updated guidelines for evaluating public health surveillance systems. The interviews addressed attributes such as system simplicity, flexibility, data quality, and stability, alongside aspects of communication, documentation, preparedness, and feedback mechanisms, and were conducted until data saturation was reached to ensure the richness and depth of the information obtained

## Data Quality Assurance

A two-day training was provided to the data collectors on the overall data collection procedure. The reports and records obtained from the health facilities were cross-checked with the documented data at the woreda health office to check the consistency and accuracy of the data. During the session of each visit, we briefed the stakeholders about the purpose of the assessment, to evaluate the performance of the system rather than individual performances. Before data collection, discussions were made with stakeholders from NifasSilk Lafto sub-city health department, and the health

facilities, to ensure evaluation of the system addresses appropriate questions and attributes, to produce useful and acceptable findings.

## Data Processing and Analysis

The quantitative data were entered and analyzed using Microsoft Excel 2016. All questionnaire responses were dichotomized except for the open-ended questions. Quantitative findings were summarized by their frequency and proportion. Qualitative data were analyzed manually using thematic analysis. Data were cleaned before analysis, and the qualitative findings were narrated and summarized based on thematic areas to supplement the quantitative results.

## Operational Definitions

### Usefulness

A public health surveillance system is useful if it contributes to the prevention and control of adverse health-related events, including an improved understanding of the public health implications of such events. The level of usefulness was measured by the actions taken as a result of analysis and interpretation of the data from the public health surveillance system, the system useful to detect the diseases and outbreaks, providing estimates of the magnitude of morbidity and mortality.

### Completeness

The proportion of health facilities that submitted a weekly report to the higher level, out of the expected facilities in the catchment area (Sub-City, Woredas).

### Timeliness

The timeliness of the report was assessed at two levels. First, it was calculated by assessing how many of its expected reports were submitted to the next level within the prescribed time. The report is timely for the health facilities if a weekly report is submitted to the sub-city health bureau every Tuesday before midday, and a timely report for the sub-city is if the sub-city health bureau submits the compiled report to the Addis Ababa City Administration Health Bureau every Wednesday before midday. Second, the time interval between the onset of a health-related event and the reporting of the event, and the time required for the identification of a cluster of NCDs and initiation of control and prevention measures.

### Simplicity

Refers to the structure of the system and the ease of implementation while still meeting its objectives. In this study, the simplicity of the surveillance system was measured in terms of clear and easily understandable case definition, route of data flow, difficulty in completing surveillance data, and time taken to complete surveillance data.

### Flexibility

The ability of the system to adapt to changing information needs or operating conditions with little additional time, personnel, or allocated funds. In this study, the flexibility of the surveillance system was assessed in terms of accommodating change in the existing procedure, a revised case definition, additional data sources, personnel, case detection, and reporting format.

### Data Quality

Data quality was assessed based on content completeness of the reporting formats and the validity of the data recorded. The fields examined for completeness include the number of cases and deaths, the date of the report sent and received, and the blank responses. Validity of recorded data at health facilities compared to the reported data at the Woreda level.

### Acceptability

Willingness of surveillance stakeholders to implement the system, as expressed by their active participation in case detection and reporting. Acceptability was measured by completeness of report forms, data reporting timeliness, and standard case definition use.

### Predictive Value Positive

The proportion of cases detected by the surveillance case definition that actually have the disease.

### Representativeness

Measured in terms of the distribution of a health-related event by time, place, and person, the health service coverage, and the reporting of surveillance data from all health facilities.

### Stability

Refers to the reliability (ie, the ability to collect, manage, and provide data properly without failure) and availability of the public health surveillance system, which is the ability to be operational when it is needed. Measured by the availability of a surveillance focal person at all levels and integration of the system to routine healthcare delivery.

## Ethical Considerations

Ethical clearance was obtained from the Addis Ababa University, School of Public Health, the Ethiopian Public Health Institute, and the Addis Abeba Health Bureau. Each participant was informed about the objectives of the research and all the procedures involved to secure informed consent, and confidentiality and voluntary participation were assured. Data was stored securely and used solely for research purposes.

### 3.1.5. Result

#### General Information

The assessment targeted the NCD surveillance system in five of the eight health centers reporting to the Nifas Silk Lafto Sub-City Health Bureau. Both the sub-city health office and selected facilities were assessed for governance, data reporting, analysis, resource availability, preparedness, and key attributes of surveillance.

A total of 12 key informants participated in qualitative interviews, all of whom consented to participate. Of these, 10 (83.3%) were from the five health centers (two per facility) and 2 (16.7%) were from the sub-city health bureau. Key informants included Public Health Emergency Management (PHEM) officers and NCD focal persons. Qualitative findings were supplemented with direct observations of resource availability and documentation quality. Quantitative data were collected through the KoboToolbox platform.

#### Governance & System Structure

Governance and operation of NCD surveillance in Nifas Silk Lafto Subcity applies a multi-tiered model, guided by the national PHEM strategy. At the level of the sub-city, coordination between the health office and public health facilities is done through routine communication channels: via phone calls, emails, and the national electronic health information system DHIS2. Such mechanisms provide consistency to the flow of surveillance data and allow timely decision-making on emergency responses and in regard to routine activities concerning NCD monitoring.

A defined schedule is followed for reporting on priority diseases. The health centers should report the surveillance data every Tuesday of the week, and the consolidated reports from the sub-city health office are submitted to the Addis Ababa City Health Bureau every Wednesday.

Despite the structured reporting process, the current scope of weekly PHEM reporting is limited to only two NCDs, hypertension and diabetes mellitus, across the five assessed health centers. Other significant NCDs, including cardiovascular diseases other than hypertension, cancers, and chronic respiratory illnesses such as chronic obstructive pulmonary disease (COPD), are excluded from weekly reports and are instead captured in the routine monthly Health Management Information System (HMIS) reporting.

The governance structure promotes multi-level communication. Sub-city surveillance officers r outinely prepare and disseminate summary updates to administrative leaders and program coordinators, thereby contributing to more informed planning, prevention, and control strategies. NC D surveillance data are collected from a diverse range of service providers, including public hospitals,

health centers, private clinics, and NGO-supported facilities. A hybrid reporting system is utilized, co mbining electronic platforms (DHIS2), Microsoft Excel spreadsheets, and paper-based forms, depending on the facility's capacity and resource availability.

Despite the presence of an organized structure and regular reporting workflows, the system's narrow disease focus and fragmented data sources limit its comprehensiveness. Expanding the scope of weekly reporting and strengthening integration across all levels of care would enhance the utility and responsiveness of the NCD surveillance system.

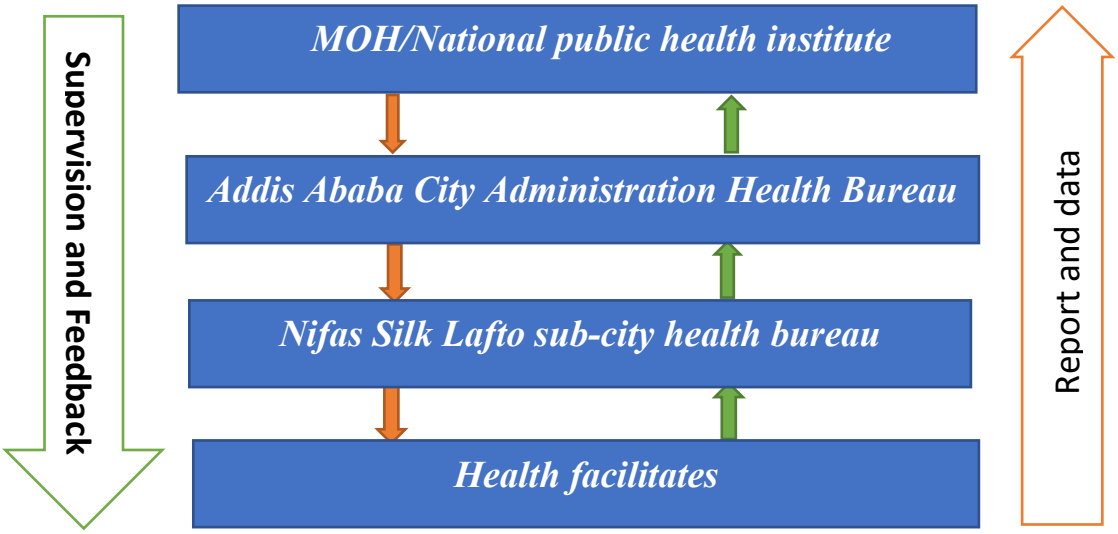



**Figure 21: Structure and workflow of Nifas Silk Lafto sub-city health Bureau, Addis Ababa, Ethiopia**

**Table 16: Governance in Nifas Silk Lafto Sub-city, Addis Ababa, Ethiopia**

| Attribute | Status | Limitation |
|---|---|---|
| Weekly reporting scope | Hypertension, Diabetes only | Excludes other major NCDs |
| Data sources | Public, private, and NGO facilities | No full integration across sources |
| Reporting tools | DHIS2, Excel, Paper forms | Risk of inconsistency |

## Data Collection, Reporting & Analysis

All health facilities that were assessed reported using multiple data collection and reporting platforms, including paper-based forms, DHIS2, and Excel spreadsheets. This triangulated approach provides some levels of redundancy as a protection against data loss but also creates potential inefficiencies and the risk of inconsistent data. One facility did not use paper-based reporting; this could be due to either a transition to digital platforms or an underpinning resource constraint.

Over the last year, each of the five facilities reported 12 monthly reports for 100% completeness and timeliness of reporting. However, a reporting discrepancy was noted in one woreda because of misinterpretation regarding the time of reporting, emphasizing the need for standard definitions and consistent guidance regarding reporting intervals.

The regularity and depth of data analysis differed among facilities. Only two facilities reported weekly analysis, while the rest analyzed data on a monthly basis. At the sub-city level, it was done on a weekly basis, disaggregated by age, sex, and other key variables. However, no epidemiological follow-up investigations were mounted as response mechanisms, even though increases in NCDS case numbers were registered.

Data visualization practices were observed in all five facilities, although the level of disaggregation differed. Only two facilities consistently disaggregated data by age, sex, and location. The other three facilities did not disaggregate data by geographic location, which reduced the system's ability to identify hotspots and target interventions effectively. This inconsistency in the disaggregation of data undermines the utility of the collected data for strategic planning and burden assessment.

### Availability of resource and surveillance documentation, registers, and forms

At the facility level, a closer review indicates strengths and challenges in the implementation of the system. From data collected from five health facilities, all five facilities had the PHEM guideline and weekly reporting format available, plus an adequate backup supply of tally sheets, intake forms, follow-up forms, referral forms, and cohort registers. Despite this, 60% of the health centers (3 out of 5) did not have the National Non-Communicable Diseases Management Protocol (November 2021), and one health center out of five did not have an appointed NCD focal person, which raises the issue of accountability and leadership in implementing activities concerning NCDs. All facilities had standard case definitions for hypertension, diabetes, and CVDs, but two facilities did not have case definitions for COPD, indicating inconsistency in surveillance coverage for high-burden NCDs. Of importance, all PHEM officers reported knowledge of the case definition, an indicator of good capacity building.

At the sub-city health bureau level, all the key guidelines and reporting tools were available: PHEM guideline, weekly reporting format, line list. The National Strategic Plan for Prevention and Control of Major Non-Communicable Diseases (2024–2025) was not available.

While there isn't a standalone national NCD surveillance manual, the revised PHEM guideline in 2022 recognizes NCDs as an emerging public health priority. It called for their integration within the national surveillance framework with a multi-hazard approach; however, this integration is still narrow. The operationalization of the integration differs from one administrative level to another. This guideline highlights a need for enhanced emergency preparedness, improvement of the surveillance

infrastructures, and continuation of care for patients with NCDs during crises like natural disasters, displacement, or conflict.

**Table 17: Availability of Key Resources Across Facilities (%)**

| Resource | Facilities with resource (%) |
|---|---|
| PHEM guideline | 100 |
| Weekly reporting format and Registers | 100 |
| NCD Management Protocol (2021) | 40 |
| Assigned NCD focal person | 80 |
| COPD case definitions | 60 |

## Preparedness

The NCD surveillance system within Nifas Silk Lafto Sub-City demonstrates critical gaps in emergency preparedness. It was noted that there is a lack of an emergency preparedness and response strategy for non-communicable diseases. While case numbers are reportedly increasing, no epidemiological investigations were carried out, nor were risk assessments conducted. Besides, emergency preparedness plans and stockpiled resources were also lacking in all health facilities across the sub-city.

While four woredas reported having emergency response mechanisms in place, the absence of clearly defined action thresholds at the sub-city level, along with the lack of routine epidemiological investigations, is a major weakness in the capacity of the system to effectively respond to NCD-related public health events.

## Case detection

In the period from January 2024 to May 2025, a total of 3,036 newly diagnosed cases of hypertension were identified in the health facilities under the Nifas Silk Lafto Sub-City Health Bureau. At the same time, 1,642 new diabetes mellitus diagnosed cases were identified and reported. These numbers show high prevalence of non-communicable diseases in the sub-city and reflect the need to strengthen prevention, early detection, and management strategies.

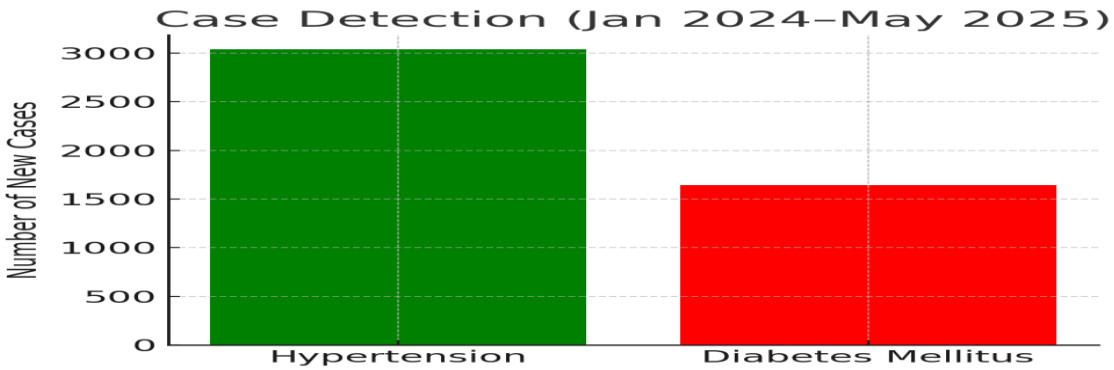



**Figure 22: Case Detection (January 2024–May 2025)**

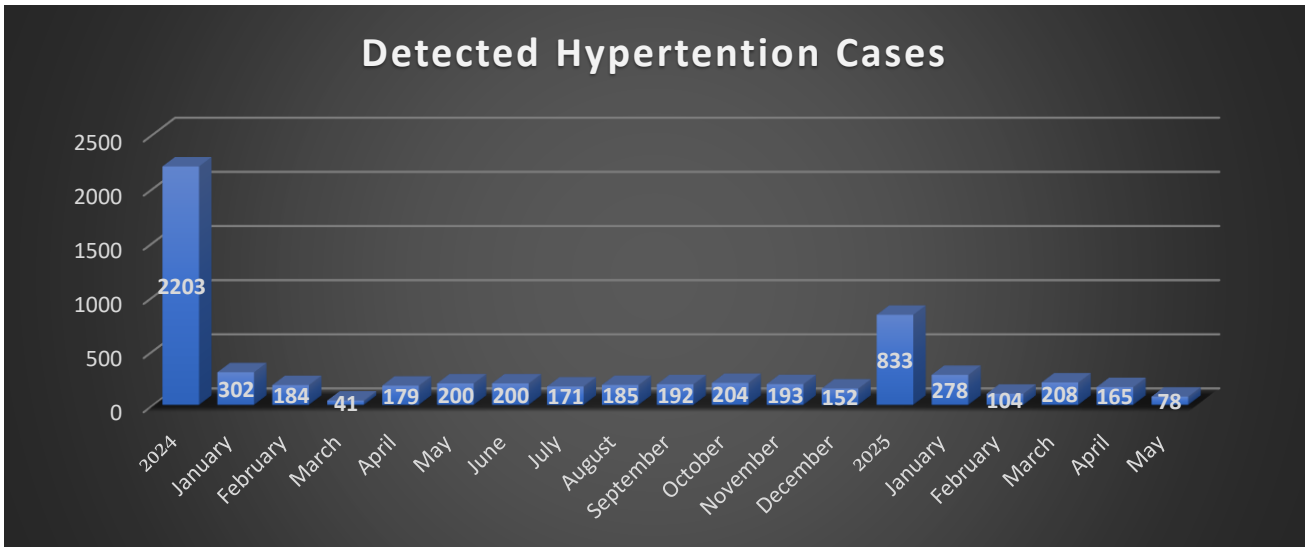



**figure 23: Detected Hypertension cases in Nifasilk Lafto Sub-city, Addis Ababa (January 2024–May 2025)**

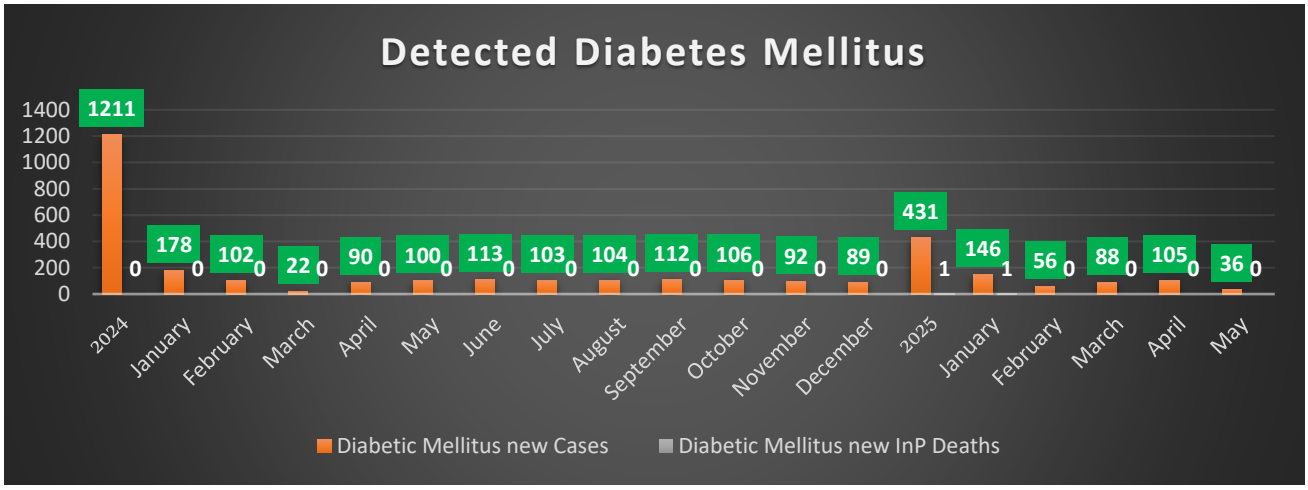



**Figure 24: Detected Diabetes Mellitus cases in Nifasilk Lafto Sub-city, Addis Ababa (January 2024–May 2025)**

## Feedback, Training & Supervision

Critical gaps were identified in the provision of feedback, staff training, and supportive supervision within the assessed health facilities. Only three health centers reported that they were provided with staff training, though four health centers indicated a continued need for capacity building. When available, the Addis Ababa City Health Bureau, Sub-City Health Bureau, the Federal Ministry of Health, public health institutions, and non-governmental organizations (NGOs) facilitated these training opportunities.

At the sub-city level, staff filled only 60% of the required positions, and no staff received training during the evaluation period. Moreover, during the review period, no preparedness training focused on non-communicable diseases; thus, there were important training and capacity gaps.

Feedback mechanisms were available in all the facilities assessed, but were not uniformly applied. Only one facility reported receiving feedback quarterly, while the rest received it less often. At the health centers, all five reported having received some type of feedback related to data use, but the frequency and structure of such feedback were highly variable. At the sub-city level, no formal feedback documentation was identified, indicating a general absence of systematic feedback processes.

The supportive supervision was also minimal, with a total of two supervisory visits during the year, showing minimal oversight and follow-up. Some critical fields, like suggestions and recommendations in the surveillance system were also left blank, representing missed opportunities for improvement through participation and strengthening of the system.

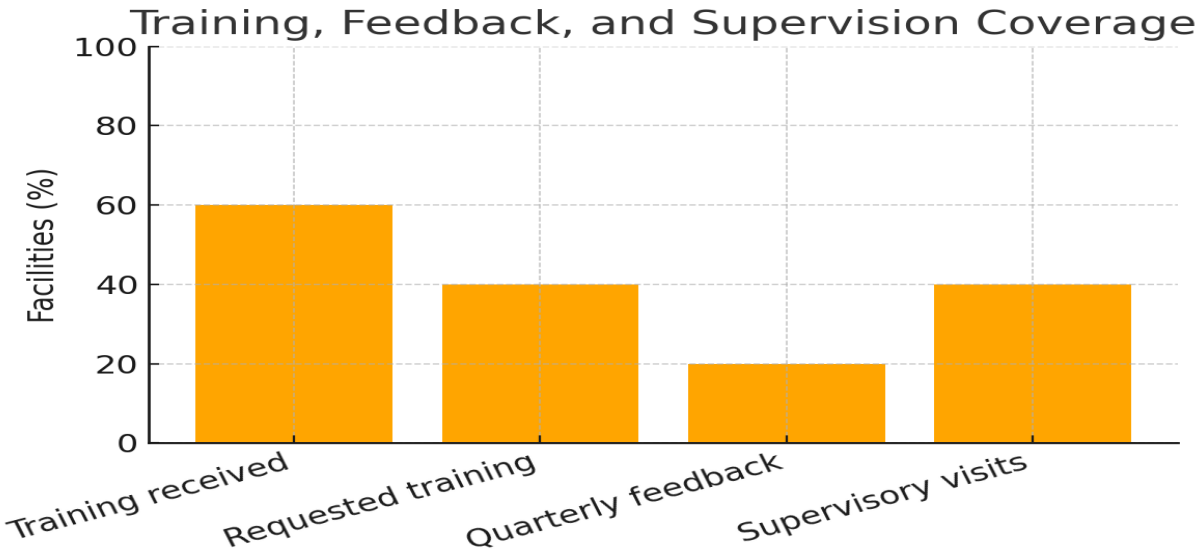



**Figure 25: Training, Feedback, and Supervision Coverage**

## Infrastructure & Resources

All the assessed health facilities reported having the necessary infrastructure and operational resources for NCD surveillance in place. These included a reliable power supply, functional computers, access to the internet, and key reporting materials. Printers were available at four out of the five facilities to further support basic data management functions.

Despite this solid infrastructural base, there were critical gaps identified in financing and human resources: no facility had a budget line for NCD surveillance activities, and overall, activities were seen as under-resourced to sustain or expand the system. This lack of specific funding represents one of the major barriers to effectively carrying out the program and to its long-term sustainability.

The sub-city level faced serious human resource constraints, with only 60% of the required posts occupied. Of the five health centers sampled, two, or 40%, reported shortages of clinical and PHEM personnel. But while this infrastructure suggests a state of operational readiness, inadequate staffing

and the lack of a dedicated funding point to the need for strategic investments if the NCD surveillance system is to be efficient and resilient.

## Surveillance System Attributes

The evaluation assessed the performance of the NCD surveillance system, using responses from the five health facility representatives within Nifas Silk Lafto Subcity on a number of dimensions. Key attributes assessed for surveillance were usefulness, simplicity, flexibility, data quality, acceptability, sensitivity, predictive value positive, representativeness, timeliness, and stability.

### Assessments of Qualitative Attributes

#### Usefulness

All respondents (100%, 12/12) confirmed that NCD surveillance data had been used either to plan or modify NCD programs and were useful for decision-making at their level. Furthermore, all respondents (100%) felt that the data contributed toward reducing the burden of NCDs and were useful in planning interventions. Lastly, all respondents (100%) confirmed the use of surveillance data to monitor health inequities, which suggests strong utility of the system to support equity-focused interventions.

#### Simplicity

Regarding the ease of completing reporting forms, 5 out of 12 respondents (42%) described the process as “very easy,” while 7 (58%) rated it as “moderate.” The time required to complete a single report varied, with 5 respondents (42%) taking less than 5 minutes, and 7 (58%) taking more than 10 minutes. While 9 respondents (75%) reported that staff required special training to understand the forms, only 3 (25%) indicated no need for such training. All respondents (100%, 12/12) agreed that the process of case identification and reporting was clear. However, the involvement of two or more levels in forwarding reports (responded by 100%, 12/12) could contribute to complexity.

#### Flexibility

The surveillance system's adaptability was perceived with variation. The ability to incorporate new NCD conditions was acknowledged by 6 respondents (50%), while 6 (50%) were uncertain. Adaptation to new reporting requirements was reported by 7 (58%) respondents, and integration with other surveillance platforms was acknowledged by 5 (42%) respondents. Modifications in case definitions or data elements had been suggested by 4 facilities (33%), and 8 (67%) expressed confidence in the system’s ability to handle NCD threats. These findings indicate moderate flexibility, with remaining uncertainty in some areas.

### Acceptability

It was also reported that health professionals participated willingly in all facilities (100%), and the respondents all felt that the reporting process was valuable to them. However, 10 of the 12 (83%) respondents reported that there were no incentives for participation. Satisfaction about the reporting system among stakeholders was noted in 8 facilities (63%), while 37% complained about the report data elements." Known complaints about the reporting process were acknowledged by 9 respondents (75%). Overall, acceptability was high, though incentives and minor dissatisfaction remain areas to address.

**Assessments of Quantitative Attributes**

### Data Quality

All facilities (100%, 5/5) reported that reporting forms were consistently completed ("always"), and all had quality checks in place before data submission. However, when asked about missing fields, 2 facilities (40%) responded "rarely," 1 (20%) "never," 1 (20%) "always," and 1 (20%) was "not sure." Consistency of data across facilities was confirmed by 4 (80%), with 1 (20%) uncertain. Feedback when errors were identified was provided in all cases (100%, 5/5), indicating strong data quality, despite isolated concerns around missing data.

### Completeness

From January 2024 to May 2025, the completeness of the weekly surveillance reports submitted by all health facilities to the sub-city level was 100%, indicating full compliance with reporting requirements during the review period. At the facility level, completeness of socio-demographic and clinical variables recorded in patient registers and forms was high: four out of the five woredas consistently completed all required fields, and occurrences of blank or missing data were infrequent. Routine consistency checks were reported throughout most facilities, contributing to improved data accuracy and reliability. One woreda had irregular field completion, reflecting a minor gap in data quality assurance practices.

### Sensitivity and Predictive Value Positive

All health facilities (100%, 5/5) confirmed that diagnosed NCD cases were being reported and that missed cases were identified through audits. All facilities (100%) also confirmed that reporting units were included in the surveillance system. The detection of clusters or patterns of NCDs was reported by 4 facilities (80%), while 1 (20%) stated it occurred "rarely." Regarding the predictive value, 2 respo ndents (40%) said reported cases were "always" confirmed as true NCD cases, 2 (40%) said "rarely," and 1 (20%) said "never." Importantly, all facilities (100%) reported that over-reporting (false

positives) was not evident. These findings suggest high sensitivity, while the predictive value is moderate and may require improvement in case confirmation practices.

### Representativeness

The system was reported to capture all key population groups by all 5 facilities (100%). Equal rep resentation of males and females was confirmed by 4 facilities (80%), with 1 (20%) indicating a discrepancy. However, only 2 facilities (40%) reported that data were disaggregated by age, sex, and location, while 3 (60%) did not. This reflects adequate general representativeness but points to a significant gap in demographic data disaggregation.

### Timeliness

All 5 facilities (100%) stated that NCD reports were submitted within the required timeframe. However, the timeliness of feedback varied: 3 facilities (60%) reported "always," 1 (20%) "often," a nd 1 (20%) "sometimes." While reporting timeliness is excellent, delayed feedback in 40% of facilities suggests a need to improve response time to submitted data.

### Stability

The system was generally stable. Four out of five facilities (80%) reported no interruptions in the past six months, while one facility (20%) experienced a disruption. Similarly, 4 facilities (80%) stated the system operated consistently without data loss or failure, while 1 facility (20%) reported an issue. This indicates a mostly stable system with occasional reliability concerns.

| Attribute | Performance Summary |
|---|---|
| Usefulness | 100% (12/12) reported data used for program planning, burden reduction, and monitoring health inequities. |
| Simplicity | 42% (5/12) found reporting "very easy"; 58% (7/12) "moderate"; 75% required special training. |
| Flexibility | 50% could incorporate new conditions; 58% adapted to new requirements; moderate uncertainty remains. |
| Acceptability | 100% willing participation without complain; 83% no incentives; 63% satisfied overall. |
| Data Quality | All facilities had quality checks; minor missing fields in some facilities. |
| Completeness | Weekly report completeness 100% (Jan 2024–May 2025); minor gaps in field completion in one woreda. |
| Sensitivity | 100% reported all diagnosed cases; clusters detected in 80%; predictive value moderate (40% "always" confirmed). |
| Representativeness | All facilities capture key groups; 40% disaggregate fully by age, sex, location. |
| Timeliness | Reporting 100% on time; feedback delays in 40% of facilities. |
| Stability | 80% no interruptions; occasional reliability issues in one facility. |

**Figure 26: Performance of NCD Surveillance System Attributes in Nifas Silk Lafto Sub-city, Addis Ababa, Ethiopia**

### 3.1.6. Discussion

This study systematically assesses the NCD surveillance system of the governmental health facilities in the Nifas Silk Lafto Sub-city in Addis Ababa, Ethiopia. The results show a system characterized by both functional strengths and critical systemic weaknesses. The system demonstrates high usefulness and completeness for its current scope, while its narrow focus on diseases, fragmented data management, inadequate resource allocation, and critical preparedness, training, and supervision gaps raise vital concerns. These findings are placed in the context of the greater body of literature related to NCD surveillance through comparison and contrast with the existing evidence in Ethiopia, the African continent, and global health frameworks. Such an analysis can help interpret the public health implications of the findings of this study and provide a basis for evidence-based recommendations that will go toward strengthening the NCD surveillance system.

#### Governance and System Scope: The Disconnect Between Policy and Practice

The fact that the weekly surveillance reports from Nifas Silk Lafto Sub-city are limited to only two NCDs, namely hypertension and diabetes mellitus, is thus a significant finding with broader ramifications for the national health system. While the other major NCDs are picked up through the monthly HMIS reports, their exclusion from the more frequent stream of surveillance reporting suggests a contradiction between the operational emphasis of the system and the focus of national strategic priorities. The Ministry of Health in Ethiopia has developed a national strategic action plan for NCDs, detailing an approach comprising a broad array of NCDs such as cardiovascular diseases, cancers, and chronic respiratory diseases [24]. This national plan emphasizes the need for a multi-sectoral response and integrated clinical interventions for a wide spectrum of NCDs[24]. The operational reality observed in Nifas Silk Lafto would thus suggest that this high-level policy has not been fully translated into a standardized comprehensive and frequent reporting mechanism at sub-city level.

This narrow focus is not unique to Ethiopia. It reflects a common pattern in many LMICs, where health systems are undergoing an epidemiological transition[25]. Public health systems in Sub-Saharan Africa have been historically designed and resourced to fight the communicable diseases that were the leading causes of morbidity and mortality for decades[25]. Global and regional frameworks now track a wider range of NCDs, such as the four main NCDs of the WHO's Global Monitoring Framework; many national health systems remain far behind in terms of their ability to fully integrate these conditions into their routine surveillance activities[26]. The findings of Nifas Silk Lafto demonstrate a system still in transition, capturing the most prevalent NCDs, hypertension, and diabetes, but with incomplete ability to monitor the full NCD epidemic. This is a crucial point of concern because the true burden of NCDs beyond those two conditions is being underestimated, and

this can easily lead to a misallocation of resources and inability to adequately prepare for the growing public health challenge. The disconnect between policy and practice in the Nifas Silk Lafto surveillance system represents a microcosm of a larger institutional lag in adjusting to the country's changing health landscape.

## Data Management and Information System Fragmentation

The study's finding that health facilities use a hybrid system involving paper forms, DHIS2, and Excel spreadsheets for data collection and reporting is another central issue. While the monthly reporting completeness and timeliness were found to be 100%, this impressive figure must be interpreted with caution in the context of system fragmentation. Ethiopia has made a strategic shift toward digital health by implementing the District Health Information System 2 (DHIS2) since 2018 to address the limitations of traditional paper-based methods[27]. The introduction of DHIS2 has been heralded as a transformative leap for health information systems in the country with improvement in the quality and timeliness of data[27]. However, coexistence of the multiple data platforms, as seen in this study, is a well-documented challenge in LMICs and a key operational constraint identified in other reviews of NCD service delivery in Ethiopia[28].

This hybrid model, with persistence over time, creates significant "utilization tensions" and may lead to redundancies and underutilization of the digital tools[29]. Healthcare staff often prefer paper-based systems that are easy to handle and more aligned with established workflows, while digital systems may be met with resistance due to their complexity, requiring high-level skills, and a general lack of stable infrastructure[29]. The study's finding of a 100% completeness score for monthly reports may, therefore, reflect a successful data transfer from paper to digital platforms rather than a high-quality, real-time data collection and analysis process. The real failure point lies in the subsequent use of this data. Despite the increase in NCD cases, the study found that no follow-up epidemiological investi gations were conducted at the sub-city level. This suggests a fundamental breakdown in the surveillance system's ability to move from data collection to data-driven action, which is the primary purpose of surveillance[30]. The system is functioning as a passive data repository rather than a dynam ic public health tool. This failure to act on surveillance data is a waste of scarce resources and a missed opportunity to address a growing public health crisis.

## Resource and Capacity Gaps: A System-Wide Deficit

A System-Wide Deficit The evaluation's identification of a lack of a dedicated budget line for NCD surveillance, personnel shortages, and missing national protocols and guidelines at the facility and sub-city levels are a series of interconnected findings. These challenges are not isolated issues but rather symptoms of a systemic lack of resource allocation that is consistent with the broader Ethiopian

and global contexts. A study on health facility readiness for NCD services in Ethiopia confirms a low and gradually decreasing availability of resources, equipment, and medicines, highlighting the need for increased readiness at the primary care level[28]. Similarly, national reviews and policy briefs have consistently pointed to critical weaknesses in the health workforce, including inadequate staffing and capacity at sub-national levels[31]. The absence of key policy documents, such as the National N CD Management Protocol and the National Strategic Plan for NCDs, at the local level is particularly concerning, as it points to a documented "leadership gap" and "poor prioritisation" of NCDs at the local level[31].

These resource deficits are a direct consequence of historical funding patterns in LMICs. NCDs were not part of the Millennium Development Goals and have historically received minimal global health funding compared to communicable diseases like HIV/AIDS, malaria, and tuberculosis[25]. The Nifas Silk Lafto study reveals the downstream effects of this under-prioritization. The lack of a dedicated budget line for NCD surveillance makes it impossible to fill staff vacancies, fund NCD-specific training, or purchase essential equipment and supplies, all of which were identified as deficiencies in the study[32]. This financial under-prioritization creates a cascade of other problems, as a poorly resourced team cannot effectively implement a comprehensive surveillance system, leading to the narrow scope and lack of epidemiological investigations noted in the evaluation. The core problem, therefore, is not a lack of commitment at the local level but a systemic failure to allocate the necessary resources that originates from higher-level policy and funding decisions.

### Human Resource Development: Inconsistent Training and Deficient Supervision

The study's findings on human resource development point to critical weaknesses in staff training and supervision. Only 60% of facilities reported receiving staff training, and this training was not NCD-specific. Furthermore, supportive supervision was minimal, with only two visits in the past year, and the quality of feedback was inconsistent, with recommendation fields in reports often left blank. These results are a direct reflection of broader challenges in Ethiopia's health system. A qualitative study on the country's Health Extension Program found that NCD training "lacked breadth and depth," was "inconsistently delivered," and was of "low quality" with "scant content specific to NCDs"[33]. The Ministry of Health and partners have recently begun to address this gap through new blended-learni ng NCD training for community health workers, acknowledging the long-standing need for improvement[34].

The problem of minimal and unsupportive supervision is equally significant. Supportive supervision is a recognized best practice for improving health worker performance, motivation, and quality of care, and is distinguished from traditional, authoritative supervision by its focus on mentorship, pr

oblem-solving, and continuous learning[35]. The findings from Nifas Silk Lafto indicate that supervision has often failed to transition from a top-down, fault-finding model to a bottom-up, supportive one[33]. This failure is not merely a human resources issue; it represents a critical breakdown in the surveillance system's feedback loop. The timely dissemination of data to those responsible for prevention and control is a core function of public health surveillance[30]. The delayed and unspecific feedback observed in the study demonstrates that while data are being reported upward, the actionable intelligence and guidance necessary to improve the system are not consistently flowing back down to the front-line health workers. Without consistent, supportive supervision and feedback, health workers are less likely to be motivated or knowledgeable, and the system becomes a one-way street of data transmission rather than a dynamic tool for problem-solving and improvement.

### Low-Scoring Performance Attributes: Simplicity, Flexibility, and Representativeness

Key attributes of the NCD surveillance system were assessed; Usefulness and Completeness had the highest scores. Simplicity, Flexibility, and Representativeness scored poorly. In fact, the system was rated as only moderately simple; a majority of the key informants felt that it was not "very easy" and required special training. This is directly related to the challenge of the hybrid data management system, in which staff has to navigate multiple platforms and workflows, hence intrinsically making the process more cumbersome and prone to resistance[29].

Flexibility, or the amount to which a system can adapt to new conditions or information needs, was also a concern: There was moderate uncertainty about the system's capacity for adaptation. This phase of strategic thinking will limit the system's ability to expand its disease scope or incorporate new data points as the NCD epidemic evolves[36]. Perhaps the most important result pertains to Representativeness, since only 40% of the facilities consistently disaggregated data by age, sex, and location.

Representativeness is a core surveillance attribute that enables public health officials to accurately describe the occurrence of a health event by person, place, and time, thereby identifying at-risk subgroups and addressing health inequities[37]. The failure to consistently disaggregate data means that the surveillance system is actively hindering the ability of public health authorities to understand and respond to disparities in the NCD burden. This is a critical deficiency because NCDs dispr oportionately affect vulnerable and socially disadvantaged people in LMICs[20]. A surveillance system with low representativeness is not just inefficient; it makes it impossible to design targeted, equitable interventions for the most vulnerable populations, perpetuating the cycle of disease and poverty[20].

## Synthesis of Findings and Comparison with Literature

The evaluation identified a number of key findings that reflect the complex realities of implementing NCD surveillance in a low-resource setting. The results, as summarized in the table below, highlight both the successes and the challenges, which are frequently echoed in the global literature on public health systems.

**Table 18: Synthesis of Findings and Comparison with Literature**

| Key Study Finding | Comparison with the Ethiopian Context | Comparison with African/Global Context | Explanation | Relevant Source IDs |
|---|---|---|---|---|
| **Governance & Scope:** Weekly NCD surveillance reports limited to hypertension and diabetes. | **Contradiction:** National strategic plans aim to address a broader range of NCDs, including cardiovascular diseases, cancers, and chronic respiratory diseases. | **Similarity:** Many African health systems are still primarily built to focus on communicable diseases, and a narrow focus on a few key NCDs is a common transitional stage. | This finding reflects a lag between high-level national policy ambitions and on-the-ground operational implementation, as the health system is still adapting to the full scope of the NCD epidemic. | [24] |
| **Data Management:** Use of a hybrid system (DHIS2, Excel, paper forms). | **Similarity:** Studies on NCD service delivery in Ethiopia note that fragmented information systems are a key operational barrier. | **Similarity:** The coexistence of paper-based and digital systems is a well-documented challenge in low- and middle-income countries (LMICs), often leading to data redundancy and underutilization of digital tools. | Healthcare staff's familiarity with paper-based workflows, coupled with technical barriers like a lack of advanced skills and unstable infrastructure, perpetuate this hybrid model despite the national adoption of digital platforms like DHIS2. | [27] |
| **Resources:** No dedicated budget line for NCD surveillance; personnel shortages. | **Similarity:** National reviews and facility readiness assessments highlight critical weaknesses in the health workforce and a lack of resources for NCD services. | **Similarity:** Globally, NCDs have historically received insufficient funding, and health systems in LMICs struggle with resource constraints due to competing priorities. | The lack of a dedicated budget is a direct consequence of global and national funding priorities that have not yet fully shifted to address the rising NCD burden. | [31] |

| | | | | |
|---|---|---|---|---|
| **Preparedness:** No NCD-specific emergency preparedness strategy; no epidemiological investigations despite rising case numbers. | **Similarity:** Consistent with the general under-prioritization of NCDs and the historical public health focus on acute infectious diseases. | **Similarity:** The traditional public health focus on infectious disease outbreaks has led to a lack of proactive, data-driven response mechanisms for chronic conditions. | The system is structured for passive reporting, failing to translate data into a proactive public health response, which is a critical gap in the surveillance mission. | [25] |
| **Human Resources:** Inconsistent training and minimal, unsupportive supervision. | **Similarity:** Qualitative studies on Ethiopia's Health Extension Program report similar issues with inconsistent, low-quality NCD training and a lack of supportive supervision. | **Similarity:** A lack of supportive, problem-solving supervision is a documented problem in many African health systems, hindering staff performance and motivation. | This reflects a breakdown in the feedback loop, where data are sent up the health system hierarchy, but actionable guidance and mentorship do not consistently flow back down to front-line health workers. | [33] |
| **Performance Attributes:** Low scores for Simplicity, Flexibility, and Representativeness. | **Similarity:** Consistent with the challenges of hybrid systems and limited staff capacity. | **Similarity:** The trade-off between simplicity and other attributes is a known challenge in surveillance. Representativeness is often a weakness in systems that do not collect comprehensive demographic data. | A complex, inflexible system that fails to consistently disaggregate data makes it difficult to identify and address health inequities, hindering a targeted public health response. | [37] |

## Strengths and Limitations of the Evaluation

The strengths of this evaluation include that it adopts a mixed-methods approach, combining quali tative interviews with quantitative data analysis and direct observation. This provides a robust and comprehensive picture of the NCD surveillance system through methodological triangulation, hence allowing for deeper understanding of its operational challenges from the perspective of the health workers themselves. The study's focus on the Nifas Silk Lafto Sub-city provides a detailed, localized snapshot that can be used to inform targeted improvements. However, the study also has several limitations. The evaluation was conducted in a single sub-city of Addis Ababa, which limits the generalizability of the findings to other sub-cities or to rural areas of Ethiopia, which face unique challenges with health facility readiness and access to car [31]. The small sample size of five health centers and 12 key informants further restricts the ability to draw broader conclusions. The cross-

sectional design of the evaluation (a single point in time) does not allow for a longitudinal analysis o f changes in the system over time, such as the impact of recent digital health initiatives or training programs[34]. Finally, there is a potential for reporter bias, as key informants may have been reluctant to report on system deficiencies or negative experiences.

### 3.1.7. Conclusions and Recommendations

The evaluation of the NCD surveillance system in Nifas Silk Lafto Sub-city reveals a system that, while functional and useful for a narrow set of conditions, suffers from critical, systemic deficiencies that threaten its ability to effectively respond to the rising NCD epidemic. The very high scores in Usefulness and Completeness are a tribute to the base which the national health information systems have provided and the dedication of health workers. These successes, however, are eclipsed by a number of limitations on the current system, including narrow scope of disease, fragmented data management environment, profound resource and capacity deficits, and lack of proactive data-driven action. These problems are consistent with the documented challenges of NCD surveillance and cont rol in Ethiopia and other LMICs, where health systems are still struggling to adapt to the ongoing epidemiological transition.

The public health implications of these findings are substantial. The system's limitations mean that public health officials in the sub-city are operating with an incomplete picture of the NCD burden, are unable to conduct timely epidemiological investigations, and lack the data necessary to design targeted interventions for at-risk groups. The observed deficiencies, particularly in supportive supervision, training, and data disaggregation, actively hinder the system's ability to address health inequities and respond effectively to emerging NCD threats. These gaps must be addressed to ensure the sub-city and the nation can effectively combat the growing NCD epidemic.

Based on the findings of this evaluation and their comparison with existing literature, the following recommendations are proposed:

1. Expand the Surveillance Scope and Standardize Reporting: The Nifas Silk Lafto Sub-city Health Bureau should align its weekly surveillance reporting with the broader national NCD strategic plan to include major NCDs such as cardiovascular diseases, cancers, and chronic respiratory diseases[24]. This requires a clear, top-down mandate to expand the scope of reporting to ensure that the true burden of NCDs is being monitored.
2. Harmonize Data Platforms and strengthen the DHIS2 Implementation: The health facilities should be supported in transitioning away from fragmented, hybrid data systems. This requires a concerted effort to address the technical and social barriers to DHIS2 adoption through targeted training on its use, and ensuring that the necessary infrastructure, such as reliable internet co nnectivity, is consistently available[27].

3. Allocate Dedicated Resources and Address Staffing Deficits: The Federal Ministry of Health and the Addis Ababa City Health Bureau must establish a dedicated budget line for NCD surveillance and prioritize filling the identified personnel shortages[25]. These financial and human resource investments are critical to funding training, purchasing essential equipment, and improving the overall capacity of the system.
4. Strengthen Human Resource Capacity Through Training and Supportive Supervision: A systemat ic and integrated training program for health workers on NCDs, building on recent national initiatives, must be implemented for all staff involved in surveillance[34]. Furthermore, supervision practices must be formally structured to be supportive and problem-solving, with clear documentation of feedback and follow-up on recommendations[33].
5. Enhance Data Use and Action: Clear protocols must be established at the sub-city level to mandate and guide epidemiological investigations when NCD case numbers exceed predefined thresholds. This will ensure that surveillance data are not just collected but are actively used to inform and drive public health action[30].

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# Chapter 4: Health Profile Description Report

## 4.1. Health Profile Assessment Report of Daleti Woreda, Glela-Guda Sub-City, Oromia Region, Ethiopia (2023-2024)

### 4.1.1. Abstract

**Introduction:** A district health profile consolidates key information on health and its determinants, using indicators to describe population health and influencing factors. Beyond reporting, it provides evidence for planning, monitoring, and decision-making in the health sector. Such profiles stimulate action aimed at improving health outcomes. In Ethiopia, these assessments are particularly important given resource constraints. The Daleti Woreda assessment was conducted to identify priority health problems and guide targeted interventions within the woreda.

**Methods**: A mixed-methods cross-sectional assessment was conducted in Daleti Woreda from March 20–30, 2024. Health profile data were obtained through review of secondary sources, including reports from the Woreda Health Office, health facilities, and community records. Key informant interviews with health managers and surveillance focal persons, along with direct observations, were used to capture contextual factors. Quantitative data were analyzed using Microsoft Excel 2016 to generate descriptive statistics. Qualitative information was thematically analyzed to explain system performance and challenges

**Results:** The woreda population is predominantly urban, with females comprising 52%. Maternal and child health indicators are relatively strong, with a contraceptive acceptance rate of 94%, antenatal care coverage of 91% (four visits), postnatal care at 93%, and immunization rates between 86–89%. Despite these achievements, systemic gaps persist. Health infrastructure is limited, with only two health centers and no hospitals serving nearly 97,000 people. The health workforce is critically ina dequate, with no general practitioners and a nurse-to-population ratio of 1:12,091. Safe water coverage is only 61%, while frequent power interruptions hinder service delivery. Typhoid fever, pneumonia, and diarrheal diseases remain leading causes of morbidity, reflecting persistent WASH challenges. He alth financing is constrained, with only 13.5% of the woreda's budget allocated to health, and Community-Based Health Insurance coverage remains partial.

**Conclusion:** Daleti Woreda demonstrates commendable progress in maternal and child health but faces fragility in sustaining these gains due to critical deficits in infrastructure, workforce, financing, and essential services. Strengthening health system capacity through improved road access, electricity, and water infrastructure, increasing health budget allocation, expanding CBHI coverage, and addressing workforce shortages are key priorities. Implementing these recommendations will enhance healthcare access and quality, fostering healthier and more resilient communities in Daleti Woreda.

**Keywords:** Health profile, Daliti Woreda, Acute Watery Diarrhea, Non-Communicable Diseases, Surveillance System, Ethiopia

### 4.1.2. Introduction

According to the WHO, Health does not only mean a state of freedom from disease or infirmity but also of complete physical, mental, and social well-being[1]. Health is a component of human rights and well-being that is the foundation for development and achievement everywhere[2]. Throughout the globe, nations strive to ensure access to quality health care services among their people, acknowledging the intrinsic link between health and socio-economic progress[3]. In the case of Ethiopia, a nation famous for its diverse cultural heritage and lively communities, the quest for better health outcomes still tops the list[4].

Ethiopia, located in the Horn of Africa, is a heterogeneous country with highlands, plateaus, and lowlands. Ethiopia has more than 110 million people and is the second most populous country in Africa[5]. ]. Despite its diversity of culture and geography, Ethiopia has significant health problems, ranging from infectious diseases to child and maternal health[6].

At the district level in Ethiopia, there exists a significant administrative level for delivering healthcare, which serves as the interface between the communities and the health system. There is a critical actor in each district, or woreda, in deciding on the health status of its population, as it is responsible for implementing health policies, offering basic services, and addressing the specific health issues of its populace.

District health profile is a public health publication produced by WHO that brings together important information on health determinants and health in the district and interprets and analyzes the data. They use health indicators to determine the population's health for specific districts and offer data on the city lifestyles, environment, and social determinants of health affecting it. The main function of the profile is to stimulate action that will improve health[7, 8].

This health profile aims to provide a comprehensive picture of Dalete Woreda, examining various sides of health, ranging from epidemiological patterns to the healthcare system, health-seeking behavior, and present initiatives aimed at improving health outcomes. By understanding unique dynamics at play in Dalete Woreda, stakeholders are better positioned to develop interventions and allocate resources accordingly, ultimately toward the advancement of health and well-being for all residents.

In addition, Dalle Woreda is a classic example of the challenges and opportunities in the Ethiopian healthcare case. Its physiography, demographic composition, customary cultures, and socio-economic environments are determinants to its residents' health status.Therefore, it is imperative to understand these diverse determinants in detail for purposeful interventions aimed at tackling the universal prevalent health issues and also to enable holistic well-being.

In this report of health profile assessment, we will address the prevailing indicators of health, such as mortality rates, disease burden, and access to healthcare services, and note areas of progress and priority areas. We will also address the interaction between socio-cultural determinants, economic disparities, and environmental factors in shaping the health outcomes in the district.

In addition, we will also point out the interagency partnerships between government institutions, civil society, community organizations, and other partners in developing a health system that is resilient and improves people's health literacy and enables them to make effective, well-informed health choices. We will critically examine such programs as part of trying to obtain best practices, lessons, and opportunities for scaling up for interventions aimed at improving sustainable health development.

Ultimately, this district health profile is a resource for policymakers, healthcare providers, researchers, and community members themselves, providing a platform for discussion, evidence-based decision-making, and action together toward the mutual interest of building healthier, more resilient communities in Daleti woreda and across Ethiopia as a whole.

## Rationale of the Study

The reason for conducting this study on Dalete Woreda's health profile is to provide policymakers with evidence-based information, improve health equity, empower communities, make policy more relevant, and strengthen local capacity to achieve improved health outcomes and sustainable development in Ethiopia.

Through critically examining the health indicators and contextual determinants at the level of Dalete woreda, this study aims to develop priority intervention areas, enhance targeted resource allocation, and enable evidence-based policy and program development. Through enabling stakeholder engagement at all levels and community participation, the research study aims to enable a culture of cooperation, accountability, and inclusion in the response to the varied health needs of the population. In the long run, results of this study are likely to contribute to enhancing health systems, reducing health inequalities, and better overall well-being in Dalete Woreda and beyond.

### 4.1.3. Objectives

#### General Objective

The primary objective of this study is to comprehensively assess the health status and health-related challenges in Daleti Woreda, and to identify priority problems that require targeted interventions.

#### Specific Objectives

- Assess key health indicators, healthcare access, and service quality in Daleti Woreda, including maternal, child, preventive, and disease treatment services.
- Identify socio-economic, cultural, environmental, and community perception factors influencing health outcomes and healthcare-seeking behaviors.
- Generate evidence-based recommendations to address health challenges, promote equity, and improve overall health outcomes in Daleti Woreda.

### 4.1.4. Methods and Materials

#### Study design and setting

A descriptive cross-sectional study was conducted in Daleti Woreda, Gelan Guda sub-city, Sheger City, Oromia Region, Ethiopia, from March 20 to 30/2024.

#### Study variable

District health profile systematically analyses some of the health factors in the district. It deals with demographic variables such as age, gender, ethnicity, geographical climate, political administration, socioeconomic status, level of education, availability of water and electricity supply, transport, and economy. These health status indicators like disease prevalence, mortality rate, disaster situation, environmental health, immunization, child health, maternal health, and vital statistics inform about the overall health of the people. In addition, the profile analyzes healthcare utilization and access, including insurance coverage, availability of healthcare facilities, distribution of the workforce, and accessibility obstacles. Data Collection Tool and Procedures

#### Data Collection Tool and Procedures

Data for a district health profile is collected through a checklist in the FETP resident manual and by concentrating on parameters of area information collected from concerned offices like Woreda and town health bureau, Education, Trade, Culture and Tourism, Water, agriculture, vital statistics, land administration, electricity, Transport, Telecommunication, and others by obtaining records through a checklist, interview, and observation a good idea of the district health is achieved.

#### Data Analysis

The data was gathered and processed using Microsoft Excel 2016 to arrange and analyze data in a proper format. Frequency distribution tables and graphs were employed to display the findings.

#### Ethical considerations

Permission/consent letter was obtained from the Oromia Regional Health Bureau, Sheger City Health Bureau, and Gelan Guda sub-city health Bureau.

### 4.1.5. Result

#### Historical, geography, and climate

Daleti Woreda, which is located in the heart of Ethiopia, comes under the administration of Gelan Guda Sub-city, Sheger City, in the Oromia Region. "Daleti" also derives its name from the erstwhile neighborhood designation during the period when it was declared as a woreda in October 2022. The woreda had previously come under the administration of the Sebeta Hawas district of Sebeta town.

Daleti Woreda was established by merging six Oromia towns that ring Addis Ababa, i.e., Sebeta, Burayu, Legatafo, Legedadi, Sululta, and Gelan towns, to form Sheger City in October 2022. The towns were merged into a single city with a single mayoral government on the periphery of Addis Ababa. The government has 12 sub-cities, 36 districts, and 40 rural kebeles, and its headquarters are found in the Saris area in Addis Ababa.

Daleti Woreda is found about 20 km away from the Addis abeba capital city. Daleti Woreda stretches from north latitude 8° 55' 52.121" to east longitude 38° 39' 41.798". It has a total area of 1995 square meters and covers 30% of the surface area of the sub-city, with an elevation above sea level of 2369 m. Daleti Woreda is bordered by Negule Geja Woreda to the south, Megule Woreda to the north, Chefe Kerabu Woreda to the east, and Chefe Woreda to the west.

Daleti weather is subtropical and height-affected, and there is a wet season between June and September. The dry season lasts from November through January. The average temperature of the coldest month (December) is 15.5 °C (59.9 °F), and that of the warmest month (April) is 18.8 °C (65.8 °F). The average yearly precipitation is 1165 millimeters and the average yearly temperature is 19°C.

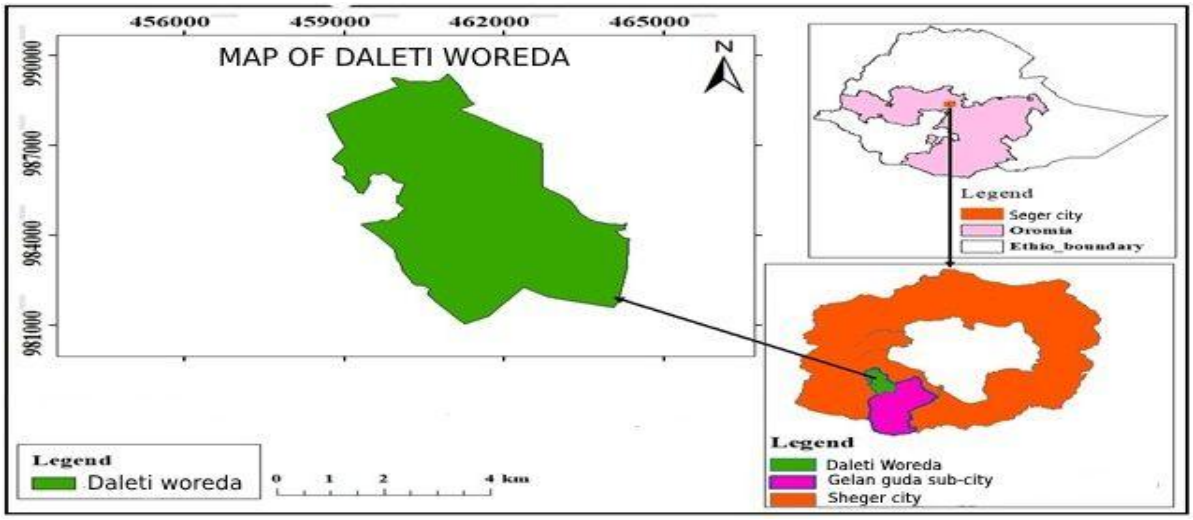



**Figure 27: Map of Daleti Woreda**

## Political and administrative organization

Political and administrative organization is the central framework of the way any nation or region functions and is managed. The organization decides the working of power and operations between different governmental levels, from national to local levels. It includes the mechanisms for policy formulation, implementation, and follow-up and also the administration procedures for right provision of governmental services. Good political and administrative organization is required to offer stability, ensure development, and present public services such as healthcare, education, and infrastructure.

Daleti woreda contains 14 urban kebeles, which is the most elementary form of administrative division in the country, and all Daleti woreda kebeles are urban. Daleti Woreda is governed by the Woreda head and the Woreda council, and the Woreda administration is under Gelan Guda Sub-City. All woreda and town sections are included in the compound, and it is estimated to have 96,728 inhabitants in the locality.

## Population structure, demography, and vital statistics

It is estimated to have 96,728 people, consisting of 46,429 (48%) males and 50,299(52%) females, with a sex ratio of 0.92 males per female. On the other hand, the majority of the Daleti Woreda kebeles possess a relatively evenly dispersed population, the maximum being Wato Kebele with 7989(9%) inhabitants, and the minimum being Gara Furi with 6346(7%) inhabitants, and all inhabitants were urban dwellers.

55% of the population are Oromo, 26% are Amhara and 14% are Gurage and Selte and 5 % are Tigray and another ethnicity respectively.

49% of the population are Muslim, 37% are Orthodox Christians, 11% are protestant and 3% of the population will practice catholic, wake-feta, and other religions respectively

Daleti woreda data indicates that over half of the woreda population 38.4% of the population are between 15-64 years of age among whom 53.6% of them are women in the reproductive age group, although no infant, child, and maternal death occurred in 2015. if we take deliveries seen by skilled birth attendants was 1,420 with crude birth rate of 14.6 /1000 and contraceptive acceptance rate of 94%.

**Table 19: Population of Daleti Woreda by kebele**

| kebeles | woreda names | Male | Female | Total population | population ratio |
|---|---|---|---|---|---|
| 1 | Wato | 3239 | 4750 | 7989 | 9% |
| 2 | ijara | 3217 | 4659 | 7876 | 8% |
| 3 | Arada Gora | 3180 | 4010 | 7190 | 8% |
| 4 | Hambisa | 3133 | 3975 | 7108 | 7% |
| 5 | Dawara | 3724 | 3365 | 7089 | 7% |
| 6 | Malka Irecha | 3768 | 3244 | 7012 | 7% |
| 7 | Nawuso | 3735 | 3197 | 6932 | 6% |
| 8 | H/Lamani | 3470 | 3289 | 6759 | 6% |
| 9 | Birbirsa | 3120 | 3480 | 6600 | 7% |
| 10 | Qarsa | 3096 | 3450 | 6546 | 6% |
| 11 | Zenaba | 3360 | 3095 | 6455 | 7% |
| 12 | Garmama Farda | 3198 | 3230 | 6428 | 7% |
| 13 | Gullalle | 3053 | 3345 | 6398 | 7% |
| 14 | gara Furi | 3136 | 3210 | 6346 | 7% |
| Total population | | **46429** | **50299** | **96728** | **100%** |

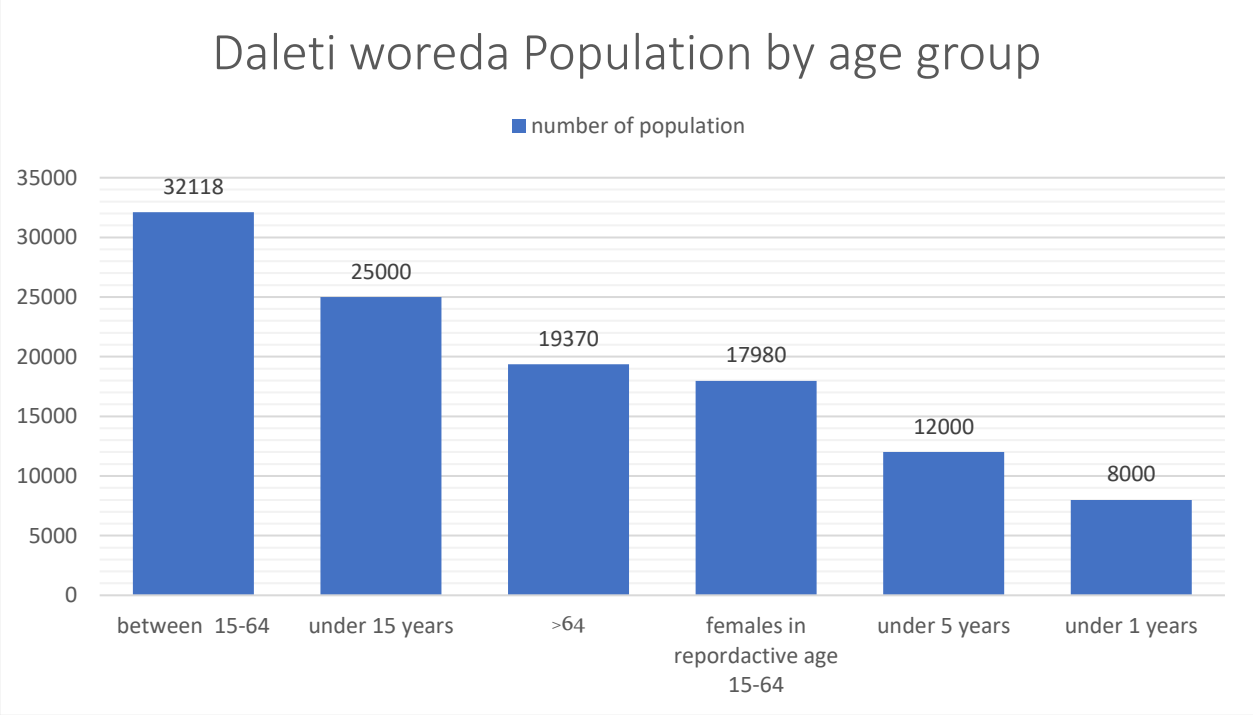



**Figure 28: Population age distribution of Daleti Woreda, Sheger City**

## Economy and household income

Economy and household income are connected variables that play a significant role in determining the well-being and standard of living for individuals and groups. The condition of an economy, as shown by indicators like GDP growth, employment rate, and inflation, directly relates to the household incomes' level and the state of stability within the economy. A robust economy generally leads to more opportunities for employment, better pay, and standard of living. Alternatively, financial recessions lead to unemployment, salary freezes, and rising poverty levels, thereby a negative impact on family incomes.

As we observe, the principal sources of income for the Daleti people are businesses and other trade with almost approximately 20% (20,312) of the population. At the same time, around 6% (5,804 people) of the population engage in farming and animal rearing, cultivating 755 hectares of land and grazing about 821 cows and sheep. In terms of employment, 5% (4,836 people) are unemployed, 8% (7,738) are state civil servants, and 16% (15,476) are private sector workers as well as those employed on a daily wage rate.

## Education and school health

School health and education are the pillars for the development and wellbeing of any population. In Daleti Woreda, the educational setup consists of a sequence of government and private institutions for various levels of education ranging from kindergartens to high schools. That there are school health units with functional latrines and handwashing facilities indicates the emphasis on having a clean environment in learning. And also the establishment of hygiene and HIV/AIDS clubs for schools indicates the early awareness approach in handling issues related to health among the students.

Upon visits to educational institutions within Daleti Woreda, 53% of the kindergarten schools are private schools, while primary schools are split equally between private and government schools. Furthermore, 67% of the secondary schools are government schools. There aren't any universities, colleges, or TVETs within the woreda, however.

Contrarily, 30,175 students who are enrolled in 2023 consist of 50.2% males and 49.7% females respectively. Out of 30,175 enrolled, 1.7% dropouts are there due to different reasons Moreover, all schools have operational latrines, handwashing facilities, and hygiene and HIV/AIDS clubs. Nonetheless, no data on the education status of the community is provided.

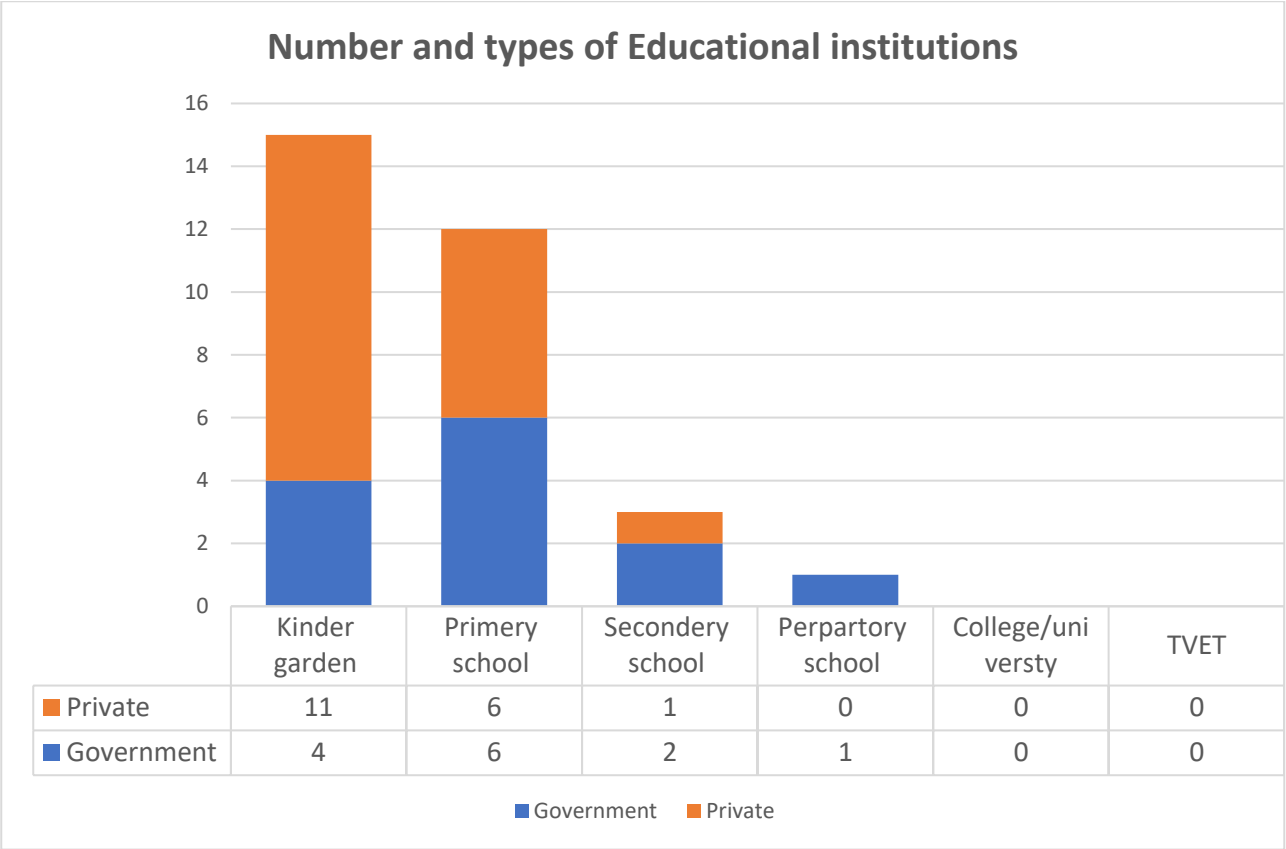



**Figure 29: Number and types of educational institutions**

## Transportation, telecommunication, electricity and water supply

Development of transport, telecommunications, electricity, and water supply infrastructure in Daleti woreda is crucial to socio-economic growth. Efficient transport infrastructure facilitates human and goods movement that triggers trade and access to services, and increased accessibility can be brought about by efficient public transport. Extension of mobile networks and internet services development is critical to closing the digital divide, enabling education, improving business operations, and delivering healthcare services through telemedicine.

Continuous electricity and water supply are essential to the health of Daleti residents. Increased power network extension and incentivizing the use of renewable energy systems would ensure the reduction of the power shortage and accessibility of green energy supplies. Improved water supply systems need to be provided for public health and require interventions like drilling additional wells and utilizing water purification technologies. Equal and equally distributed access to electricity and clean water is crucial for the improvement in the level of living as well as economic growth in the area.

The Daleti woreda is crossed by the main road from Addis Ababa to Alem Gena (Kenetry). The kebeles within the woreda were linked by cobblestones, and this makes it possible for a road to be used intensively throughout the year It also has the benefit of draining water instantaneously, and not getting muddy in the rainy season or dusty in the dry season. Out of 14 kebeles, they are all accessible

by a mode of transportation but 2 kebeles have no good road conditions and it is difficult to move in and out of vehicles and reach health facilities in case of an emergency and 4 of the health facilities lack access to the main road. They have network coverage to all the kebeles in the woreda. They subscribe primarily to mobile phones and rarely use a fixed line. Nearly 95% of the houses have received main electricity power supply but they are subject to power supply cuts. Among the health facilities in the woreda, all the facilities are equipped with electric lines. But they stated that they are subject to power supply cuts so it is hard to depend upon an electric supply. The safe water coverage of the woreda is 61% and 59,004 individuals are estimated to have accessed safe water. The most frequent source of water supply is deep well water taps. The woreda has 3 operational deep wells and one under installation but still there is lack of water because the water is only given once a week or once every fifteen days in some kebeles of the woreda.

## Disaster situation

Disaster situation is any catastrophic occurrence that has a very significant effect on the normal operation of a society or community and triggers extensive human, material, economic, or environmental losses. They can be natural, e.g., earthquakes, floods, hurricanes, and droughts, or man-made, e.g., industrial accidents, war, and nuclear disasters. In Daleti Woreda No recent Disaster is registered.

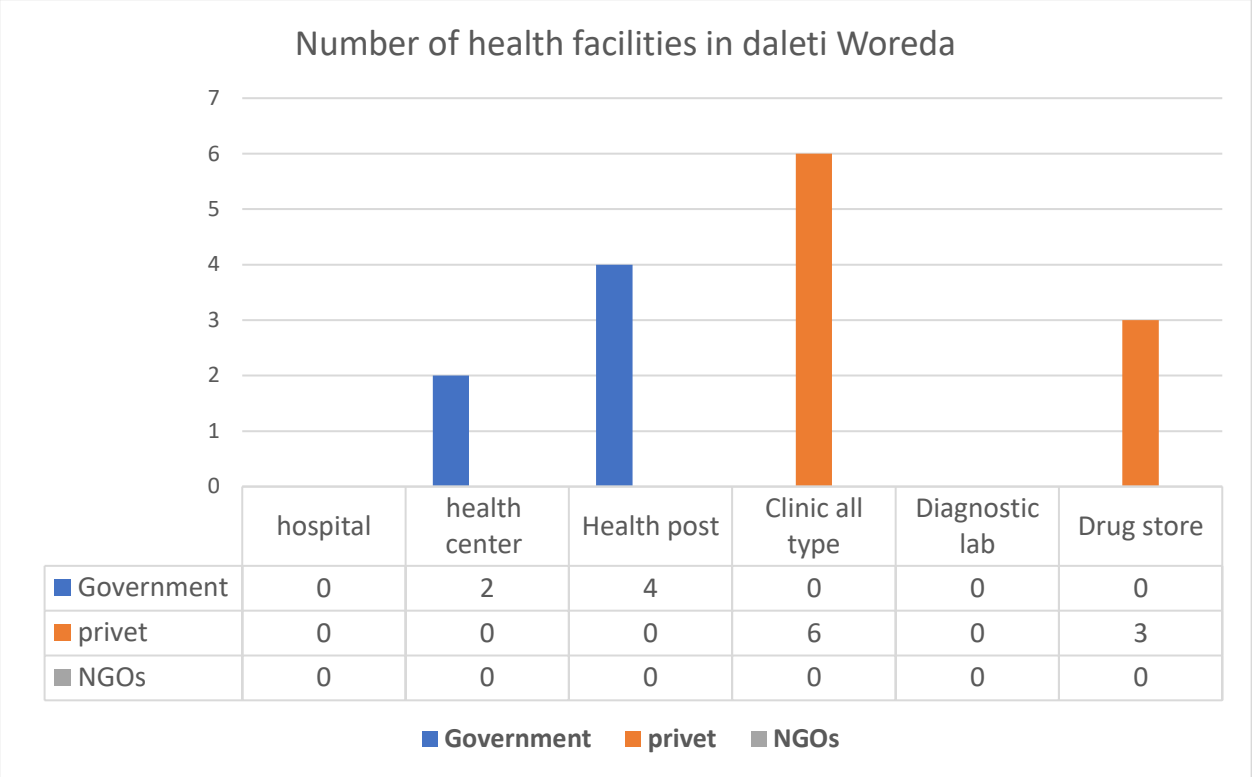
## Health delivery system

A health delivery system is the overall process by which health care services are delivered to populations and individuals. It involves a variety of services, facilities, and health practitioners in collaboration to ensure that individuals access the right medical care and health interventions.

The main function of a health delivery system is to enhance the state of people's health. It includes preventive, curative, and rehabilitative care with the overall goal of preventing disease, treating illness, and facilitating healing from disease or injury. Good health delivery systems are marked by accessibility, quality, efficiency, and equity so that everybody, regardless of socio-economic status, can access key healthcare services.

Centers of a health delivery system are specialty care facilities, clinics, hospitals, and community health centers. These facilities have a varied staff of midwives, allied health workers, physicians, nurses, and community health workers employed by the facilities. They together offer a continuum of care ranging from immunizations and routine check-ups to emergency and specialty care.

There are 2 health centers, 3 health posts, 6 privet clinics, and 3 drug stores in daleti woreda but no hospital and diagnostic laboratory in the woreda. While the coverage of health centers to population is 1:48,364 and that of health posts to population is 1:24,182 with 87% of health service coverage.




| | hospital | health center | Health post | Clinic all type | Diagnostic lab | Drug store |
|---|---|---|---|---|---|---|
| Government | 0 | 2 | 4 | 0 | 0 | 0 |
| privet | 0 | 0 | 0 | 6 | 0 | 3 |
| NGOs | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 30: Number of health facilities by type in Daleti woreda**

## Human resources for the health sector

Human resources are a key part of the healthcare sector, and they are pivotal in the provision of healthcare services and the management of health systems. They consist of a broad array of professionals such as physicians, nurses, midwives, pharmacists, laboratory technologists, community health workers, and administrative staff. The functioning of any health delivery system heavily depends on the presence, capability, and distribution of its workforce. There must exist a suitably trained, suitably staffed, and suitably supported health workforce to deliver high-quality care, enhance health results, and make available equitable health services between regions and groups of individuals.

In Daleti woreda, the ratios of population to health workers in terms of medical personnel reflect critical shortages in terms of medical personnel availability. The ratio of Health Extension Workers to population is 1:8,061, with a single HEW having a mandate to cover more than eight thousand people. This ratio is several times over required levels and reflects an overwhelming workload for such workers and thus may have implications for quality and scope of healthcare delivery.

Additionally, the nurse-population ratio stands at 1:12,091, and each nurse is attending to over twelve thousand individuals. The ratio is atrociously low and reflects a deplorable shortage of nursing

personnel, which is needed to render basic and emergency medical assistance. The health officer-population ratio stands at 1:10,747, reflecting the same kind of situation wherein each health officer will have to attend to over ten thousand citizens.

These are complemented by problems that no general practitioners exist in the woreda. In the absence of general practitioners, residents lack a family medicine doctor to diagnose and treat a variety of different types of health issues.

**Table 20: Number of health professionals to population ratio in Daleti woreda**

| Types of Health Professionals | No. of professionals | Health professionals to population ratio |
|---|---|---|
| HEWs(Urban) | 12 | 1: 8,061 |
| Nurses(Degree and Diploma) | 8 | 1: 12,091 |
| Supportive staffs | 9 | 1: 10,748 |
| Health Officer (HO) | 9 | 1: 10,748 |
| Pharmacy (Degree and Diploma | 3 | 1: 32,243 |
| HIT (health information technicians) | 3 | 1: 32,243 |
| Midwife (Degree and Diploma) | 3 | 1: 32,243 |
| Laboratory (Degree and Diploma | 2 | 1: 48,364 |
| Specialist | 0 | - |
| G.P (general practitioners) | 0 | - |
| Environmental Health (Degree and Diploma) | 2 | 1: 48,364 |

## Maternal Health

Maternal health is an essential public health element that involves pregnancy, delivery, and postpartum care among women. Maternal health care, such as family planning, antenatal care, childbirth by skilled personnel, emergency obstetric care, and postnatal care, is critical in minimizing maternal and neonatal mortality. They ensure the prevention of complications during pregnancy and childbirth and safeguard the health and well-being of women and children.

There are two government health centers and four medium private clinics in Daleti Woreda government that offer maternal health services. They are the main channels through which pregnant women access prenatal services, delivery, and postnatal services.

The rate of acceptance of contraception is the proportion of women of reproductive age who are neither pregnant nor using, or whose partner is using, some form of contraception at a specific point in time. Daleti woreda has approximately 17,980 women of reproductive age that would be expected

to use family planning services. Of these, approximately 94% are utilizing some type of contraception. This high rate of acceptance is an indication of effective outreach and education activities within the community such that most women know about and are already practicing family planning services in an effort to control their reproductive lives.

when considering the contraceptive acceptance rate (CAR) by method, long-term methods were mostly utilized, at about 62%. Out of them, implants were the dominant method, and they were trailed by intrauterine contraceptive devices (IUCDs). Short-term methods, on the contrary, comprised about 37% of contraceptive use. This reflects a vast preference by the population for more stable and long-term contraceptive solutions with the need for access and information around long-term contraceptive solutions.

As far as maternal health interventions were concerned, deliveries by skilled birth attendants were 1,420 and crude birth rate was 14.6 per 1,000. Antenatal care (ANC) visits were very high as 89% of pregnant women had a minimum ANC visit (ANC 1) and 91% had four or more visits (ANC 4). Postnatal care (PNC) visits were also high with 93% postnatal care visits received by mothers upon delivery. They are indicative of a significant improvement in maternal health care, and they highlight the most significant demand for skilled birth attendants and full antenatal and postnatal care in achieving maximal maternal and neonatal outcomes.

## Child health

Child health refers to the health and well-being of children, infants, and adolescents. There are several health programs for the best child health results in Daleti Woreda. They include regular immunization, nutrition, monitoring of growth, and management of serious childhood diseases like pneumonia, diarrhea, and malaria.

When we observe Child health in daleti woreda 7% low birth weight was documented whereas under-five children were screened and measured for malnutrition out of which around 0.9% were moderately malnourished (MAM) and 18 children 1.4% were severely malnourished (SAM).

## Immunization coverage

Immunization is an important component of public health planning in Daleti Woreda, guaranteeing protection against preventable illnesses through services offered at government health facilities and outreach. The core vaccines such as those for measles, polio, diphtheria, pertussis, tetanus, and hepatitis B are given based on national immunization schedules. Achievements for these interventions are measured in terms of immunization coverage levels, a measure of the proportion of population vaccinated within recommended time intervals. Having high rates of coverage is crucial in the sustenance of herd immunity and safeguarding vulnerable individuals.

For Daleti Woreda, the coverage of children completing the full course of recommended vaccines by one year of age is around 89%. These injections comprise vaccinations such as BCG, pentavalent, polio, pneumococcal, inactivated polio, rotavirus, and measles vaccines. Babies are also provided with the immunization of their mothers against tetanus during pregnancy, which safeguards them throughout infancy months when they are most vulnerable. A rate as high as immunization coverage is a tribute to the concerted efforts of health authorities and outreach programs for administering vital vaccinations at hand.

**Table 21: Immunization coverage in Daleti Woreda 2015**

| No. | Vaccine | Target population | Coverage | Percentage |
|---|---|---|---|---|
| 1 | BCG | 2147 | 1648 | 86 |
| 2 | Penta1 | 2147 | 2142 | 86 |
| 3 | Penta3 | 2147 | 1982 | 89 |
| 4 | Rota1 | 2147 | 1991 | 90 |
| 5 | Rota2 | 2147 | 1980 | 91 |
| 6 | MCV1 | 2147 | 2990 | 86 |
| 7 | MCV2 | 2147 | 1994 | 77 |
| 8 | Fully immunized | **2147** | 1868 | 86 |

## Disease Prevention and Control

### Top 10 causes of morbidity

The major cause of morbidity in daleti woreda is typhoid fever, followed by pneumonia, respiratory disease system, urinary tract infection, gastritis infection, and acute tonsillitis they are among the top 5 major causes of morbidity in adults and children respectively in the woreda. On the other hand, pneumonia, thyroid fever, bacterial intestinal infection, acute tonsillitis, and diarrhea are the leading 5 disease cases in children aged below 5 years. but there is no data available to indicate the mortality of the woreda.

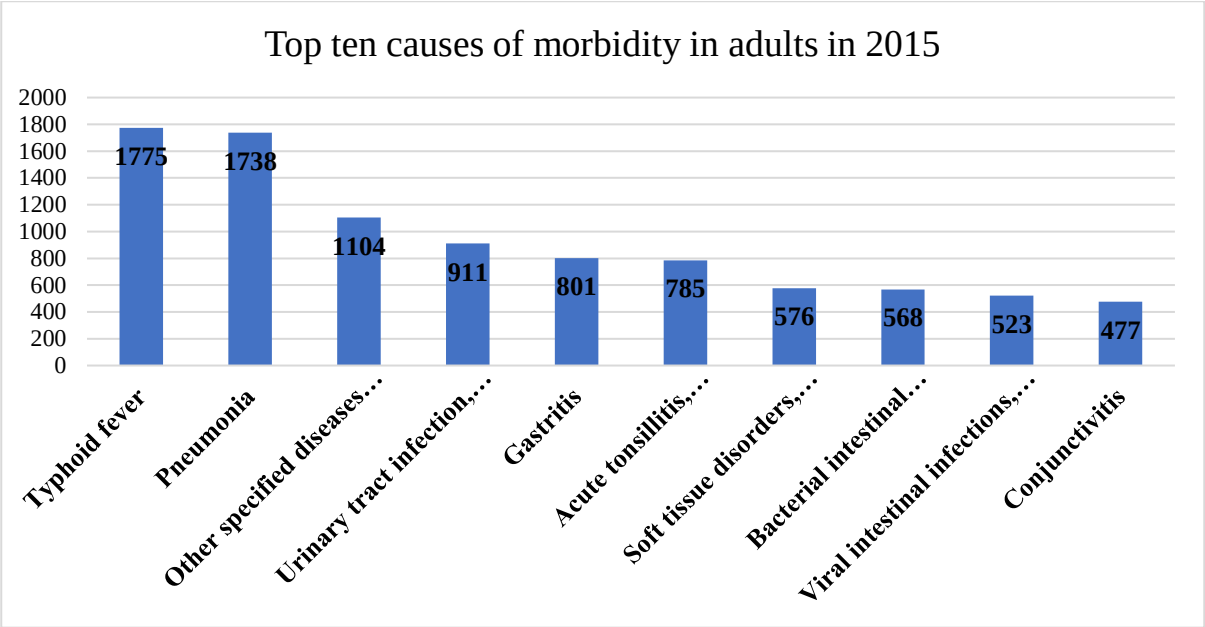



**Figure 31: Top ten morbidities in adults in 2015**

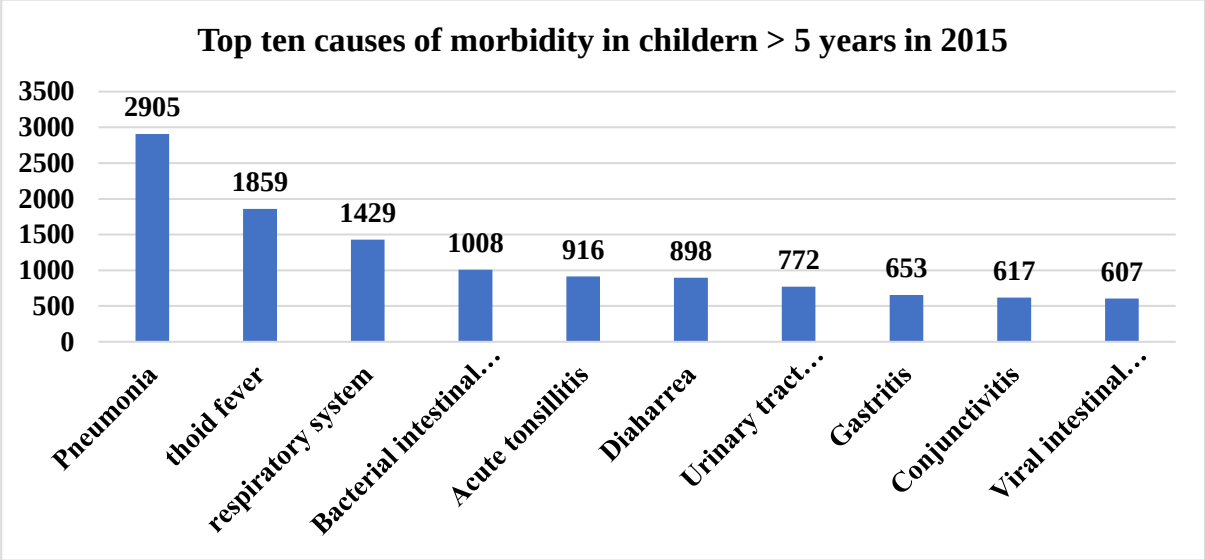



**Figure 32: Top ten morbidities in >5 years**

## Malaria

Malaria is a deadly disease that is transmitted to human beings by some species of mosquitoes. Malaria is prevalent in all tropical nations. Malaria can be cured as well as averted. Despite the fact that shegercity is not a Malaria zone, 81 RDT tests were conducted and 7 came out to be positive, of which 3 were Plasmodium falciparum and 4 were Plasmodium vivax, giving a malaria positivity rate of 8.6%, no admissions and deaths resulting from malaria occurred in the Woreda.

## TB and leprosy

In Daleti Woreda, leprosy and tuberculosis are public health issues of great concern and necessity and should be given special emphasis and action. Tuberculosis (TB), a bacterial disease that mainly infects

the lungs, is targeted through active case finding, early initiation of treatment, and follow-up to track patients' compliance with the treatment regimen. Diagnosis stations are provided in health centers, and health workers are educated for early symptom detection. Mass awareness campaigns in the community are central to helping break the stigma of TB, encouraging people to come for treatment in time.

Leprosy may not be as prevalent as TB, but it is an issue with its long-term nature and the possibility of disability if not detected on time.

The total of all TB client categories (New and Relapse) notified and treated at Daleti Woreda during 2015 was 79(0.08%), and there is no case of leprosy.

### HIV/AIDS

HIV/AIDS is a major public health problem in Daleti Woreda, and this warrants an integrated prevention, treatment, and support response. Daleti administration for health has developed several programs aimed at fighting the spread of HIV as well as assisting infected individuals with the disease. They include mass campaigns of increasing awareness among the public on the means of transmission, testing frequency, and advantages of safe sex. There are voluntary testing and counseling (VCT) centers available to help promote individuals to get their status known, and an attempt at decreasing the stigma and discrimination against the disease.

For those who test positive for HIV, Daleti Woreda offers them access to antiretroviral therapy (ART), which is crucial in controlling the virus and keeping HIV-positive individuals healthy. The health centers also specialize in mother-to-child prevention (PMTCT) by providing pregnant women with testing and treatment. Counseling and support groups have been established to allow individuals with HIV/AIDS to live with the psychological and social issues that they can encounter. The integrated strategy towards the HIV/AIDS management in Daleti Woreda indicates the dedication of the community towards mitigating the effects of the disease and enhancing the livelihood of affected individuals.

1,99 clients were screened, including PICT, and VCT in Daleti woreda. 10 were positive cases with an increased positivity rate of 0.5%, The STI cases tested for HIV were 59, and 6 were HIV positive.

## Latrine coverage

Latrine coverage is a crucial aspect of public health, directly influencing the hygiene and sanitation standards of a community. In Daleti Woreda, efforts have been made to improve latrine coverage, recognizing its importance in preventing diseases and promoting overall well-being. The local

administration, in collaboration with health organizations, has been working towards increasing the availability and use of latrines among households.

Recent assessments indicate that a significant proportion of households in Daleti Woreda now have access to latrines, which has contributed to better sanitation and reduced the prevalence of sanitation-related diseases. Community-led total sanitation (CLTS) initiatives have played a vital role in this progress, encouraging residents to build and maintain their latrines. These efforts aim to achieve not just improved coverage but also sustainable hygiene practices, fostering a healthier and cleaner environment for all residents.

The latrine coverage of Daleti Woreda is estimated to be about 80,284(83%), among which 14451(18%) are using community latrines, and about 65,833(82%) of the population have their own toilet. Still, there are 17% of the population has no access to a latrine.

## Budget allocation for health and CBHI

Budget allocation for health and the Community-Based Health Insurance (CBHI) scheme is essential for improving healthcare services in Daleti Woreda. A well-planned budget ensures that sufficient resources are allocated to maintain and enhance healthcare facilities, procure necessary medical supplies, and support health programs. In Daleti Woreda, the local government prioritizes healthcare in its budget, recognizing the critical role it plays in the community's well-being.

The introduction of CBHI in Daleti Woreda has been a significant step towards providing financial protection against health-related expenses for the residents. CBHI helps to ensure that even low-income households can access essential healthcare services without facing financial hardship. By pooling resources through community contributions, CBHI enables broader access to healthcare, reduces out-of-pocket expenditures, and promotes equity in healthcare access. The budget allocation for CBHI includes funds for raising awareness, enrolling community members, and managing the scheme effectively to ensure its sustainability and success.

The total budget of the daleti woreda for the year 2016 was 17,126,120 birr including a municipality budget of 7,000,000 out of which 2,312,026 birr (13.5%) was allocated for health. The budget allocated for health was found to be inadequate to hire adequate manpower and avail necessary medical supplies by the health office.

When we see community-based health insurance, 12,183 households paid for CBHI service, out of which 8,456 received CBHI cards and received care.

## Gap identified

- There are four of the woreda health centers with no access to the main road, and two kebeles with low-quality roads that create it difficult for cars to enter and leave the kebele as well as reach the health centers. The road plays a crucial role in enhancing the health service of a region in the sense that it allows health practitioners to select. Road is also fundamental in the sense that it facilitates the delivery and supply of other services such as water supply, electricity power supply, and relief of distress.
- Continuous power supply interruptions are found to be a major gap and need improvement in the woreda. Among all health facilities in the woreda, health facilities have electric lines but some of the health facilities have no backup electrical generator in case of power supply interruptions. In t hose with electric lines, there are continuous power interruptions. In a health facility without an electric supply, it is difficult to store some drugs that require a refrigerator. It is also difficult to provide adequate laboratory service without electricity.
- In the woreda only 61% of the population have access to safe water coverage there are still 39% left who have no access to safe water also some kebeles with access to safe water have a continuous water shortage due to the water comes once in a week or a fifteen day. That is a critical issue that may lead to waterborne disease and increase the transmission of infections like cholera and others.
- There is also a gap in vital statistics registration like birth, death, and marriage not being properly registered due to most of the residents will come only when they need the service/certificate.
- Reports are not properly recorded have many missing values and are under-reporting problems of importance indicators this may lead to a lack of evidence-based decision-making.
- The woreda has an Inadequate health budget will to inadequate human power and inadequate health service.

### 4.1.6. Discussion

The assessment of Daleti Woreda's health profile reveals a situation that is emblematic of the broader challenges facing rural health systems in Ethiopia, but with certain local nuances that merit particular attention.

According to Ethiopia's primary health care standards, one health centre is expected to serve up to 25,000 rural or 40,000 urban residents, supported by five satellite health posts forming a Primary Health Care Unit (PHCU)[9]. In Daleti Woreda, which has a population exceeding 96,000, only two health centres exist. This translates to an average of one health centre per ~48,000 residents—almost double the recommended rural standard—creating significant service overload. While health posts offer some relief, their capacity is often limited to basic preventive and promotive services, meaning the gap in curative and specialized care remains.

Geographic access is further constrained by poor road conditions and limited transportation options. Unpaved roads become impassable during the rainy season, effectively isolating some kebeles and delaying emergency referrals. In rural Ethiopia, such barriers are strongly associated with delays in receiving care and higher mortality, particularly for maternal and neonatal emergencies.

The high prevalence of typhoid fever and pneumonia as leading morbidities reflects a dual challenge of infectious disease transmission and environmental health risk factors. Typhoid is directly linked to unsafe water and poor sanitation—conditions still prevalent in Daleti, where safe water coverage is just 61% and functional public taps are limited. Pneumonia, especially in under-fives, may be driven by indoor air pollution from biomass fuel use, poor housing ventilation, and delayed care-seeking.

Frequent diarrheal disease and bacterial infections among children under five indicate persistent WASH (water, sanitation, and hygiene) gaps. This is consistent with findings from similar rural Ethiopian settings, where inadequate water quality and low sanitation coverage directly drive under-five morbidity.[10]

The human resource situation is a critical bottleneck. Ratios such as 1 health extension worker (HEW) per 8,061 people and 1 nurse per 12,091 people fall far short of WHO and national norms, which recommend one HEW per 5,000 people and far more nurses per capita. The absence of general practitioners is particularly concerning, as it limits access to advanced clinical decision-making, surgical interventions, and management of complex cases. This shortage also places excessive burden on mid-level health workers, increasing the risk of burnout and compromising service quality.

Despite these structural challenges, the woreda demonstrates commendable performance in maternal and child health: 94% contraceptive acceptance rate, 89% ANC1, 91% ANC4 coverage, 93% postnatal care coverage, and Immunization coverage (86–89%), These figures surpass the Ethiopian national averages in several indicators, reflecting the dedication of local HEWs and community engagement.

However, sustaining these gains is fragile in the face of underfunded health facilities, supply chain interruptions, and human resource shortages. A single disruption—such as a vaccine stock-out—could quickly reverse progress.

The study revealed incomplete vital events registration and inconsistencies in health data reporting. Weak data systems undermine not only disease surveillance but also evidence-based planning and resource allocation. This is not unique to Daleti; several Ethiopian rural woredas face similar data gaps due to limited staff training, absence of standardized tools, and low prioritization of data veri fication in supervision.

With only 13.5% of the woreda's budget allocated to health (about 2.31 million birr), financing remains insufficient to meet infrastructure and staffing needs. The Community-Based Health Insurance (CBHI) scheme has enrolled thousands, but coverage is incomplete, and enrolment gaps leave many households vulnerable to catastrophic health expenditures. In contexts where out-of-pocket health costs deter service utilization, low CBHI penetration can perpetuate inequities.

### Implications

The findings suggest that Daleti Woreda is caught between success in primary health outcomes and fragility in the systems supporting them. The imbalance between high service demand and low facility capacity risks undermining future progress. Without targeted investment in infrastructure, human resources, and health financing, gains in maternal and child health could stall, and the burden of com municable diseases could persist.

## 4.1.7. Conclusion

The health profile of Daleti Woreda paints a mixed picture: commendable performance in maternal and child health and immunization coverage set against serious infrastructural, human resource, and financial deficiencies. The woreda's health infrastructure is overstretched, environmental and logistical conditions undermine service delivery, and the shortage of skilled health workers and general practitioners further impairs healthcare quality. In addition, data inconsistencies, budget shortfalls, and partial CBHI penetration compromise the ability to sustain progress and plan effectively. Addressing these systemic challenges is vital to achieving equitable, resilient, and high-quality health services for all residents.

## 4.1.8. Recommendation

Based on the findings of this health profile assessment, it is recommended that targeted interventions be implemented to address the identified gaps in healthcare infrastructure, service delivery, and community health in Daleti Woreda. Firstly, the construction and rehabilitation of roads leading to

health facilities should be prioritized to ensure timely access to care, particularly in emergencies, and to facilitate the delivery of medical supplies and services.

Secondly, uninterrupted electricity supply must be ensured in all health facilities through the installation of backup generators and the exploration of alternative energy sources, such as solar pow er, to support essential medical equipment and cold-chain storage for vaccines. Efforts should also focus on expanding safe water coverage and addressing intermittent shortages through improved water infrastructure and management practices to prevent waterborne diseases.

Thirdly, administrative and community-level strategies should be strengthened to promote timely registration of vital events, including births, deaths, and marriages, and to improve data recording and reporting systems within health facilities, thereby supporting evidence-based decision-making. Healthcare workforce capacity should be enhanced through recruitment, training, and equitable distribution of health professionals to ensure adequate service provision.

Furthermore, advocacy for increased budget allocation is essential to address infrastructure gaps, sup ply shortages, and human resource deficits. Community engagement should be institutionalized through health committees and participatory planning to ensure local needs are incorporated into health strategies. Implementing these recommendations is expected to improve healthcare access, quality, and equity, ultimately enhancing the health and well-being of the residents of Daleti

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# Chapter 5: Disaster Situation Assessment

## 5.1. Humanitarian and Health Impacts of Landslide in the Gofa Zone, Southern Region, Ethiopia, 2024: A Rapid Cross-Sectional Study.

### 5.1.1. Abstract

**Introduction:** Landslides are recurrent natural disasters in Ethiopia, often triggered by heavy rainfall and environmental degradation. Despite their devastating impacts, they have received less attention compared to other disasters such as droughts and floods. In July 2024, a massive landslide occurred in Gofa Zone, South Ethiopia Regional State, causing extensive loss of life and property. This study aims to describe the magnitude, impacts, and response actions associated with the event.

**Methods:** A descriptive cross-sectional study was conducted using secondary data from the affected woredas. Data sources included official situation reports, line lists, field assessment summaries, and response coordination documents obtained from the Gofa Zone Health Department. Field observations were also carried out using structured checklists to verify physical damage and response activities. The data were analyzed in Microsoft Excel 2016 and summarized by location, affected population, mortality, displacement, and response actions. The study was conducted from September to October 2024.

**Results:** The landslide affected 34 kebeles in four woredas, displacing 3,936 households (24,139 individuals), of whom 4,936 were children under five and 1,117 were pregnant or lactating women. A total of 250 deaths were reported, 99% of which occurred in Geze Gofa Woreda, mainly in Kencho Shacha Gozdi (169 deaths) and Kencho Woyza (79 deaths). Twenty-one internally displaced population (IDP) sites were established, and 6,746 medical cases were treated. Nutritional screening covered 4,478 children under five and 1,252 pregnant or lactating women. Mental health and psychosocial support services identified 157 individuals with disorders, including depression and acute stress. Partners such as WHO, EPHI, UNICEF, and the Red Cross provided support in health, nutrition, and shelter. A sustainable resettlement project initiated construction of 627 permanent houses, of which 110 were completed and handed over to affected families.

**Discussion and Conclusion**: The Gofa landslide caused severe human, social, and economic losses, highlighting gaps in early warning, preparedness, and coordinated emergency response. Limited access to search and rescue equipment, poor communication, and unstable terrain hindered immediate rescue operations. Strengthening community-based disaster preparedness, integrating landslide risk mapping into development planning, and establishing effective early warning systems are critical to reducing future impacts and building resilience in Ethiopia's landslide-prone areas.

**Keywords**: Landslides, Ethiopia, Gofa Zone, Displacement, Mortality, Emergency response

**Word count**: 332

## 5.1.2. Introduction

### Background

Disasters, whether natural or man-made, pose profound threats to human life, livelihoods, and critical infrastructure. A disaster is generally defined as a sudden event causing serious disruption to the functioning of a community or society, resulting in widespread human, material, economic, or environ mental losses that exceed the affected population's capacity to cope using its own resources [1]. Of the natural hazards, landslides are among the most calamitous geophysical hazards, especially in mountain and hilly areas where there are slopes and unstable ground[2].

Landslide refers to the gravity-driven sliding flow of rock, soil, or debris down a slope. These events are most often triggered by a combination of natural and human factors like intense rainfalls, earthquakes, volcanism, forest cutting, and uncontrolled land use practices[3]. Poorly designed human settlements and environmental degradation in low-capacity environments improve exposure, with an added number and severity of landslides[4].

Worldwide, landslides are a major natural disaster that cause thousands of fatalities and billions of dollars of economic damage annually. A spatiotemporal analysis between January 2004 and December 2016 reported that 55,997 individuals died from 4,862 unique landslide events, with an average estimated 4,000 to 9,000 fatalities yearly worldwide [5]. The highest prevalence is in regions such as South and Southeast Asia, Central America, and certain regions of Africa, where there is hilly ground, deforestation, and heavy rainfall that overlap[5, 6].

In the African continent, landslides mostly hit the East African highlands region, comprising Uganda, Rwanda, Kenya, and Ethiopia. They occur with prolonged rainy seasons in most cases and are usually caused by unsustainable land use [7]. One of the continent's most devastating recent events was the 2017 Freetown landslide in Sierra Leone, which claimed over 1,000 lives[8].

In Ethiopia, landslides have historically received less attention and less publicized compared to other disasters such as droughts and floods. However, their occurrence is becoming more frequent and severe due to environmental degradation, population pressures, and changing rainfall patterns influenced by climate change [9, 10]. Notable recent landslide disasters include the 2017 Koshe garbage landslide in Addis Ababa and the 2016 Wolayita Zone landslide, which resulted in at least 41 fatalities and significant displacement of communities [11, 12].

Most recently, Gofa Zone experienced a devastating landslide triggered by prolonged and intense rainfall. The first landslide occurred on July 22, 2024, in Kecho Sacha Gozdi Kebele, located in Geze Gofa District, causing widespread destruction to homes and infrastructure. Tragically, a second landslide followed shortly afterward, burying many individuals who had gathered to assist the initial victims. These events highlight the urgent need for comprehensive disaster risk reduction strategies

in Ethiopia, including the implementation of early warning systems, improved land-use planning, and community-based preparedness programs to mitigate the devastating impacts of future landslides.

Despite the recurrent nature and severe consequences of landslides in Ethiopia, there remains a significant gap in research, early warning systems, and preparedness measures, particularly at the local level. The Gofa Zone landslide disaster of July 2024 exemplifies this gap, where inadequate disaster response capacity, limited risk mapping, and the absence of community-based preparedness mechanisms resulted in high mortality and extensive property damage. Without evidence-based interventions, similar or even worse events are likely to recur, amplifying human suffering and economic loss.

This study is significant as it provides an in-depth assessment of the recent Gofa Zone landslide, documenting the extent of human and material losses, identifying spatial patterns of vulnerability, and highlighting key drivers of risk. The findings will contribute to the knowledge base necessary for policymakers, humanitarian agencies, and community leaders to design targeted mitigation and preparedness strategies. By addressing the underlying causes of vulnerability and promoting risk-informed development planning, the study aims to reduce the future impact of landslides and enhance the resilience of at-risk communities in Ethiopia.

## Disaster Description

Geographically, Gofa Zone is characterized by undulating and hilly topography that spans across midland and upper lowland agroecological zones. The intricate topography, combined with seasonally varying rainfall, makes the region highly exposed to hydro-meteorological hazards, floods and landslides being the dominant types. Vulnerability is also enhanced by environmental degradation and unplanned human settlements, which not only increase the likelihood of such disasters but also enhance their intensity and impact on local populations.

As a result of persistent heavy rain, on the evening of 21, 2024 July, there was a landslide at Kencho Shacha Gozdi Kebele, Gezei Gofa District, southern Ethiopia, which buried some of the villagers and resulted in fatalities. On the morning of July 22, rescue operations were underway as police and locals were present at the site. Sadly, at around 10 a.m., a second large-scale landslide happened, burying the rescuers and onlookers, significantly worsening casualties.According to the Gofa zone report, as of July 27, 2024, at least 250 people were confirmed dead. Among those dead were emergency responders, including police officers, teachers, religious leaders, and other local volunteers, and agricultural bureau personnel who were actively engaged in rescue efforts. Due to the continued instability of the slopes and the high probability of further landslides, more than 27,559 individuals across four districts Geze Gofa, Demba Gofa, Bulki, and Melekoza- require immediate evacuation and relocation to safer areas. The emergency response process was uncoordinated and inefficient, with

rescue efforts lacking scientific approaches. Survivors and volunteers resorted to digging through mu d and debris using only their bare hands, spades, and pickaxes.

This tragic event underscores the urgent need for disaster risk reduction strategies, including early warning systems, improved land use planning, and enhanced community preparedness in Gofa Zone and similar high-risk areas across Ethiopia.

### 5.1.3. Objective

#### General objective

- To assess and describe the impacts, causes, and response gaps from the landslide disaster in Gofa Zone, South Ethiopia Regional State, Ethiopia, 2024

#### Specific objective

- To describe the landslide impact in terms of Person, place, and time.
- To describe local disaster preparedness and response activities.
- To assess gaps in landslide preparedness and response and propose actions to reduce risks and strengthen resilience.

## 5.1.4. Method And Material

### Study Area And Period

Gofa Zone is one of the administrative zones located in the South Ethiopia Regional State. It's char acterized by plateau landforms, with elevations ranging from 535 m to 3,464 m[13]. It shares boundaries with Kamba and Daramalo woredas to the south, the Debub (South) Omo Zone to the southwest, Basketo Special Woreda to the west, and Dawro Zone to the northwest and north. To the east, it is bordered by Kucha Woreda. The zonal administrative capital is Sawla, situated approximately 564 kilometers southwest of Addis Ababa, the capital of Ethiopia [14].

This diverse topography spans midland and upper lowland agroecological belts, making the area particularly susceptible to natural hazards such as landslides and floods, especially during periods of heavy rainfall. According to the 2007 National Population and Housing Census conducted by the Central Statistical Agency of Ethiopia (CSA) [15], Gofa Zone had a total population of 1,593,104, comprising 793,322 men and 799,782 women. With a total land area of 18,010.99 square kilometers, the zone had a population density of approximately 144.68 persons per square kilometer. Urban residents accounted for 9.88% (157,446 individuals) of the total population, while 0.03% (4,80 individuals) were identified as pastoralists. The census recorded 337,199 households, with an average household size of 4.72 persons, and 324,919 housing units across the zone[15].

### Study Design

A descriptive cross-sectional study that used document review and field observation to assess the disaster, its impacts, and gaps in preparedness and response in the Gofa Zone, South Ethiopia Regional State, Ethiopia.

### Source Population

The source population for this study comprised all residents of the Gofa Zone, South Ethiopia Regional State

### Study Population

The study population comprises woredas affected by the landslide disaster in Gofa Zone, including Geze Gofa, Demba Gofa, Bulki, and Melokoza woredas

### Data Collection Tool

Data were gathered through document review and field observation. The document review used a structured extraction checklist to collect information from situation reports, line lists, field assessment summaries, response coordination documents, and other official records. For field observation, a standardized observation checklist was used during site visits to verify physical damage, review response activities, and assess the overall condition of the affected areas. These tools helped organize

the information consistently and ensured that key aspects of the disaster and the response efforts were captured.

## Dissemination of the Results

The results of the study will be shared with stakeholders at the zonal and regional levels such as the Gofa Zone Disaster Risk Management Office, administration and health offices, and humanitarian agencies. A summary report will also be submitted to the South Ethiopia Regional Health Bureau and other government departments that are concerned. The results can also be presented at policy and academic forums to guide disaster preparedness and response planning

## Ethical Consideration

Ethical clearance and permission to conduct the study were obtained from zonal and woreda-level authorities. All data were handled confidentially, anonymized, and used solely for research purposes. The study strictly adhered to ethical principles, including respect for persons, beneficence, and justice, throughout the research process.

### 5.1.5. Result

#### Impact of the Gofa Landslide

The research verified that the landslide in the South Ethiopia Region (SER) hit 34 kebeles, displacing 3,936 households and a total of 24,139 people as a result of the disaster and the resulting risk of another landslide. Of the displaced, 4,936 were under the age of five years, while 1,117 were pregnant and lactating women. The effect was worst in Geze Gofa Woreda of Gofa Zone made up of 22 kebeles and 18,810 internally displaced persons (IDPs). Damba Gofa Woreda was the second worse with 3,060 IDPs. In family structure, 3,056 were male-headed and 880 were female-headed. It also caused 250 fatalities, the highest fatality burden (249 fatalities) of which occurred in Gofa Zone Geze Gofa Woreda, which shows the disproportionate damage to this region.

#### Description by place

There were 250 deaths caused by the landslide disaster in different woredas of Gofa Zone. The highest number of the deceased were discovered in Gĕze Gofa Woreda and counted a total of 248 (99.2%) deaths with the most affected kebeles being Kencho Shach Gozde (169 deaths, 67.6%) and Kencho Woyza (79 deaths, 31.6%). Bulki and Damba Gofa Woreda each reported 1 death (0.4%). This spatial distribution shows that the majority of the impact was localized in Geze Gofa Woreda, and more specifically in the Kencho Shach Gozde and Kencho Woyza kebeles, showing a focal epicenter of the disaster.

***Table 22: Distribution of the affected population by landslide in Gofa zone, southern Region, Ethiopia, 2024***

| **# of Kebeles affected** | **Total HH IDPs in SER** | | **Total Individual IDPs in SER** | | **Total U5 IDPs in SER** | | **Total PLW IDPs in SER** | | **Total deaths** | |
|---|---|---|---|---|---|---|---|---|---|---|
| **34** | **3936** | | **24,139** | | **4,936** | | **1,117** | | **250** | |
| Gofa Zone/Woredas | Sum of Kebeles Affected | # Male-Headed HH IDPs | # of Female Headed HH IDPs | # Sum of total HH IDPs | Sum of male individual IDPs | Sum of Female individual IDPs | Sum of Total individual IDPs | Sum of # of U5 children in IDPs | Sum of PLW | Sum of Total Deaths |
| Geze Gofa | 22 | 2,114 | 691 | 2,805 | 10,316 | 8,494 | 18,810 | 3,841 | 859 | 248 |
| Damba Gofa | 4 | 553 | 107 | 660 | 1,541 | 1,519 | 3,060 | 502 | 120 | 1 |
| Bulki | 2 | 236 | 45 | 281 | 605 | 657 | 1,262 | 343 | 51 | 1 |
| Melokoza | 6 | 153 | 37 | 190 | 466 | 541 | 1,007 | 250 | 87 | 0 |
| Total | 34 | 3,056 | 880 | 3,936 | 12,928 | 11,211 | 24,139 | 4,936 | 1,117 | 250 |

*Table 23: Distribution of landslide-affected population by woredas and kebeles in Gofa zone, southern Region, Ethiopia, 2024*

| Woredas | Affected Kebeles | Frequency | Precentage |
|---|---|---|---|
| Geze Gofa woreda | Kencho shach gozde | 169 | 67.6% |
| | Kencho woyza | 79 | 31.6% |
| Bulki Woreda | Bulki city | 1 | 0.4% |
| Damba Gofa | Damba Gofa | 1 | 0,4% |
| **Total** | **Total** | **250** | 100% |

## Description by person

### Distribution by sex

The research revealed that out of 250 landslide-related deaths, 204 (81.6%) were of a known sex. Among them, 111 (54.4%) were male. Of note was that among the females, 0.1% were lactating women and 0.5% were pregnant, indicating increased vulnerability among women in the reproductive age group in such disasters.

*Table 24: Distribution of landslide-affected population by Sex in Gofa zone, southern Region, Ethiopia, 2024*

| Affected Kebeles | Male | Female | Lactating | Pregnant | Total |
|---|---|---|---|---|---|
| Bulki city | 2(1.8%) | 0(0%) | 0(0%) | 0(0%) | 2(1.0%) |
| Kencho shach gozde | 60(54.1%) | 66(71%) | 0(0%) | 0(0%) | 126(61.8%) |
| Kencho woyza | 48(43.2%) | 23(24.7%) | 2(2.2%) | 1(1.1%) | 71(34.8%) |
| Unknown Kebele | 1(0.9%) | 4(4.3%) | 0(0%) | 0(0%) | 5(2.5%) |
| Grand Total | 111(54.4%) | 93(45.6%) | 2(0.1%) | 1(0.5%) | 204(100%) |

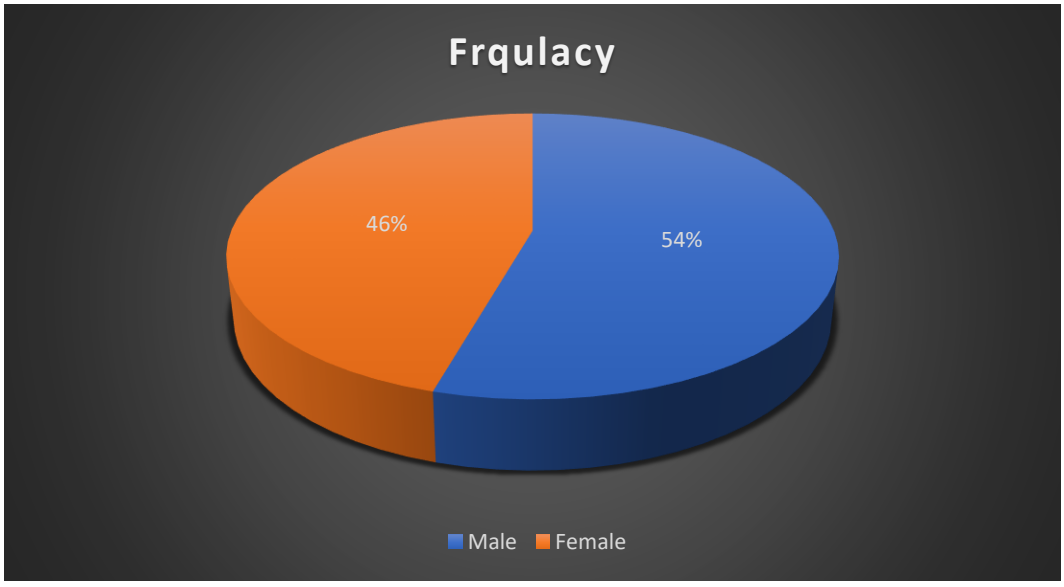


*Figure 33: Distribution of the Landslide Affected Population by Sex in Gofa zone, southern Region, Ethiopia, 2024*

### Distribution by Age

The analysis of landslide-related deaths showed that children aged ≥15 years were disproportionately affected, accounting for 181 (88.7%) of the total deaths.

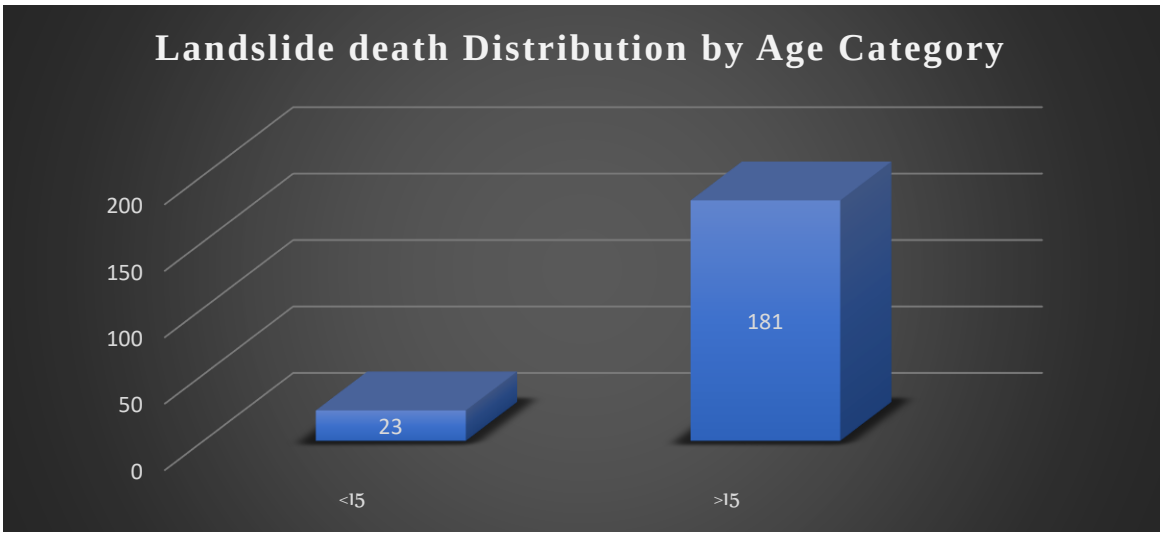


***Figure 34: Distribution of the Landslide Affected Population by Age Group in Gofa zone, southern Region, Ethiopia, 2024***

## Response activities

The area is not far from Addis Ababa, a few hundred kilometers. It lacks proper transport infrastructure. Local restrictions severely hampered the rescue mission. The rescuers used shovels and bare hands for the most part, which were time-consuming and inefficient. The disaster site could not be accessed by heavy machinery, and the fact that heavy machinery and special equipment were not available made it more challenging. Drones were used to scour for survivors. Though the rescue group attempted their utmost in the complicated landscape and dynamic setting, the loose and friable ground and adhesion following the infiltration of the rains facilitated the excavation to be somewhat easier. Moreover, more than 24,139 individuals need to be evacuated to help eliminate future landslide risks.

## Coordination and Emergency Response Activities

A prompt emergency response was launched after the landslide, aided by an inclusive action plan and hierarchical delegation of responsibility to specialized teams. The health and humanitarian response was organized into nine major components: operations, surveillance, case management, nutrition, IPC/WASH, RCCE, planning, logistics, and administration/finance. Rapid needs assessments were also implemented in order to inform evidence-based responses, resulting in temporary and mobile clinics and more than 21 IDP sites in three woredas, which are Demba Gofa, Geze Gofa, and Melo Koza, for the protection of the displaced community's health and well-being.

The response placed priority on internally displaced persons (IDPs) known to be at greater risk for the spread of disease outbreaks, malnourishment, and restricted access to essential services. Multidisciplinary teams were dispatched, including emergency medical responders, nutritionists, WaSH specialists, mental health and psychosocial support (MHPSS) experts, and health education specialists. Surveillance teams carried out systematic house-to-house visits in IDP camps in order to locate affected households, screen uppon diseases with epidemic potential, and ensure early referral and treatment. Psychosocial interventions were provided in addition to community and religious leaders to help overcome trauma in addition to building community resilience.

Coordination procedures were strengthened by frequent inter-agency meetings to follow up on progress, align activities, and enhance strategies. At the same time, emergency appeals for medicine, medical supplies, and non-food items were established to cater to the short-term needs of IDPs and mitigate the likelihood of secondary health emergencies.

***Table 25: Distribution of the established IDP sites for Gofa zone landslide, southern Region, Ethiopia, 2024***

| Zone | Woredas | Count of IDP Sites |
|---|---|---|
| Gofa | Demba Gofa | 7 |
| Gofa | Geze Gofa | 13 |
| Gofa | Melo Koza | 1 |
| | Grand Total | **21** |

## Role of the Emergency Medical Team

The emergency medical teams provided first aid, clinical treatment, and referral services for severe cases. They screened and managed malnutrition, conducted disease surveillance, and ensured timely reporting of outbreak-prone conditions. In addition, they identified gaps in medical supplies, facilitated procurement of essential drugs, and documented service delivery for accountability.

## Surveillance in IDP sites

Surveillance activities conducted among inter nally displaced persons (IDP) sites in Gofa Zone on September 23, 2024, encompassed house-to-house visitation, case detection, and alert verification. There were visits to a total of 1,303 households, which included 6,139 individuals. Out of these, 21 health alerts were reported, and all were investigated and verified. The most common condition seen was malaria, with 110 confirmed cases, followed by 409 under-five diseases, five scabies cases, and two new tuberculosis cases. Suspected cases of cholera or measles were not reported during the surveillance period. The these results suggest ongoing malaria and under-five morbidity burden in the IDP sites, as well as an active alert verification and response mechanism.

*Table 26: Surveillance activities in landslide affected IDP sites in Gofa zone, southern region, Ethiopia*

| woreda/ Town | # House Visited | # Individual addressed | # Alerts reported | # Alerts Invt. & Verf. | Malaria cases | Susp. Cholera | Measles cases | New TB | U5 Bcases | Scabies |
|---|---|---|---|---|---|---|---|---|---|---|
| Geze Gofa | 802 | 4290 | 21 | 21 | 99 | 0 | 0 | 1 | 64 | 2 |
| Demba Gofa | 453 | 1633 | 0 | 0 | 10 | 0 | 0 | 1 | 279 | 0 |
| Melo Koza | 48 | 51 | 0 | 0 | 1 | 0 | 0 | 0 | 9 | 0 |

## Case Management

There were 6,746 cases that were treated in temporary clinics and locations, of which 48 patients were referred for further treatment. The most commonly reported disease was pneumonia (1,013 cases), followed by other unspecified diseases (711 cases) and acute febrile illness (674 cases).*Table 27: case management in landslide affected IDPs in Gofa Zone, Southern region, Ethiopia*

**Gofa Zone Landslide Response Case Management as of Sep 19, 2024**

| Total Cases Treated in Temp. Clinic/sites | Total Referral |
|---|---|
| 6,746 | 48 |

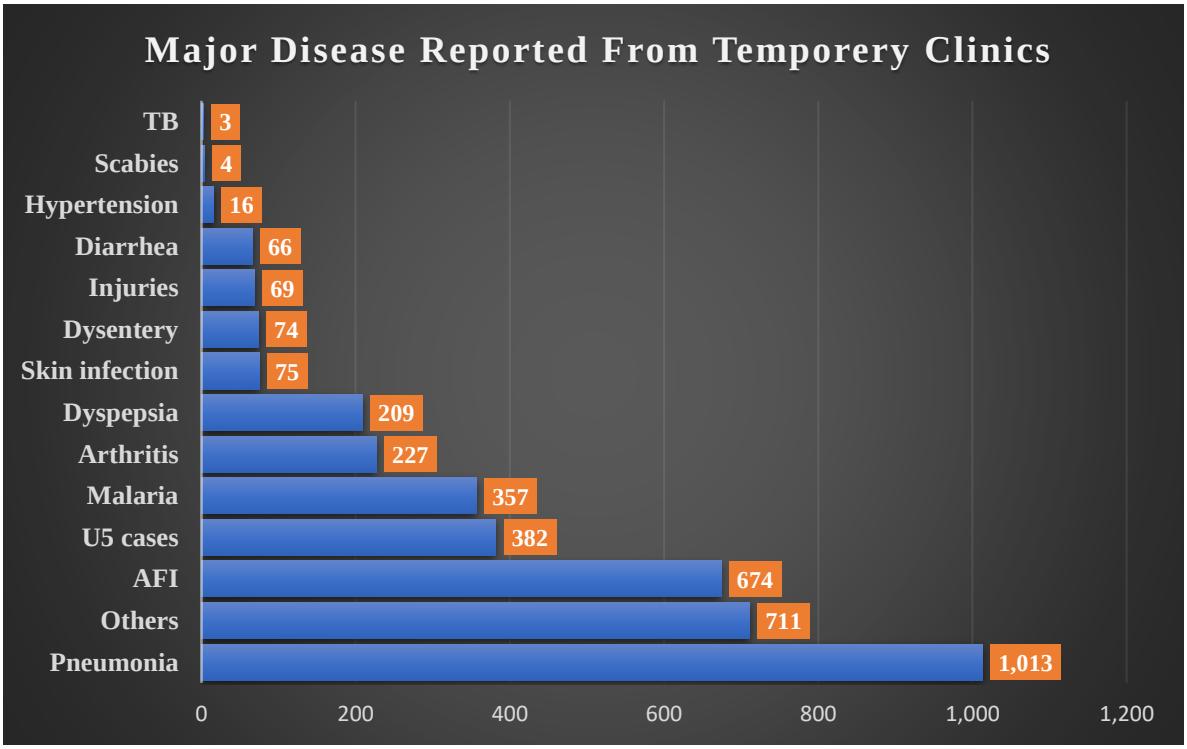


*Figure 35: Major Reported Diseases in IDPs Temporary Clinics in Gofa Zone, Southern Region, Ethiopia.*

## Nutritional activities

A total of 4,478 under-five children and 1,252 pregnant and lactating women were screened for m alnutrition. Among under-five children, 185 were linked to TSFP, 16 to OTP, 20 had SAM, and 209 had MAM. For PLW, 195 were linked to TSFP, and 214 had MAM reported.

*Table 28: Nutritional activities in IDP sites in Gofa zone, Southern region, Ethiopia*

| Nutritional Activities | Under 5 Children | Nutritional Activities | Pregnant and Lactating Women |
|---|---|---|---|
| Screened | 4478 | Screened | 1252 |
| Linked to TSFP | 185 | Linked to TSFP | 195 |
| Linked to OTP | 16 | SAM | 0 |
| SAM | 20 | MAM | 214 |
| MAM | 209 | - | - |

## Water, Sanitation, and Hygiene Activities (WASH)

A total of 19 handwashing points, 35 toilets, 16 kitchens, 13 shower rooms, and 9 water schemes were put in place, in addition to 22 solid waste pits. Moreover, 5,073 liters of water were treated and distributed.

*Table 29: Water, Sanitation, and Hygiene Activities (WASH) in IDP Sites in Gofa Zone, Southern Region, Ethiopia*

| WASH Activities | Value |
|---|---|
| # of Hand Washing Facilities Established | 19 |
| # of Latrine Constructed | 35 |
| # of Food Preparation Room | 16 |
| # of Shawor Room Established | 13 |
| # of Water Scheme Supply | 9 |
| # of Solid Waste Disposal Pit Prepared | 22 |
| Treated Water Distributed (Liter) | 5073 |
| # of Water Chemical Distributed | 977 |
| # of Dignity Kits Distributed | 181 |
| # of Water Scheme Treated | 1 |

## Risk Communication and Community Engagement Activities (RCCE)

A total of 91,682 of the recipients were contacted by Risk Communication and Community Engagement (RCCE) messages. 53,061 members of the community also engaged actively in response operations.

*Table 30: Gofa Zone Landslide Response Risk Communication and Community Engagement Activities (RCCE) as of Sep 19, 2024*

| # Beneficiaries received RCC Messages | Total BCC Materials Distributed | # People Engaged in Response |
|---|---|---|

| | | |
|---|---|---|
| 91,682 | 462 | 53,061 |

## Mental Health and Psychosocial Support Activities (MHPSS)

A total 909 individuals were assessed for mental illness and 157 were diagnosed with disorders. Of them, 154 received individual counseling, 77 depression, 21 acute stress, and 2 substance use. Psychoeducation was also imparted to 905 individuals.

***Table 31: Gofa Zone Landslide Response Mental Health and Psychosocial Support Activities (MHPSS) as of Sep 19, 2024.***

| MHPSS Activities | **Value** |
|---|---|
| # of Screened MH Conditions | 909 |
| # of Identified Disorders | 157 |
| # of Individual Counseling | 154 |
| # of Substance Case | 2 |
| # of Acute Stress | 21 |
| # of Cases with Depression | 77 |
| # of Psychoeducation Given | 905 |
| # Linked to HF | 0 |

## National and International Support

The Ethiopian Public Health Institute deployed a national emergency medical team supported by the World Health Organization (WHO), comprising a general surgeon, emergency physician, general practitioner, and two nurses with trauma kits and ambulances. Local authorities, such as the Kebele chairman, police, health extension workers, and agricultural bureau staff, evacuated people after the first landslide on July 21 but were themselves swept away by a subsequent landslide.

The Ethiopian Disaster Risk Management Commission (EDRMC) and the national Red Cross Society's regional branch conducted search, rescue, and evacuation operations. Forty people were dispatched to provide first aid, accompanied by ambulances and emergency logistics. Four life-saving vehicle loads of supplies arrived and 54 volunteers, two ambulances, and three logistics units were dispatched by the Ethiopian Red Cross Society on July 23.

The WHO and the Ministry of Health sent a health response team and contributed essential medical equipment. Four health clinics were set up in a bid to offer health care to internally displaced individuals. UNICEF distributed household items like water purification tablets, storage tanks, tarpaulins, and soap, in addition to screening 1,200 under-five children and 340 pregnant and breastfeeding women for malnutrition. The World Food Programme provided food aid, whereas the UNFPA provided medical consumables. The Africa CDC sent health experts to enhance disease

surveillance and case management. Other responders such as World Vision provided emergency kits and nutritional supplements.

### Sustainable Recovery and Housing Response

A rebuilding program for high-density housing was started to provide sustainable and long-lasting settlement to families displaced by the Gofa landslide. The program aimed to construct 627 houses for an equal number of displaced families to be completed in three stages of approximately 200 houses each by the end of September 2024 (Meskel period). The construction commenced on September 6, 2024, through collaborative efforts of the zonal and regional governments, the Ethiopian Public Health Institute (EPHI), and citizens. As of September 18, 2024, 110 permanent houses were completed in a new resettlement village named Burda Village. On 24th September 2024, phase one of the project was completed, where 110 houses were transferred to displaced individuals from Geze Gofa Woreda, specifically Kencho Secha Gozede Kebele. High priority was given to vulnerable populations, including families who had lost more than one member and whose head was a woman. The transfer of the houses was accompanied by a formal ceremony for the transition from displacement to recovery and community resilience.

### 5.1.6. Discussion

The double landslide tragedy in Gofa Zone exposed Ethiopian highland societies to geophysical risks with serious exposure when preparedness and risk management are absent [16]. While a nation familiar with steep slopes and intermittent heavy rainfall, the failure of adequate prevention measures, early warning, and governed settlement planning turned a natural hazard into a mass humanitarian disaster. Nearly 250 died, and thousands were displaced in Geze Gofa Woreda alone, highlighting major lacunae in land-use planning, coordination of emergency response, and awareness among the community.

The concentration of fatalities in the kebeles of Kencho Shacha Gozdi and Kencho Woyza shows how geographic and human factors combined to intensify the impact. Settlements built on unstable slopes, vegetation loss, and limited drainage infrastructure increased susceptibility to slope failure [17]. Most of the victims of the second slide were people attempting to rescue others after the first incident, emphasizing the manner in which unorganized and spontaneous reactions can exacerbate circumstances without even basic geohazard knowledge. Road access was limited, there was no heavy resque machinery, and manual excavation, with attendant delays, hobbled lifesaving operations. Evacuations progressed slowly and were not completed, emphasizing the absence of contingency planning and insufficient pre-positioned emergency gear. Emergency response measures were triggered rapidly, but the magnitude of disaster rapidly outpaced available resources and coordinating capabilities.

WASH and health responses were mobilized, but competing priorities and limited logistics achieved only partial fulfillment of vital needs in shelter, protection, and nutrition. Mental health and psychosocial support (MHPSS) personnel documented hundreds of cases of depression and acute stress, with follow-up care hampered by staffing and accessibility issues. Over time, these early gaps were mitigated through strong multi-sectoral collaboration between humanitarian partners, government bodies, and community organizations. This collective effort streamlined coordination, expanded resource mobilization, and assisted stabilization of affected populations. The experience emphasizes the benefit of institutionalizing modular, scalable, and well-coordinated emergency response systems that can be rapidly, cross-sectorally deploymented to address the entire range of needs during future crises. Beyond the immediate humanitarian interest, the Gofa tragedy revealed deeper structural causes common to Ethiopian highland landslides. Steep terrain, intense rainfall, deforestation, and unregulated settlement patterns persist in destabilizing slope stability. The literature has recognised that many national landslide susceptibilit;y appraisals neglect hydro-geotechnical factors such as soil cohesion, pore-water pressure, and rainfall intensity thresholds, resulting in poor predictive accuracy and delayed warnings. Strengthening early warning systems using high-resolution hazard mapping, slope monitoring, and community-based obseration networks is therefore critical [18,

19] During the adversity, the recovery phase in Gofa demonstrated strong community commitment and institutional collaboration.

A notable effort was made to construct 627 durable houses for displaced households in three phases. With joint efforts of zonal and regional governments, the Ethiopian Public Health Institute (EPHI), and the community, construction was initiated at a fast pace, and within weeks, 110 permanent dwellings were built in a newly established resettlement settlement named Burda Village. The first stage of housing delivery targeted vulnerable groups like persons who lost over one household member and lactating or pregnant women. Gofa case depicts an even wider national need for integrated disaster risk management. Effective risk reduction will entail the combination of structural interventions, such as slope reinforcement, improved drainage, and bioengineering, with non-structural interventions, such as land-use regulation, environmental restoration, and community-based education [20, 21]. Strengthening local capacity, logistics decentralization, and development of interoperable assessment frameworks can improve coordination between the WASH, health, and MHPSS sectors. Environmental rehabilitation, specifically reforestation and soil conservation, will also stabilize slopes and reduce the risk of future landslides [22, 23]. The lessons of Gofa consequently stress that response is not enough upon which to construct resilience. Sustainable safety in Ethiopia's highlands needs to be constructed through proactive governance and resolution of root issues before disaster.

Investing in evidence-based planning, establishing settlement regulations, integrating risk reduction into development programs, and educating communities on these risks are essential steps to resilient sustainability. The Burda Village rebuilding process is a heartening model of reconstruction, but sustained security for the communities will depend on translating such efforts into a broader, more ingrained culture of disaster preparedness and care for the environment.

### 5.1.7. Conclusion

The double landlisde in Gofa Zone revealed the manner in which natural hazards and human vulnerability intersect on Ethiopia's highlands. After long experience with steep terrain and heavy rain, a lack of preparation, weak early warning, and uncontrolled settlement patterns turned what had been an enticeable risk into a disaster of unimaginable proportions. The large number of fatalities in Geze Gofa Woreda especially in Kencho Shacha Gozdi and Kencho Woyza kebeles demonstrate how deforestation, unstable slopes, and unsafe housing interacted to increase the destruction. Emergency response operations were initiated quickly, but they were hindered due to poor accessibility, lack of heavy machinery, and shortages in WASH, health, and psychosocial services. However, strong

collaboration between government institutions, humanitarian agencies, and local communities helped stabilize the situation and deliver life-saving assistance.

Recovery efforts, particularly the construction of Burda Village, was an important stride in rehabilitation and sustainability. The new settlement, starting with its initial 110 permanent homes, was a symbol of unity and hope created out of loss. The Gofa experience, however, serves as a concrete reminder that rebuilding after a tragedy is simply not enough. Sustainable safety in the highlands of Ethiopia depends on proactive measures stronger risk governance, reforestation, regulated land use, and effective hazard mapping. True resilience must be built prior to disasters striking, by prevention, preparation, and community-centered planning rather than reaction.

### 5.1.8. Recommendations

- Strengthen community-based early warning systems and preparedness.
- Enforce land-use regulations and support reforestation to stabilize slopes.
- Develop modular, well-coordinated emergency response systems.
- Develop hazard-resistant housing and infrastructure.
- Improve coordination across WASH, health, and MHPSS sectors through shared data systems.
- Educate and empower communities to engage in risk reduction.
- Incorporate disaster risk management into development planning.

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# Chapter 6: Scientific Manuscript for Peer-reviewed Journals

## Original research

# Distribution and Temporal Trends of Colorectal Cancer Incidence in Addis Ababa, Ethiopia: A Five-Year Retrospective Study (2018-2022)

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## 6.1. Distribution and Temporal Trends of Colorectal Cancer Incidence in Addis Ababa, Ethiopia: A Five-Year Retrospective Study (2018-2022)

### 6.1.1. Abstract

**Background:** Colorectal cancer (CRC) is a significant public health issue globally, with increasing incidence rates in many regions. Addis Ababa, Ethiopia, has shown rising colorectal cancer cases, yet comprehensive studies on its incidence trends and demographic distributions remain limited. Understanding these trends is crucial for developing effective public health strategies.

**Methods:** This study conducted a five-year retrospective analysis (2018–2022) using data from the Addis Ababa Population-Based Cancer Registry. We examined annual incidence rates of colorectal cancer, demographic characteristics (age and sex), anatomical tumor site, and basis of diagnosis. Statistical analyses were performed to assess temporal trends and identify significant patterns using Microsoft Excel 2016. Age-standardized incidence rates (ASIR) were calculated to facilitate comparisons across years and between sexes.

**Results:** A total of 1,222 CRC cases were analyzed, with nearly equal incidence among males (ASIR: 8.93 per 100,000) and females (ASIR: 8.77 per 100,000). Age-specific incidence peaked in the 60–69-year age group, while 22% of cases occurred in individuals under 50, indicating a notable early-onset CRC burden. Temporal trends fluctuated over the study period, rising from 6.85 per 100,000 in 2018 to 8.05 in 2019, declining to 5.94 in 2021, and modestly rebounding to 6.24 in 2022. Anatomically, the rectum, NOS (519 cases), and sigmoid colon (436 cases) were the most frequently affected sites, with left-sided tumors predominating, consistent with global epidemiologic patterns. Most cases were managed at Black Lion Specialized Hospital (698 cases), followed by Saint Paul's Hospital (225 cases) and other facilities, reflecting tertiary center referral patterns. Histological confirmation accounted for the majority of diagnoses (1,058 cases), underscoring robust diagnostic capacity.

**Conclusion:** Colorectal cancer in Addis Ababa demonstrates a significant burden, with notable early-onset cases and left-sided predominance. Temporal fluctuations in incidence may reflect healthcare service disruptions and population growth, highlighting the need for continuous surveillance and high-quality data collection. Strengthened screening programs, clinical vigilance for younger populations, and sustained histopathological diagnostic capacity are essential for effective CRC control.

**Keywords:** Colorectal cancer, incidence, Addis Ababa, early-onset, histopathology, temporal trends

### 6.1.2. Introduction

Colorectal cancer (CRC) is a significant global health challenge, marked by the rapid proliferation of abnormal cells in the colon or rectum that can invade surrounding tissues and metastasize to distant organs[1]. Globally, CRC ranks among the top three most frequently diagnosed cancers and is the second leading cause of cancer-related deaths, with approximately 1.9 million new cases and over 900,000 fatalities reported according to GLOBOCAN, 2022 [2, 3]. Although CRC incidence and mortality rates have historically been higher in more developed regions, including North America and Europe, there has been a notable rise in cases across low- and middle-income countries, particularly in Africa[3-5]. In Ethiopia, CRC ranks as the third most common cancer in adults, with an estimated annual incidence of 6,551 cases and over 4,863 fatalities, reflecting a significant public health burden[3, 6, 7].

The growing incidence of CRC in Ethiopia, particularly in Addis Ababa, underscores the urgent need for effective cancer control strategies. Despite the establishment of the Addis Ababa Population-Based Cancer Registry (AAPBCR) in 2011, comprehensive studies utilizing this resource remain scarce[8, 9]. Consequently, there is limited knowledge of the geographic distribution, demographic patterns, and temporal trends of CRC in the city[9, 10]. This lack of data hampers evidence-based public health interventions and policy formulation aimed at mitigating the disease burden.

The exact reason for colorectal cancer is unknown. Still, it is thought to be complex that several factors contribute to the rising CRC incidence in Ethiopia, including unhealthy dietary practices, increasing prevalence of obesity, tobacco use, physical inactivity, and low participation in cancer screening programs[11, 12]. Screening for CRC through methods such as fecal blood tests and colonoscopy is critical for early detection and improved patient outcomes[13-15]. However, access to screening and timely diagnosis remains limited, particularly outside major urban centers[16, 17]. The National Cancer Control Plan (2016-2020) aimed to enhance early detection, accurate diagnosis, treatment, and palliative care services. Despite these efforts, gaps persist in cancer surveillance and research[16].

In Addis Ababa, CRC is the leading cancer among men and the fourth most common among women, accounting for 12.4% and 5.4% of cancer cases, respectively[18]. Data from Tikur Anbessa Specialized Hospital (TASH) indicate that CRC represents 12% of cancer cases treated in its oncology ward[19] The city's urbanization and associated lifestyle changes are believed to contribute to higher CRC rates compared to rural regions[16, 18, 19]. However, current knowledge on CRC incidence in Addis Ababa is primarily derived from hospital-based studies, limiting the generalizability of findings. Given the paucity of population-based research, this study seeks to leverage the AAPBCR to conduct a detailed analysis of CRC incidence in Addis Ababa over five years (2018-2022). By examining CRC distribution across different administrative zones, sex, and age groups, and analyzing temporal trends.

This study aims to provide critical insights that can inform targeted public health interventions, improve cancer care services, and guide resource allocation. The findings will contribute to closing the knowledge gap on CRC epidemiology in Ethiopia and support broader efforts to reduce the CRC burden and enhance population health outcomes

## 6.1.3. Methods and Materials

### Study area and period

The study was conducted in Addis Ababa, the capital city of Ethiopia located in the central part of Ethiopia. Addis Ababa has an estimated population of 4,030,000, comprising 1,900,000 males and 2,130,000 females. The population of Addis Abeba is considered an urban population, the city has 96 hospitals (government and private), providing healthcare services[20]. Administratively, the city is divided into 11 sub-cities[21].

The study was conducted from February to March 2024, using Cancer Registry data from 2018-2022

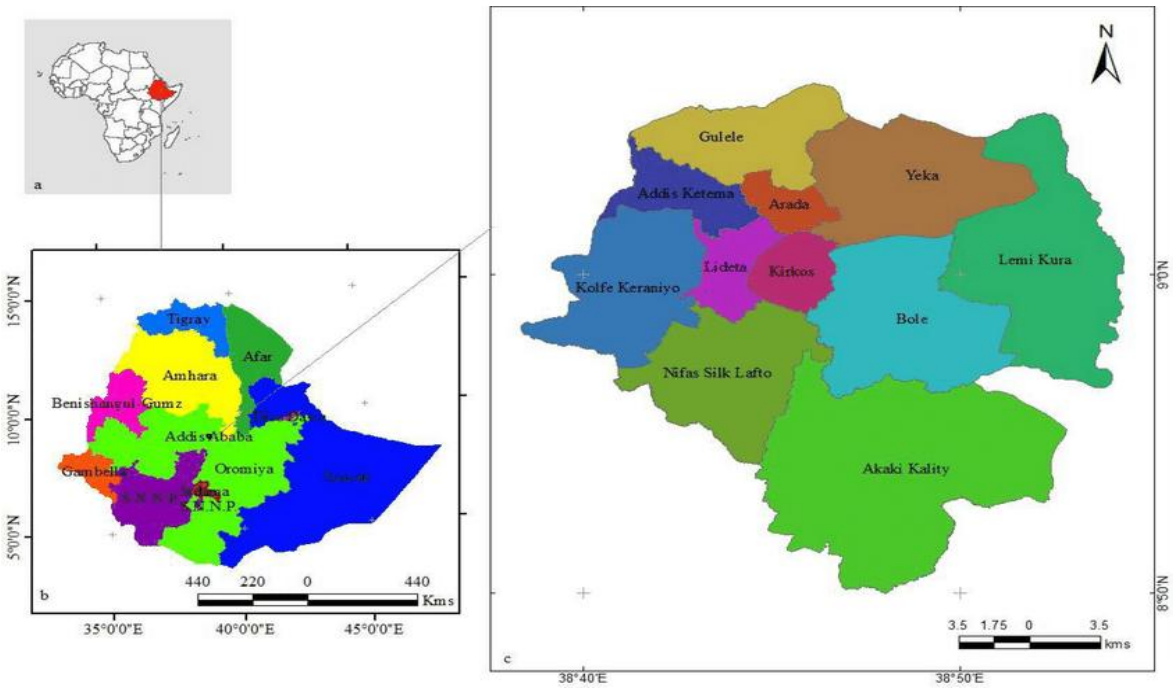


**Figure 36: Map of Addis Abeba, Ethiopia**

### Study Design

The study uses a retrospective descriptive study design to investigate the distribution and temporal trends of colorectal cancer (CRC) incidence among patients diagnosed and treated in Addis Ababa, Ethiopia, over five years (2018-2022). This design involves analyzing existing cancer Registry data to assess past occurrences and outcomes of CRC cases. Retrospective studies are well-suited for examining disease trends and incidence over time, making them ideal for this research objective. By reviewing cancer Registry data from the designated timeframe, the study captured a comprehensive overview of CRC cases at the city administration and identified patterns or changes in incidence rate s in Addis Abeba, Ethiopia from 2018 to 2022.

## Source Population

The source population was all individuals residing in Addis Ababa during the study period (2018–2022) who had the potential to develop colorectal cancer. This includes all residents of Addis Ababa, particularly those eligible for screening and diagnosis within healthcare facilities.

## Study Population

The study population consists of individuals with a confirmed diagnosis of colorectal cancer during the specified period (2018–2022) who were residing at least a 6-month duration of stay as residents of Addis Ababa City and registered in the Addis Abeba cancer registry.

## Inclusion Criteria

**Time Frame:** Patients diagnosed with CRC between January 1, 2018, and December 31, 2022, were included in the study to capture data over five years.

**Diagnosis:** Individuals with confirmed diagnoses of CRC based on standardized diagnostic criteria were included.

**Age:** Patients of all ages were included in the study to provide a comprehensive assessment of CRC burden across different age groups.

**Cases:** CRC cases registered in the Addis Abeba City cancer registry, between January 1, 2018, and December 31, 2022, were included.

**Exclusion criteria**

**Duplicate Entries:** Duplicate entries of the same patient (same id num) within the Cancer registry were excluded to avoid double counting and ensure data accuracy.

**Incomplete Data:** CRC cases with missing or incomplete information regarding patient demographics, and diagnosis were excluded from the analysis to maintain data quality and integrity.

**Suspected Causes**: Patients with Suspected causes or unconfirmed diagnosis of colorectal cancer based on clinical presentation alone, without histological confirmation.

**Non-Oncological Conditions:** Patients diagnosed with benign tumors, non-neoplastic conditions, or other non-cancerous diseases were excluded from the study to focus specifically on CRC diseases

## Sample Size and Sampling Technique

Since this is a retrospective review encompassing the entire population of eligible CRC patients during the designated period, a complete enumeration of cases was conducted. This eliminates the need for sampling techniques and ensures the analysis captures all relevant data within the defined timeframe.

## Operational Definitions

**Colorectal Cancer Cases:** Refer to patients who have been diagnosed with cancer in the colon or rectum and surrounding area based by histopathological examination of tissue samples or clinical diagnosis confirmed by medical records at Addis Abeba.

**Patients Treated in Addis Abeba:** Refer to patients who are a resident of addis Abeba at list 6 months duration of stay in Addis Ababa City and received medical care, including diagnostic evaluations, surgeries, chemotherapy, or other interventions related to colorectal cancer, at the hospital within a specified timeframe.

**Incidence:** Incidence refers to the number of new cases of colorectal cancer that occur at each year of the 2018 to 2022 duration among patients treated in Addis Abeba, Ethiopia.

**Prevalence**: Prevalence refers to the total number of cases of colorectal cancer among patients treated in addis abeba, Ethiopia from 2018 to 2022, regardless of when the diagnosis was made.

**Trends:** Trends refer to the patterns or changes observed in the incidence or prevalence of colorectal cancer cases over time among patients treated in addis abeba, Ethiopia.

**ICD-10 (International Classification of Diseases, 10th Revision):** A WHO-developed system for coding and classifying diseases and health conditions using alphanumeric codes. It standardizes health data for global reporting and comparison.

**Morphology:** refers to the histological classification of colorectal cancer cells, such as adenoc arcinoma or mucinous carcinoma, based on the ICD-10 system. it captures the microscopic structure and cellular characteristics of the tumor.

**Anatomical Topography:** classifies the specific site of cancer origin within the colon or rectum, i.e., the sigmoid colon or rectum, based on ICD-10 codes. it classifies the location of the tumor for clinic and research purposes.

## Data Collection Procedures, Quality Assurance, and Analysis

The primary data source was the Addis Ababa City Cancer Registry, managed by Tikur Anbesa Specialized Hospital Cancer Treatment Center, containing CRC case details such as age, sex, residency, morphology, diagnosis, and anatomical topography. Extracted data were cleaned and validated to address missing values, outliers, and inconsistencies, ensuring accuracy and reliability. Data quality assurance involved addressing missing or inconsistent entries through consultation with original sources, data cleaning to remove duplicates, and resolving errors to ensure a reliable dataset. The data were analyzed using Microsoft Excel 2016, employing descriptive statistics to summarize demographic characteristics, including frequencies, percentages, means, and medians. Prevalence and

incidence rates were calculated, with subgroup analyses exploring variations by demographic and clinical factors. GIS mapping visualized the geographic distribution of CRC cases across Addis Aba ba, while trend analysis identified significant changes in CRC burden over time. These combined efforts ensured a high-quality dataset, offering robust insights into CRC prevalence and trends.

## Ethical Considerations

The principles of confidentiality, privacy, and informed consent were strictly adhered to during data collection and analysis. Patient identifiers were anonymized and kept confidential to ensure the pri vacy of participants. Informed consent was waived since the study involves the analysis of the existing cancer registry, and no direct contact with patients was made. The study complied with the ethical guidelines and regulations set forth by the institution and national regulations.

## 6.1.4. Result

### Distribution by Demographics

#### Age Distribution of Colorectal Cancer Cases

Between 2018 and 2022, a total of 1,222 colorectal cancer (CRC) cases were reported in Addis Ab aba, Ethiopia. The highest proportions were recorded in the 50–59 and 60–69 age groups, with 286 (23.4%) and 284 (23.2%) cases, respectively, while the lowest proportion was observed among individuals aged over 70, accounting for 161 cases (13.2%). The mean age at diagnosis was 52.3 years (SD ±14.4), with a median age of 52 years and an interquartile range (IQR) of 40–64 years, indicating that CRC primarily affects middle-aged adults. Age-standardized incidence rates (ASIR) further support this pattern, with the highest ASIR observed in the 60–69 age group (2.80 per 100,000), followed by the 50–59 age group (2.31 per 100,000), indicating a consistent age-related gradient in incidence.

**Table 32: Crude and age-adjusted standardized incidence rate for age distribution colorectal cancer incidence in Addis Ababa, Ethiopia**

| Years | Variables | <40 | 40-49 | 50-59 | 60-69 | ≥70 | total |
|---|---|---|---|---|---|---|---|
| 2018 | CRC Case | 35(14.9%) | 39(16.6%) | 63(26.8%) | 59(25.1%) | 39(16.6%) | 235(19.2%) |
| | population | 2,696,311.00 | 418,884.00 | 211,519.00 | 119,470.00 | 72,816.00 | 3,519,000.00 |
| | ASIR | 0.85 | 1.18 | 2.95 | 3.30 | 2.83 | 11.11 |
| 2019 | CRC Case | 70(24.1%) | 48(16.6%) | 66(22.8%) | 62(21.4%) | 44(15.2%) | 290(23.7%) |
| | population | 2,760,701.00 | 428,865.00 | 216,561.00 | 122,320.00 | 74,553.00 | 3,603,000.00 |
| | ASIR | 1.66 | 1.41 | 3.02 | 3.39 | 3.12 | 12.60 |
| 2020 | CRC Case | 49(21.1%) | 39(16.8%) | 58(25.0%) | 59(25.4%) | 27(11.6%) | 232(19.0%) |
| | population | 2,625,090.00 | 564,821.00 | 273,134.00 | 146,151.00 | 79,809.00 | 3,689,005.00 |
| | ASIR | 1.22 | 0.87 | 2.11 | 2.70 | 1.79 | 8.68 |
| 2021 | CRC Case | 50(22.3%) | 43(19.2%) | 44(19.6%) | 57(25.4%) | 30(13.4%) | 224(18.3%) |
| | population | 2,685,616.00 | 577,814.00 | 279,410.00 | 149,516.00 | 81,645.00 | 3,774,001.00 |
| | ASIR | 1.22 | 0.94 | 1.56 | 2.55 | 1.94 | 8.21 |
| 2022 | CRC Case | 61(25.3%) | 57(23.7%) | 55(22.8%) | 47(19.5%) | 21(8.7%) | 241(19.7%) |
| | population | 2,746,265.00 | 590,909.00 | 285,753.00 | 152,896.00 | 83,817.00 | 3,859,640.00 |
| | ASIR | 1.46 | 1.22 | 1.91 | 2.05 | 1.32 | 7.96 |
| Total | CRC Cases | 265(21.7%) | 226(18.5%) | 286(23.4%) | 284(23.2%) | 161(13.2%) | 1222(100%) |
| | ASIR | 1.28 | 1.12 | 2.31 | 2.80 | 2.20 | 9.71 |

#### Sex Distribution of Colorectal Cancer Cases

Over the five-year period from 2018 to 2022, colorectal cancer (CRC) in Addis Ababa showed a relatively balanced gender distribution, with males accounting for 602 (49%) and females for 620

(51%) of the total 1,222 cases. Incidence rates fluctuated annually, with the highest recorded in 2019 for both sexes 7.75 per 100,000 in males and 8.32 per 100,000 in females. Despite annual variations, males consistently exhibited higher average incidence rates (6.91 per 100,000) compared to females (6.37 per 100,000). The age-standardized incidence rate (ASIR) demonstrated a declining trend in both sexes, dropping from 12.7 to 8.34 per 100,000 in males and from 9.69 to 7.67 per 100,000 in females over the study period. On average, males had a slightly higher ASIR (8.93) than females (8 .77), indicating a modest but consistent gender disparity in CRC burden.

**Table 33: Crude and age-adjusted standardized incidence rate for sex distribution of colorectal cancer incidence in Addis Ababa, Ethiopia**

| Year | Male Incidence | Female Incidence | Male Population | Female Population | Male ASIR | Female ASIR |
|---|---|---|---|---|---|---|
| 2018 | **124(20.6%)** | **111(17.9%)** | 1,664,001 | 1,854,999 | **12.70** | **9.69** |
| 2019 | **132(21.9%)** | **158(25.5%)** | 1,703,001 | 1,899,999 | **9.79** | **10.57** |
| 2020 | **107(17.8%)** | **125(20.2%)** | 1743003 | 1946002 | **8.59** | **8.88** |
| 2021 | **115(19.1%)** | **109(17.6%)** | 1782000 | 1992001 | **5.22** | **7.04** |
| 2022 | **124(20.6%)** | **117(18.9%)** | 1821691 | 2,037,623 | **8.34** | **7.67** |
| Total | **602(49.1)** | **620(50.9)** | **Average Incidence** | | 8.93 | 8.77 |

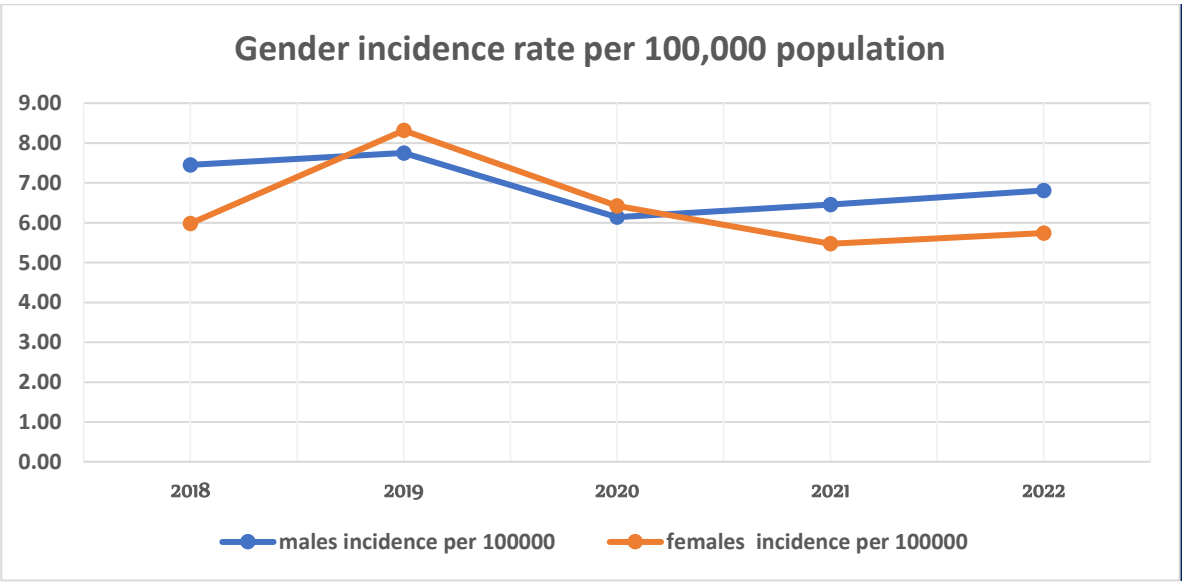


**Figure 37: Sex incidence rate of colorectal cancer in Addis Ababa, Ethiopia**

## Temporal Trends of Colorectal Cancer Incidence (2018-2022)

Over the five years from 2018 to 2022, a total of 1,222 colorectal cancer (CRC) cases were reported in Addis Ababa, with an average annual incidence rate of 6.64 per 100,000 population. The number of cases peaked in 2019 at 290 (8.05 per 100,000) and reached its lowest in 2021 with 224 cases (5.94

per 100,000). Annual fluctuations were observed, including a rise in 2022 to 241 cases (6.24 per 100,000), following a dip in 2020 and 2021. These variations in incidence do not suggest a consistent upward or downward trend but may reflect changes in disease detection, reporting practices, or heal thcare access over time. Additionally, the population in Addis Ababa grew consistently from 3.5 millio n in 2018 to 3.86 million in 2022, which could affect the calculation of incidence rates.

**Table 34: Colorectal cancer trend over five years (2018-2022) in Addis Ababa, Ethiopia**

| Year | Frequency (%) | Population | Incidence per 100,000 |
|---|---|---|---|
| 2018 | 2,35(19.2%) | 3,519,000 | 6.68 |
| 2019 | 2,90(23.7%) | 3,603,000 | 8.05 |
| 2020 | 2,32(19.0%) | 3,689,000 | 6.29 |
| 2021 | 2,24(18.3%) | 3,774,000 | 5.94 |
| 2022 | 2,41(19.7%) | 3,860,000 | 6.24 |
| Total | **1,222** | **Average Incidence** | **6.64** |

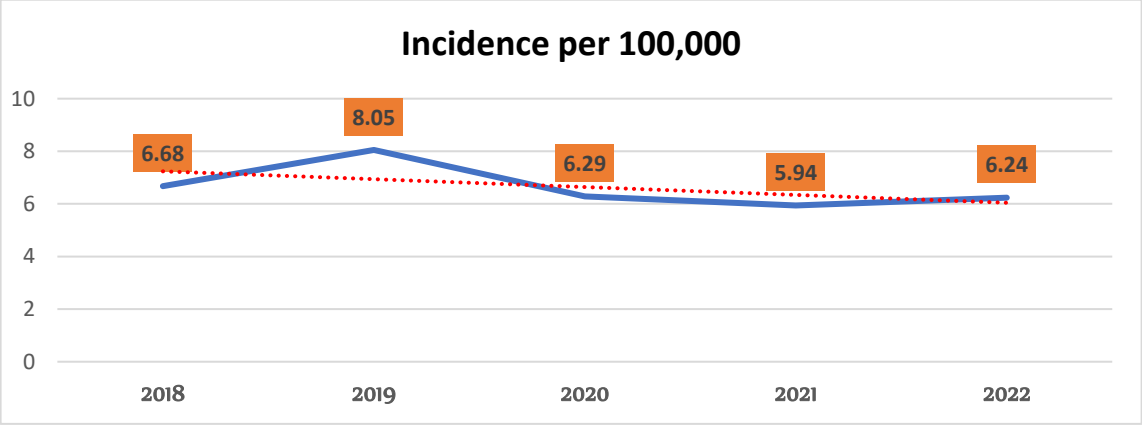


**figure 38: trend line of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia**

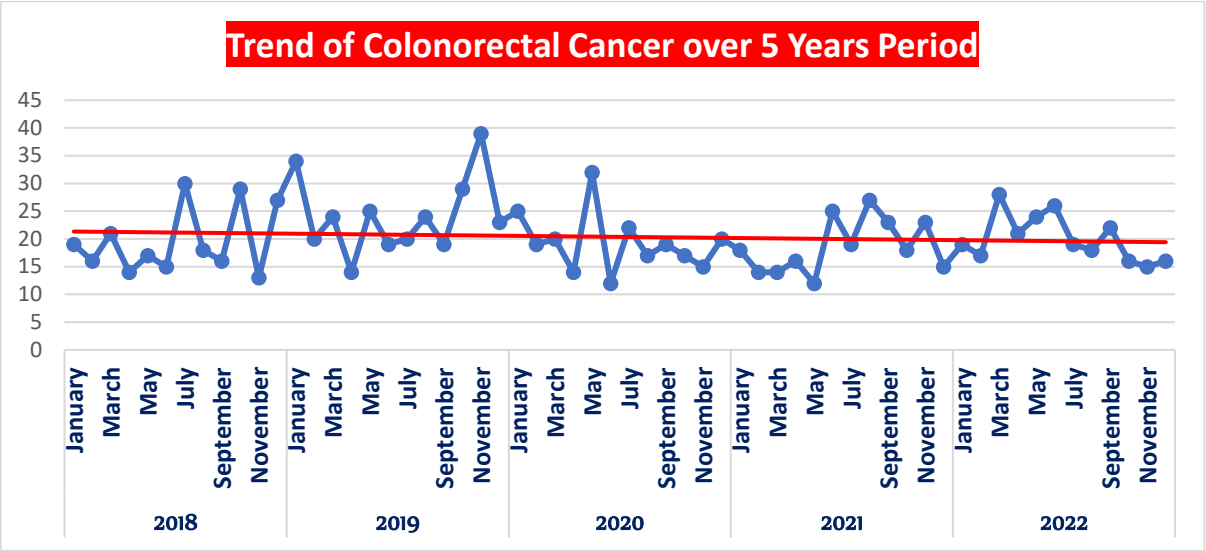


**Figure 39: Trend of colorectal cancer incidence over five years (2018-2022) in Addis Ababa, Ethiopia**

## Geographical Distribution of Colorectal Cancer Cases (2018-2022)

The geographical distribution of colorectal cancer cases across the sub-cities of Addis Ababa reveals marked disparities in incidence. Yeka sub-city reported the highest number of cases, with 182 cases representing 14.9% of the total, followed closely by Kolfe sub-city recorded 178 cases, accounting for 14.6% of the total incidence. Conversely, the lowest incidence was observed in Lideta sub-cities and Lemi Kura, with 59 and 8 cases, constituting 4.8% and 0.7% of the total cases, respectively. The notably low case count was registered in Lemi Kura sub-city.

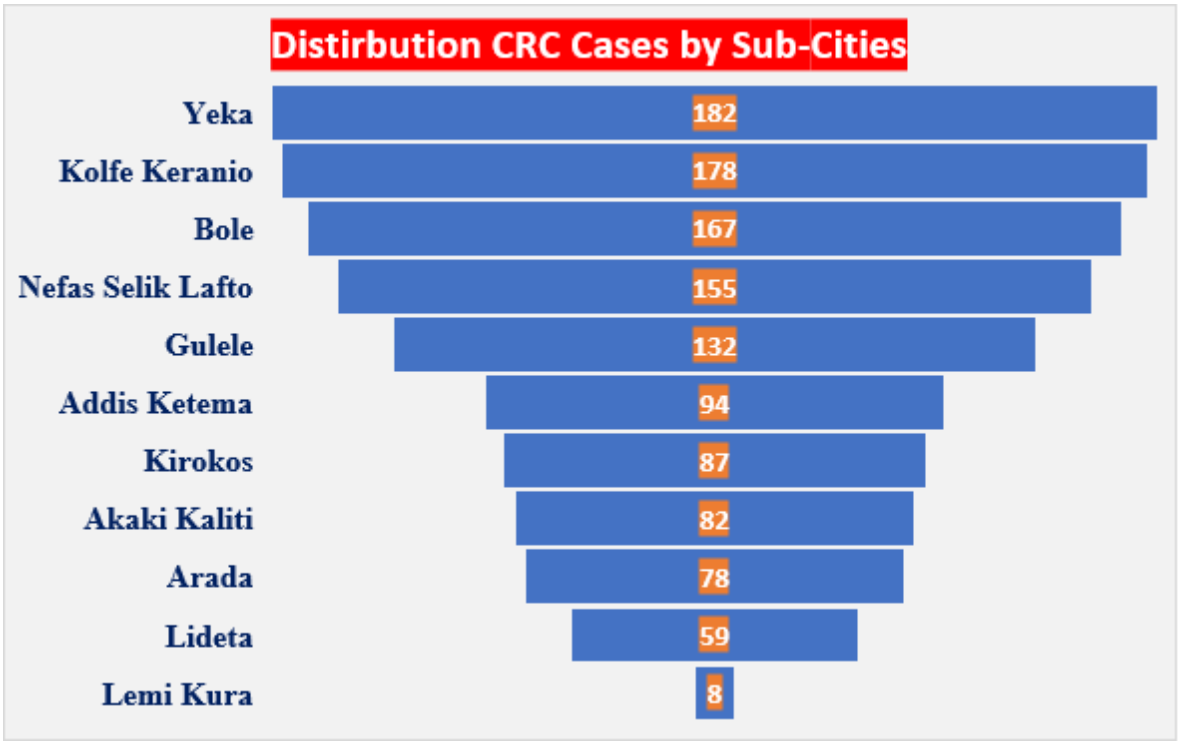


**Figure 40: Geographical distribution of colorectal cancer incidence in Addis Ababa, Ethiopia**

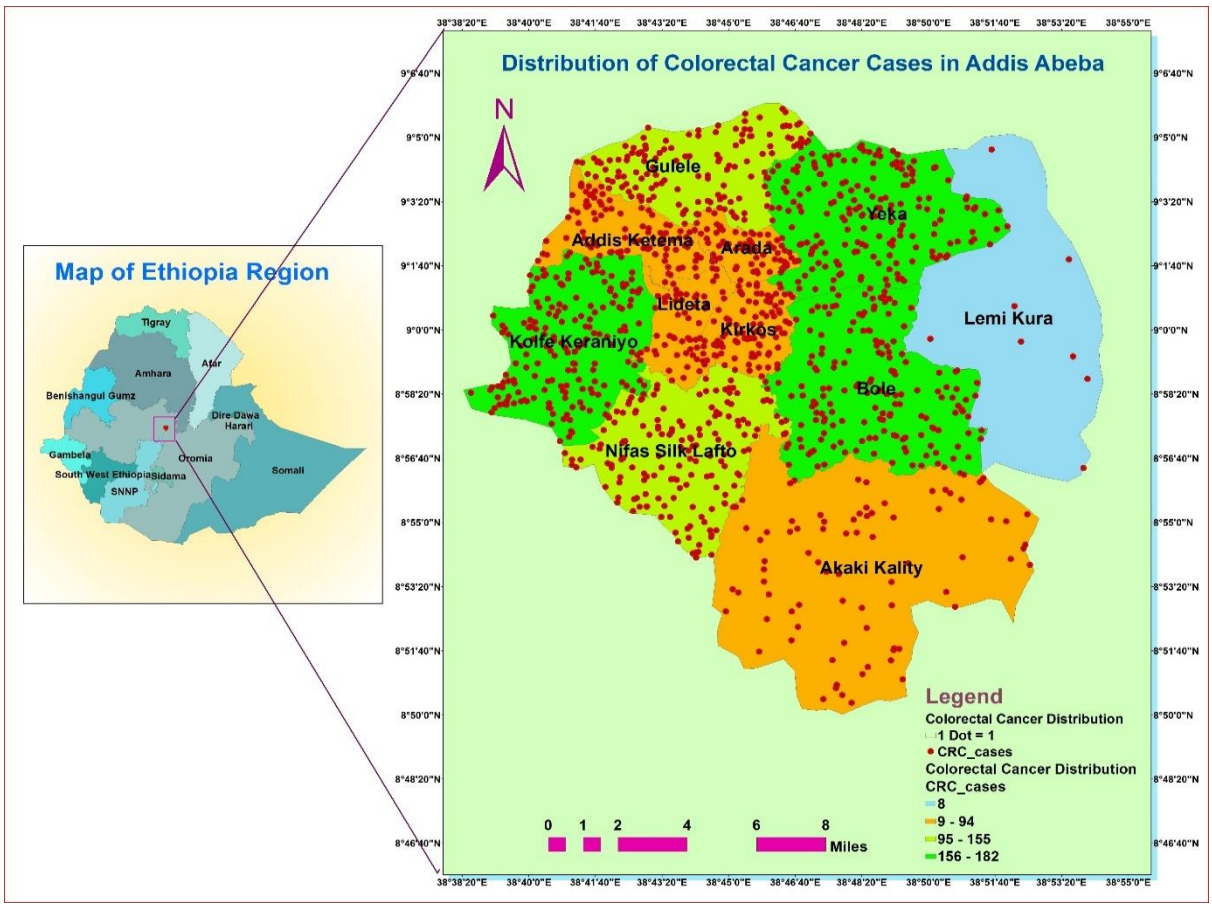


**Figure 41: Spot map of colorectal cancer distribution in Addis Ababa, Ethiopia**

## Distribution of Colorectal Cancer Cases by Anatomical Topography

The study described the distribution of colorectal cancer (CRC) cases by anatomical topography. The topography axis on the cancer registry uses the WHO-developed ICD-10 system for coding and cla ssifying the malignant neoplasms cases in Addis Ababa, based on 1222 cases recorded in the Addis Abeba cancer registry. The data reveal that the most common topographic site is the rectum, not otherwise specified (NOS), accounting for 42.5% (519 cases), followed by the colon, NOS, with 35.7% (436 cases). Other significant sites include the sigmoid colon (8.6% or 105 cases), the rectosigmoid junction (7.3% or 89 cases), and the cecum (3.3% or 40 cases). Less frequently affected regions include the splenic flexure of the colon (0.2% or 2 cases), overlapping lesions of the colon (0.2% or 2 cases), and hepatic flexure of the colon (0.1% or 1 case). These findings emphasize that CRC cases are predominantly concentrated in the rectum and colon regions, accounting for 78.2% of all cases.

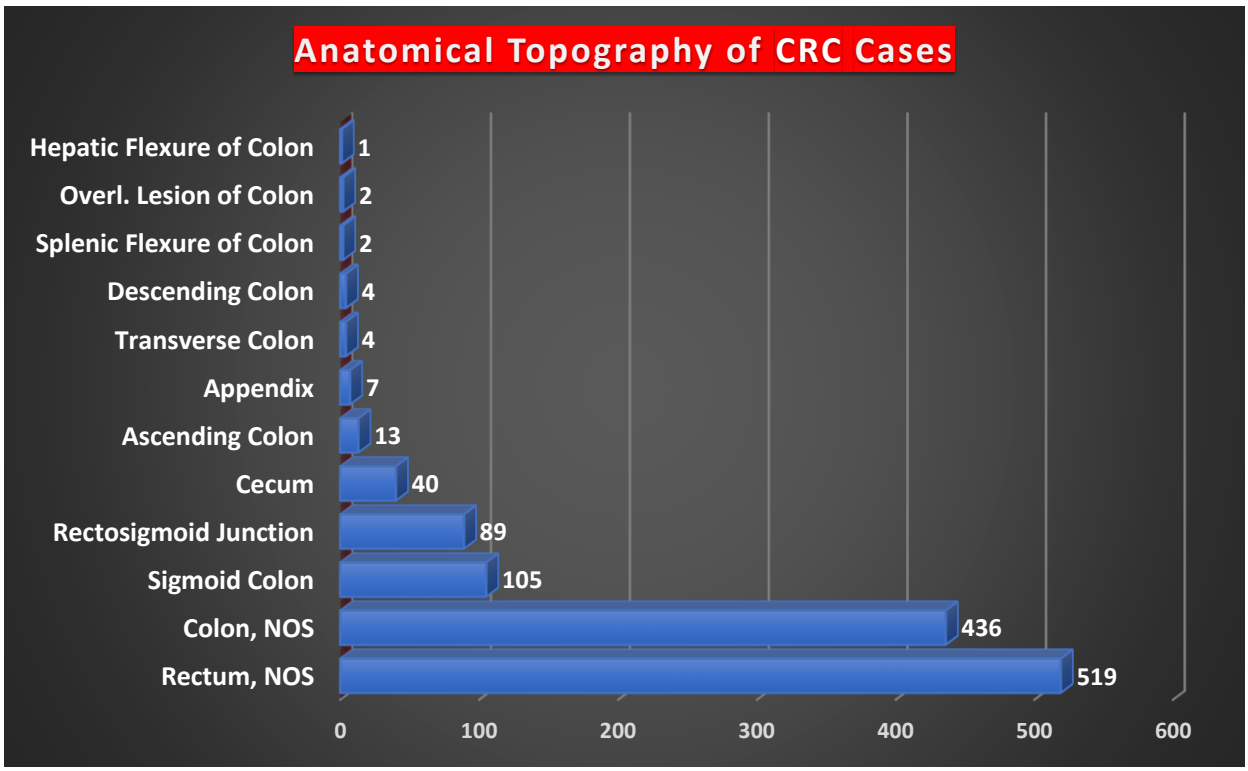


**Figure 42: Colorectal Cancer Cases distribution by Anatomical Topography in Addis Ababa, Ethiopia**

## Distribution Of Colorectal Cases by Health Facilities

The data reveal that the majority of cases were reported at Black Lion Specialized Hospital, accounting for 57.1% (698 cases), followed by Saint Paul's Hospital with 18.4% (225 cases). Other facilities include United Vision Higher Clinic (11.7% or 143 cases), Girum General Hospital (6.6% or 81 cas es), and Hallelujah General Hospital (2.4% or 29 cases). Facilities with smaller case shares include St. Gabriel General Hospital (1.3% or 16 cases), Lancet General Hospital (1.1% or 14 cases), MCM Specialized Hospital (0.7% or 9 cases), Legar General Hospital (0.2% or 3 cases), Arsho Medical Lab oratories (0.2% or 3 cases), and Betezata General Hospital (0.1% or 1 case).

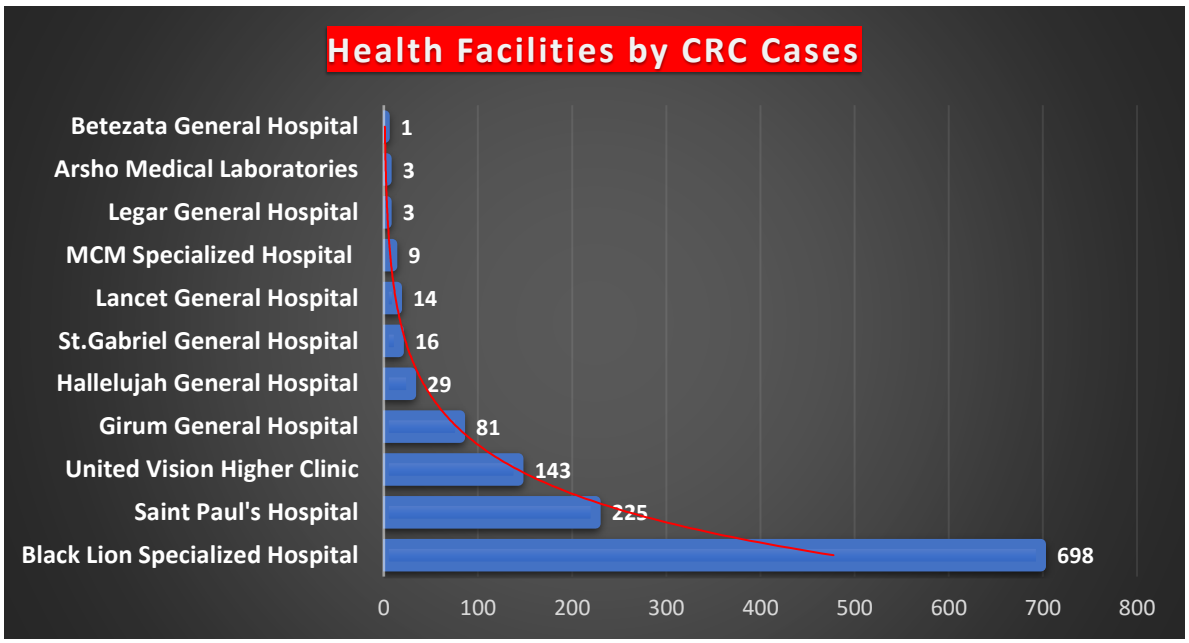


**figure 43: Colorectal Cancer Cases distribution by health facility in Addis Ababa, Ethiopia**

## Distribution by Basis of Diagnosis

The study data on colorectal cancer based on diagnosis basis revealed most cases (1,058; 86.7%) were confirmed through "Histology of Primary," followed by 107 cases (8.8%) via "Cytology." "Clinical Investigation/Ultrasound" contributed to 47 cases (3.9%), while 5 cases (0.4%) were diagnosed clinically without additional testing. Laboratory tests and histology of metastases each accounted for 2 cases (0.2%), and only 1 case (0.1%) was diagnosed posthumously through autopsy or histology.

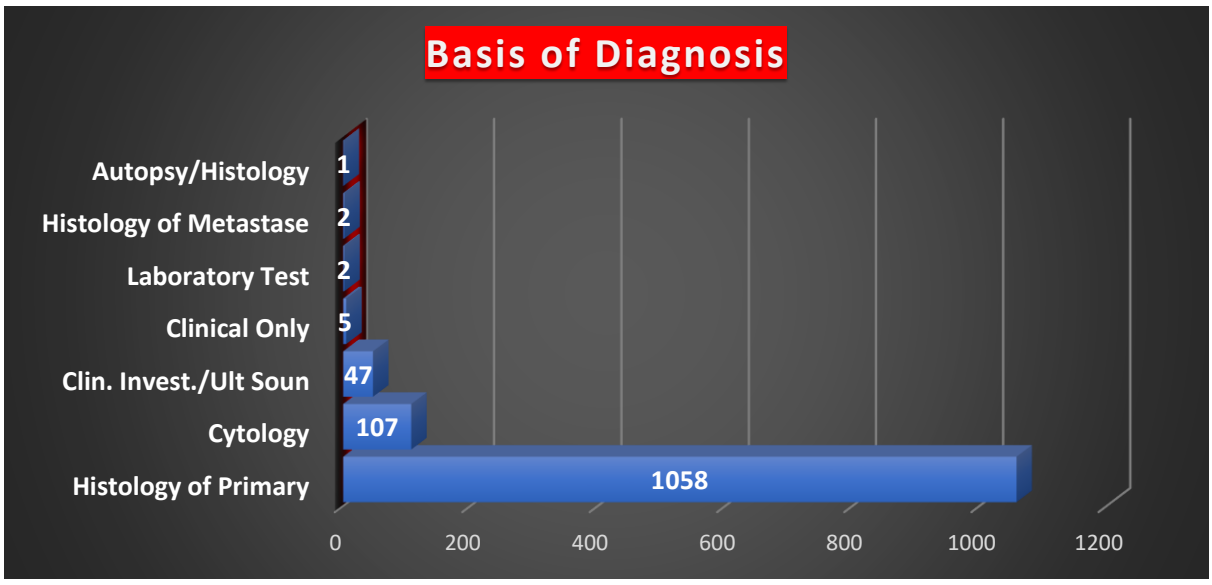


**Figure 44: Colorectal Cancer Cases distribution by basis of diagnosis in Addis Ababa, Ethiopia**

## Distribution of Colorectal Cancer Cases by Morphology

The study described the morphology of CRC cases from Addis Abeba city cancer registry which used the ICD 10 for coding and classifying the malignant neoplasms and, it identified the majority of cases were "Adenocarcinoma, NOS," accounting for 884 cases (72.3%). "Neoplasm, malignant" was the second most frequent type with 131 cases (10.7%), followed by "Carcinoma, NOS" with 69 cases (5.6%) and "Mucinous adenocarcinoma" with 65 cases (5.3%). Less common morphologies include "Signet ring cell carcinoma" (24 cases; 2.0%) and "Squamous cell carcinoma, NOS" (8 cases; 0.7%). Other rare morphologies such as "Neuroendocrine carcinoma" (7 cases; 0.6%) and "Carcinoid tumor, NOS" (5 cases; 0.4%) were reported in smaller numbers. Extremely rare morphologies, including "Sarcoma, NOS," and "Kaposi sarcoma," accounted for only 1 case each (0.1%).

**Table 35: Colorectal Cancer Cases distribution by Morphology in Addis Ababa, Ethiopia**

| Morphology of CRC Cases | Frequency | Percentage |
|---|---|---|
| Adenocarcinoma, NOS | 884 | 72.3% |
| Neoplasm, malignant | 131 | 10.7% |
| Carcinoma, NOS | 69 | 5.6% |
| Mucinous adenocarcinoma | 65 | 5.3% |
| Signet ring cell carcinoma | 24 | 2.0% |
| Squamous cell carcinoma, NOS | 8 | 0.7% |
| Neuroendocrine carcinoma, NOS | 7 | 0.6% |
| Carcinoid tumor, NOS | 5 | 0.4% |
| Squamous cell carcinoma, keratinizing, NOS | 3 | 0.2% |
| Cholangiocarcinoma | 2 | 0.2% |
| Medullary carcinoma, NOS | 2 | 0.2% |
| Malignant melanoma, NOS (except juvenile melan | 2 | 0.2% |
| Malignant lymphoma, NOS | 2 | 0.2% |
| Malignant lymphoma, large B-cell, diffuse, NOS | 2 | 0.2% |
| Large cell neuroendocrine carcinoma | 1 | 0.1% |
| Scirrhous adenocarcinoma | 1 | 0.1% |
| Carcinoma, diffuse type | 1 | 0.1% |
| A typical carcinoid tumor | 1 | 0.1% |
| Villous adenocarcinoma | 1 | 0.1% |
| Acidophil carcinoma | 1 | 0.1% |
| Mucinous adenocarcinoma, endocervical type | 1 | 0.1% |
| Infiltrating duct carcinoma, NOS | 1 | 0.1% |
| Intraductal papillary adenocarcinoma with inva | 1 | 0.1% |
| Infiltrating duct mixed with other types of ca | 1 | 0.1% |
| Polymorphous low-grade adenocarcinoma | 1 | 0.1% |
| Sarcoma, NOS | 1 | 0.1% |
| Undifferentiated sarcoma | 1 | 0.1% |
| Leiomyosarcoma, NOS | 1 | 0.1% |
| Kaposi sarcoma | 1 | 0.1% |
| Hodgkin lymphoma, NOS | 1 | 0.1% |
| Total | 1,222 | 100.0% |

## Distribution of Colorectal Cancer Cases by Treatment Types

The distribution of colorectal cancer cases by treatment type shows surgery was the most frequently administered treatment, accounting for 290 cases (23.7%) of all cases. Chemotherapy was followed in 211 cases (17.3%), while radiotherapy was utilized in 60 cases (4.9%). Hormone therapy was the least common treatment, used in only 2 cases (0.2%).

**Table 36: Colorectal Cancer Cases distribution by treatment type in Addis Ababa, Ethiopia**

| Treatment Types | Frequency | Percentage |
|---|---|---|
| Surgery | 290 | 23.7% |
| Chemotherapy | 211 | 17.3% |
| Radiotherapy | 60 | 4.9% |
| Hormone Therapy | 2 | 0.2% |

### 6.1.5. Discussion

The findings from this five-year retrospective study on colorectal cancer incidence in Addis Ababa reveal several critical insights into the distribution and temporal trends of the disease. The age-spec ific incidence of CRC demonstrates a classic pattern: risk increases with age, peaking in the 60–69-year age group, with the lowest incidence observed among individuals under 40. Nonetheless, a substantial proportion (~22%) of total cases occurred in individuals younger than 50 years over the five years, underscoring a notable early-onset CRC (EOCRC) burden. This pattern aligns with global observations of rising EOCRC rates—projections estimate that by 2030, up to 11% of colon and 23% of rectal cancers will occur in individuals under 50 [22]. Regional studies from Ethiopia similarly report mean patient ages in the late 40s to early 50s, with a considerable fraction of patients younger than 60 [23, 24]. These findings have important implications for clinical vigilance and potential consideration of earlier diagnostic strategies.

Overall, the average age-standardized incidence rates (ASIR) were nearly equivalent: approximately 8.93 per 100,000 in males and 8.77 per 100,000 in females. While males had slightly higher rates in 2018 and 2019, this difference diminished between 2020 and 2022, and in some years, female rates exceeded male rates. Globally, CRC incidence is typically higher in men, often by 30–50% in high-SDI countries, attributed to greater exposure to risk factors such as red and processed meat, alcohol, smoking, and adiposity; women often present later and with biologically different tumor subtypes, such as right-sided, microsatellite-instable cancers[25, 26]. However, in lower-SDI regions, including sub-Saharan Africa, sex incidence disparities are less pronounced, consistent with our findings. Previous Ethiopian data report similar sex distributions, with males comprising about 54–57% of cases, and a near parity in incidence[23].

The temporal trend of CRC incidence in Addis Ababa did not follow a linear trajectory. Incidence rose from 6.85 per 100,000 in 2018 to a peak of 8.05 in 2019, before declining to 5.94 in 2021 and rebounding modestly to 6.24 in 2022. The overall average was approximately 6.64 per 100,000. These fluctuations may largely reflect external factors, such as service disruptions during the COVID-19 pandemic, which globally disrupted CRC screening and diagnosis with reductions in new diagnoses of up to 40%, rather than true changes in disease occurrence[27, 28]. Additionally, Addis Ababa's population grew steadily over this period (from ~3.3 million in 2018 to ~3.86 million in 2022), and this denominator expansion likely attenuated rate increases even when absolute case counts rose[29].

In the study, rectum, NOS (not otherwise specified), and sigmoid colon accounted for the majority of colorectal cancer (CRC) cases, with 519 and 436 cases, respectively. In contrast, the cecum, appendix , and descending colon were far less frequent sites.

This pattern aligns with broader epidemiological trends: CRCs arising in the left colon (sigmoid colo n, descending colon, rectum) are generally more prevalent than those in proximal sites. For example,

an analysis by MD Anderson Cancer Center notes that about 70% of CRCs are found on the left side, including the sigmoid colon and rectum, with left-sided tumors being both more common and easier to detect via colonoscopy[30]. Additionally, U.S. data show that distribution across the proximal colon, distal colon, and rectum is roughly 41%, 22%, and 28%, respectively, with a slightly higher rectal proportion in men[31].

Such predominance of left-sided tumors in our dataset may reflect both biological factors (e.g., symptom presentation such as bleeding) and diagnostic accessibility, since left-sided lesions are more readily detected during colonoscopic evaluation[30]. From a clinical standpoint, this distribution underlines the need for adequate screening and attention to left-sided CRC, especially in settings where colonoscopy is more commonly deployed.

The majority of CRC cases in the study were concentrated at Black Lion Specialized Hospital (698 cases), followed by Saint Paul's Hospital (225 cases), United Vision Higher Clinic (143), Girim General Hospital (81), Hallelujah General Hospital (29), and smaller numbers at other institutions. This uneven distribution likely reflects the role of tertiary centers in acting as referral hubs, particularly in resource-limited settings. For instance, Tikur Anbessa (Black Lion) is a leading referral and teaching hospital with comprehensive oncology, radiology, colorectal surgery, and pathology services[32]. The concentration of cases at this facility is consistent with its capacity for advanced diagnostics and treatment, while more peripheral hospitals see fewer referrals.

Furthermore, other studies in Ethiopia have similarly emphasized that advanced and specialized services are centralized in such tertiary hospitals, resulting in higher caseloads compared to general hospitals with limited infrastructure[33].

In the study, the overwhelming majority of diagnoses were histologically confirmed (Histology of primary: 1,058 cases), followed by Cytology (107), Clinical investigations/ultrasound (47), Clinical only (5), Laboratory test (2), Histology of metastasis (2), and Autopsy/histology (1). This preponderance of histopathological confirmation is consistent with standard oncologic diagnostic practice globally. Histology remains the gold standard for CRC diagnosis and staging, providing definitive tissue-based confirmation of malignancy. Non-histological methods (e.g., imaging, cyto logy, clinical signs alone) are generally adjuncts or used when biopsy is not feasible. Although I could not locate specific global percentages for diagnostic modality breakdowns, the dominance of histology here is congruent with clinical guidelines and established research protocols. Where histological diagnosis is limited by resource constraints, diagnostic accuracy and staging may be compromised. Thus, the high rate of histological confirmation suggests robust diagnostic capacity in the institutions providing data.

## Implications for Public Health and Future Research

The findings of this study underscore the need for continuous, population-based surveillance of colorectal cancer (CRC) in Addis Ababa to monitor trends and emerging patterns, particularly the no table proportion of early-onset CRC cases among individuals under 50 years. The observed fluctua tions in incidence over the five years, likely influenced by factors such as service disruptions during the COVID-19 pandemic and population growth, highlight the importance of interpreting trends cautiously and ensuring high-quality, consistent data collection. Strengthening cancer registry systems and maintaining robust histopathological diagnostic capacity are critical to ensure accurate and timely reporting, which in turn informs public health planning and resource allocation.

Enhanced screening programs, particularly targeting middle-aged and older adults, should be prioritized, alongside clinical vigilance for early-onset cases. Public health strategies should integrate awareness campaigns, risk-based screening approaches, and adherence to standard diagnostic protocol s to improve early detection and patient outcomes.

Future research should focus on elucidating the determinants of the observed temporal trends, including lifestyle factors, genetic predispositions, and access to healthcare services. Longitudinal studies examining stage at diagnosis, treatment outcomes, and survival rates will provide essential insights to guide interventions and policy decisions. Overall, sustained surveillance and high-quality data are essential for understanding CRC dynamics and optimizing public health responses in Addis Ababa.

## Strengths and Limitations of the Study

The study included all the necessary information to show the burden of CRC in Addis Abeba, Ethiopia, this may help in prevention, screening, policy-making, and interventions of colon-rectal cancer inc idence, this study includes incidence rate, prevalence, distribution by geographical location and trend of CRC incidences in Addis Abeba, Ethiopia over 5 years period (2018-2022), it also describes CRC incidence by place, person and time.

The limitation of the study is it only includes CRC disease incidence it does not include death incidences and risk factors of colon rectal cancer.

### 6.1.6. Conclusion

This five-year retrospective study of colorectal cancer incidence in Addis Ababa has provided valuable insights into the temporal trends, demographic distribution, and geographical disparities of the disease. The key findings reveal a modest but statistically significant increase in colorectal cancer incidence over the study period, with notable fluctuations in annual case numbers, likely influenced by factors such as the COVID-19 pandemic.

The analysis identified a higher incidence of colorectal cancer in the 60-70 years age group, with a growing trend in cases among individuals aged 40-49 years. Gender-specific trends showed a slightly higher incidence among females, highlighting the need for gender-tailored prevention and screening strategies. Geographical variations in incidence underscore the necessity for targeted public health interventions in different sub-cities of Addis Ababa.

The results emphasize the importance of continuous monitoring of colorectal cancer trends and suggest that both evolving risk factors and changes in healthcare practices are influencing the incidence rates. This comprehensive understanding is essential for developing effective strategies to manage and reduce the burden of colorectal cancer in the city.

### 6.1.7. Recommendations

Based on the findings of this study, several key recommendations are proposed to address the rising incidence of colorectal cancer in Addis Ababa. Enhanced screening programs are essential, particularly with the observed increase in cases among individuals aged 40-49 years. It is recommended that the screening age be lowered to 45 years to facilitate earlier detection and intervention. Additionally, community-based screening programs should be expanded, particularly in high-incidence sub-cities such as Yeka and Kolfe, to increase access to screening and reduce geographical disparities in early detection rates.

Gender-specific interventions should be developed to address the differences in colorectal cancer incidence between males and females. Public health campaigns should be designed to consider gender-specific risk factors, with an emphasis on encouraging early screening, particularly for females who have shown a steady increase in incidence over the study period. These campaigns should also promote awareness about colorectal cancer symptoms and risk factors, particularly targeting the most affected age groups and genders. Enhancing health literacy through community outreach, workshops, and media campaigns will be crucial in encouraging regular screening and healthier lifestyle choices. In terms of healthcare access, it is important to address disparities in sub-cities like Lemi Kura, where colorectal cancer incidence is low, possibly due to barriers in access to screening, diagnosis, and

treatment services. Strengthening healthcare infrastructure is necessary to support comprehensive cancer care, including better diagnostic services, treatment facilities, and patient support programs.

Further research should be conducted to investigate the changing risk factors contributing to the inc reasing incidence of colorectal cancer in younger populations. Studies should also explore potential lifestyle or environmental factors that may be influencing these trends.

Geographical studies are recommended to better understand the regional disparities in colorectal cancer incidence, which could inform more targeted public health interventions. Additionally, suppor ting policy development that promotes colorectal cancer prevention, screening, and treatment is esse ntial. Collaborating with local and national health authorities to implement evidence-based public health policies will be crucial in mitigating the rising burden of colorectal cancer. In conclusion, addressing the increasing incidence of colorectal cancer in Addis Ababa requires a comprehensive and multifaceted approach. By enhancing screening programs, developing gender-specific inte rventions, promoting public health education, improving healthcare access, conducting targeted research, and supporting policy initiatives, public health authorities can effectively manage and reduce the burden of colorectal cancer, ultimately improving outcomes for the population of Addis Ababa.

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# Chapter 7: Abstract for Scientific Presentation

## Original research

# Cholera Outbreak Investigation in Afar Region of Ethiopia, 2024; A Case-Control Study

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## 7.2. Cholera Outbreak Investigation in Afar Region of Ethiopia, 2024; A Case-Control Study

### 7.2.1. Abstract

**Background:** On March 6, 2024, a patient with acute watery diarrhea and vomiting arrived at Dubti General Hospital in Afar Region, Ethiopia, suspecting cholera infection stool samples were collected and confirmed with Vibrio cholerae positive. As of April 15, 2024, 410 cholera cases in 2 zones were reported. We described the epidemiology, identified the determinants, and responded to the outbreak accordingly.

**Method:** We conducted a descriptive study followed by an unmatched case-control study, with a 1:2 ratio conducted from March to April 2024. 410 cases from the line list were used for the descriptive study, and 45 cases and 90 controls for the unmatched case-control study. A structured interviewer-administered questionnaire was used for the data collection with a Simple random sampling method for the sampling. ArcGis were used to show disease distribution in a Map and Data were entered into Epi info software and analyzed using SPSS version 20 software. Logistic regression was used to compute the crude and adjusted odds ratios for the factors associated with cholera infection.

**Results:** The study identified 410 cases (0.93/1000 Attack Rate) with no death was registered. Of the total cases, 76.6% were severely dehydrated, 87.3% cases used river water sources, and 76% of the cases were in zone 1, The median age was 23 years (interquartile range:18-30 years) with male to female ratio of 4:1 and 64.6% cases were daily laborers. knowledge of cholera infection [AOR=6.06, 95% CI=1.10-33.33], unimproved water sources [AOR=3.28, 95% CI=1.20-8.95], without latrine access [AOR=4.56, 95% CI=1.23-17.00], Contact with suspected cases [AOR=3.28, 95% CI=1.24-8.69], and traveled to active outbreak area [AOR=2.79, 95% CI=1.08-7.22] were the significant determinants of the outbreak.

**Conclusions:** The study highlights knowledge, that unimproved water, and lack of latrines were the causes of cholera transmission. We recommended Strengthening WASH services, and giving health education are essential to mitigating the outbreak.

**Keywords:** Cholera, Afar Region, Ethiopia, 2024, outbreak, case-control study, WASH, determinants

**Word Count: 254**

# Chapter 8: Thesis research

## 8.1. Determinants of hypertension among military patients with type 2 diabetes mellitus on follow-up at Armed Force Comprehensive Specialized Hospital, Addis Ababa, Ethiopia, 2024: A case-control study

### 8.1.1. Abstract

**Background:** Hypertension is a common comorbidity in type 2 diabetes mellitus (T2DM) patients, which enhances morbidity and mortality, particularly among high-stress occupation groups such as the military. Despite this group's high cardiovascular risk, limited data exist for certain determinants of hypertension among military service members with T2DM in Ethiopia. The aim of this research was to identify factors associated with hypertension in T2DM military patients on follow-up at Armed Force Comprehensive Specialized Hospital in Addis Ababa.

**Methods:** A facility-based unmatched case-control study was conducted among 356 T2DM military patients (119 cases and 237 controls) using a 1:2 ratio. The cases were T2DM patients with diagnosed hypertension, whereas the controls were T2DM patients without hypertension. Data were collected through structured interviews and medical records abstraction. Independent determinants of hypertension were ascertained through multivariable logistic regression. Statistical significance was determined by adjusted Odds Ratios (AORs) with 95% Confidence Intervals (CIs) and p-values less than 0.05.

**Results:** Older age, longer duration of diabetes, poor knowledge of hypertension, greater exposure to combat-related stress, very high work-related stress, current smoking, family history of hypertension, and obesity were all significantly associated with hypertension. Patients aged 50–59 years [AOR = 3.43, 95% CI: 1.43–8.22] and those ≥60 years [AOR = 3.41, 95% CI: 1.41–8.27] were more likely to be hypertensive than those aged 30–39 years. Having diabetes for more than 10 years [AOR = 3.82, 95% CI: 1.70–8.60] and poor knowledge of hypertension [AOR = 3.68, 95% CI: 1.94–6.98] showed strong associations. Occasional exposure to combat/high-stress missions [AOR = 3.13, 95% CI: 1.35–7.27] and frequent exposure [AOR = 3.02, 95% CI: 1.29–7.06] increased the odds of hypertension. Very high self-reported work stress [AOR = 2.35, 95% CI: 1.07–5.16], current smoking [AOR = 3.00, 95% CI: 1.67–5.37], and family history of hypertension [AOR = 1.97, 95% CI: 1.09–3.55] were also strong predictors, while obesity (BMI ≥30) showed the highest risk [AOR = 6.36, 95% CI: 2.90–13.93].

**Conclusion:** Hypertension in military patients with T2DM was significantly related to modifiable and non-modifiable factors, such as age, duration of diabetes, exposure to stress, smoking status, inadequate knowledge about hypertension, family history, and BMI. Targeted health education, behavioral change, and stress management interventions should be a high priority in this high-risk group to enhance cardiovascular outcomes.

**Keywords:** Hypertension, Type 2 Diabetes Mellitus, Military, Determinants, Ethiopia, Stress, Smoking, Knowledge, Case-Control Study

## 8.1.2. Introduction

### Background

Hypertension poses a significant public health issue globally, greatly contributing to various cardiovascular diseases, strokes, kidney failure, and other related complications[1-4]. The World Health Organization estimates that 1.28 billion adults aged 30 to 79 worldwide suffer from hypertension, with around two-thirds residing in low - and middle-income nations, while it is believed to account for 7.5 million deaths[5] [6, 7]. Among individuals with Type 2 Diabetes Mellitus (T2DM), the presence of hypertension further amplifies the risk of complications, resulting in increased morbidity and mortality rates[8-12]. Hypertension is noted to be prevalent among diabetics, being reported as twice as common in this group compared to those without diabetes. In the context of diabetes, the likelihood and advancement of heart disease, peripheral vascular disease, strokes, retinopathy, and nephropathy significantly escalate with hypertension [13, 14]. Projections suggest that the number of cases of T2D will grow from 415 million to 642 million by the year 2040 [15]. Additionally, individuals with hypertension often demonstrate insulin resistance and face a higher risk of developing diabetes compared to those with normal blood pressure[14]. Managing the combination of hypertension and T2DM demands careful attention since both conditions share numerous risk factors such as obesity, unhealthy dietary habits, lack of physical activity, and genetic tendencies[16-19].

A study indicated that the pooled prevalence of hypertension in individuals with type 2 diabetes across Africa ranged from 59.8% to 60.8%. Central Africa exhibited the highest prevalence at 77.6%, followed by South Africa with rates between 69.1% and 74.5%. North Africa recorded a prevalence of 63.4% to 65.5%, while West Africa ranged from 51.5% to 55.7%. Lastly, East Africa had a prevalence between 50.7% and 53.0%, respectively [20, 21].

The occurrence of hypertension in individuals with type 2 diabetes mellitus (T2DM) in Ethiopia is significantly concerning, with research showing prevalence rates between 59.5% and 82.5%. Multiple factors influence this condition, including demographic characteristics, lifestyle habits, and medical background. Recognition of these factors is critical in development of effective strategies to manage hypertension in this risk group[22, 23].

Currently, to our best knowledge, no specific studies on factors affecting hypertension in type 2 diabetes mellitus among military members have been conducted. Nevertheless, it has been estimated that worldwide prevalence rates of hypertension (HTN) and increased fasting blood sugar (FBS) among military members are 26% and 9% respectively, which suggests an elevated threat of diabetes among military groups[24].

Militaries form a homogeneous group, with their own set of stressors and lifestyle issues that are likely to propel disease development like hypertension[25, 26]. The intense physical and psychological stress of military life, along with dietary restriction and restricted access to ongoing healthcare, can enhance the development of hypertension, especially in patients with existing conditions like T2DM[24, 27, 28].

The purpose of this study is to identify significant factors influencing military patients with T2DM on hypertension, who are receiving follow-up care at the Armed Forces Comprehensive Specialized Hos pital in Addis Ababa. The result of this research will be crucial in formulating strategies to alleviate the burden of hypertension among such vulnerable patients.

## Statement of the Problem

Hypertension and type 2 diabetes mellitus (T2DM) are interrelated chronic illnesses that encompass fatal health outcomes, including increased risk of cardiovascular disease, renal failure, and shortened life expectancy. The prevalence of hypertension in patients with T2DM is high at 50% to 80%, and reportedly accounts for 7.5 million global deaths each year, while also exacerbating complications and complicating disease management.[29-34].

For military personnel, health risks are added to by some occupation-specific stressors, including heavy physical effort, alternating sleep-wake cycles, extended bouts of sedentary living, unpredictable environmental conditions, and harsh combat settings. meanwhile, lifestyle factors like Heavy alcohol consumption and smoking, common in some military environments, also increase the risk for the development of hypertension and diabetes, particularly with increasing age[25, 27, 35-38].

The growing prevalence of non-communicable diseases (NCDs) in Ethiopia, especially hypertension and type 2 diabetes mellitus (T2DM), poses a serious public health challenge. Research shows that approximately one-third of adults suffer from hypertension, while the incidence of diabetes is also increasing as a result of changes in lifestyle, eating patterns, and urban development[39, 40]. Also, hypertension is commonly occurring in type 2 diabetes mellitus (T2DM) patients in Ethiopia, with prevalence rates reported between 59.5% and 82.5%[22, 23].

Despite the increasing challenge of public health, there is currently no research that focuses on the factors influencing hypertension in military personnel with type 2 diabetes mellitus (T2DM) in Ethiopia.This is especially a cause for concern as Ethiopian soldiers can be exposed to unique occupational nditions, such as deployment at high altitudes and chronic stress, which can increase their vulnerability to the development of hypertension. The absence of specific data in relation to this setting limit the development of effective interventions for this demographic. Therefore, the aim of this study is to bridge this knowledge gap through examination of determinants of hypertension among

Ethiopian soldiers with T2DM at the Armed Forces Comprehensive Specialized Hospital in Addis Ababa. Findings will supply critical evidence for the development of targeted strategies for managing the conditions and enhancing the health, operational readiness, and resilience of military personnel in Ethiopia.

## Rationale and Significance of the Study

Hypertension and type 2 diabetes mellitus (T2DM) are two chronic illnesses that pose major global health challenges, frequently occurring together and increasing the risk of serious cardiovascular and kidney problems. The concern surrounding these conditions is heightened by the need for continuous management to avert long-term health decline[29-33].

In military environments, managing these health issues becomes more complicated due to distinctive occupational stress factors. Service personnel usually have high physical requirements, experience disturbed sleep, have unprecedented irregular work hours, expose themselves to environment shift, and experience combat and operational responsibility-related high stress levels, all of which are contributory to the hypertension and diabetes risks. Lifestyle behaviors of excess alcohol consumption, smoking, and seating inactivity during long missions enhance the risks, which are generally increase with age [25, 27, 35-38].

In Ethiopia, no previous study that evaluated the determinants of hypertension among T2DM military patients exists, and it is a crucial gap that this study aims to address. Through a gap analysis, the study will be in a position to provide insightful data on how occupational and lifestyle exposures contribute to hypertension in army patients with T2DM, whose health challenges are distinct. The findings will allow the Armed Forces Comprehensive Specialized Hospital and other similar institutions to formulate evidence-based programs relevant to the military setting, with a focus on the prevention of hypertension, lifestyle modifications, and effective stress management in T2DM military patients. This study will also lay the groundwork for more extensive research on military health in Ethiopia, helping to improve long-term cardiovascular health and enhance the overall health and operational readiness of the nation’s armed forces.

# Literature Review

## Introduction

High blood pressure ranks among the top global risk factors for mortality and disability. The prevalence of hypertension (defined as a blood pressure of ≥140 mmHg systolic or ≥90 mmHg diastolic, or those undergoing treatment) surged from 650 million individuals in 1990 to 1.3 billion by 2019[41-44]. The WHO 2023 report states that merely 54% of adults with hypertension have been diagnosed, 42% are being treated, and only 21% manage to control their hypertension[42, 45]. Hypertension is a critical risk factor for ischemic heart disease, stroke, various cardiovascular diseases (CVDs), chronic kidney disease, and dementia[46-50].

In Africa, the number of individuals with hypertension has risen consistently, starting from 54.6 million in 1990 to 92.3 million in 2000 (a 70% increase), and reaching 130.2 million in 2010 (a 41% increase from 2000). Projections show it could rise to 216.8 million by 2030[51]. In Ethiopia, population-based studies have found hypertension prevalence to range from 9.3% to 30.3%, while institution-based studies report rates from 7% to 37%, and hospital-based studies indicate prevalence between 13.2% and 18.8%[52].

Diabetes is a chronic condition that occurs when the pancreas fails to produce sufficient insulin or when the body cannot effectively utilize the insulin that is produced. The global number of individuals with diabetes grew from 108 million in 1980 to 422 million in 2014. The rise of diabetes prevalence has been more pronounced in low- and middle-income countries compared to high-income countries. Diabetes is a significant cause of blindness, kidney failure, heart attacks, strokes, and amputations of lower limbs[53].

The diabetes burden in Ethiopia is an emerging public health problem, with various studies citing high prevalence of diagnosed and undiagnosed diabetes. A systematic review revealed a pooled undiagnosed prevalence of 5.68% of diabetes among adults[54]. In Eastern Ethiopia, a prevalence of 8.64% of undiagnosed diabetes was also reported[55]. And in the Humbo district survey, there was a prevalence of 5.9% of diabetes among adults between 25-64[56]. At the national level, from a study of geospatial analysis, diabetes prevalence was 2.8%, varying by region, for instance, 8.7% in the Somali region[57]. Further, a meta-analysis study revealed a national prevalence of diabetes as 6.26%, and in other studies conducted post-2017, greater rates were identified[58].

## Hypertension and diabetes comorbidity

Hypertension is found in approximately 50% to 75% of individuals with type 2 diabetes, and conversely, diabetes is identified in around 20% of those with hypertension. The likelihood of developing hypertension in individuals with type 2 diabetes is 2 to 2.5 times greater than in those

without diabetes; similarly, the existence of hypertension raises the risk of type 2 diabetes by the same factor, while individuals with hypertension alone often display signs of insulin resistance[16, 59, 60].

Incidence and prevalence of hypertension in diabetic patients in Ethiopia show significant health challenges, as varied studies report a daunting comorbidity burden. Over-all hypertension incidence among diabetic patients was 11.4% over five years with an incidence density rate of 58.05 per 1000 person-years. Further, hypertension prevalence rates in diabetic patients also varied between studies, with estimates varying between 37.4% to 82.5%.[22, 23, 61].

Together, diabetes, hypertension, or their combination accounts for 80% of global cases of end-stage renal disease. The presence of type 2 diabetes and hypertension jointly raises the risk of cardiovascular conditions and kidney disorders, including nephropathy [62, 63].

## Risk factors of hypertension among diabetes patients

Hypertension commonly occurs alongside diabetes, increasing the likelihood of cardiovascular issues and damage to organs. Numerous studies point to significant risk factors tied to this combination of conditions. Age of 50 years and more, elevated BMI, and diabetes duration of five years or more commonly apper as a major indicators of hypertension[64]. Lifestyle choices, such as a lack of physical activity, excessive salt consumption, and tobacco use, are key contributors. Moreover, inadequate glycemic control and abnormal lipid levels, especially high triglyceride levels, are strongly linked to a heightened risk of hypertension[65, 66]. Socioeconomic factors like lower income, along with demographic aspects, including being female and belonging to certain ethnic groups, also demonstrate connections. In addition, the presence of microalbuminuria and increased waist-to-hip ratios is a marker related to hypertension among diabetes patients [67]. Efforts focusing on changing lifestyle habits, such as improving diet, enhancing physical exercise, and managing stress, are essential for reducing these risks.

## Hypertension and type 2 diabetes among military personnel

A study of the prevalence of hypertension among Nepalese Army and Royal Thai Army personnel reported overall prevalence rates of 29.4% and 13.4%, respectively[68, 69]. A study at Combined Military Hospital (CMH), Savar, reported 80.4% of retired military personnel had hypertension, while diabetes mellitus prevalence was found to be 66.7%[70]. Additionally, research involving the Military Police of Bahia State, Brazil, indicated a metabolic syndrome prevalence of 38.54% among soldiers [71].

It is estimated that the global prevalence of hypertension (HTN) and elevated fasting blood sugar (FBS) in military personnel stands at 26% (with a range of 19–34) and 9% (with a range of 5-12) respectively, suggesting a heightened risk of diabetes within military populations[24].

Studies have shown that military personnel encounter unique occupational stressors, such as demanding physical exertion, lack of sleep, stress from combat, noise, irregular work shifts, prolonged periods of inactivity, environmental fluctuations, as well as lifestyle factors like high alcohol consumption and smoking, which contribute to the development of hypertension and diabetes, with prevalence rates rising alongside age[25, 27, 38].

This proposal seeks to identify the factors associated with hypertension in military personnel diagnosed with type 2 diabetes mellitus (T2DM) at the Armed Forces Comprehensive Specialized Hospital in Addis Ababa. With the increased risk of hypertension among T2DM patients and the special stressors of military deployment, the study will utilize the case-control design to determine the particular risk factors that contribute to hypertension in this group.

The outcomes of this research will be pivotal in establishing targeted interventions for the management of hypertension in T2DM patients within the military, a goal to minimize complications to health and achieve an enhancement in long-term health conditions through patient-specific care interventions in a military healthcare environment.

## Conceptual Framework

The conceptual framework is developed after a review of different literature to show the relationship between factors that affect the Presence or absence of hypertension among T2DM patients, like lifestyle factors, demographic factors, military-related factors, knowledge-related factors, and clinical factors. It presents the relationship between factors and outcome variables.

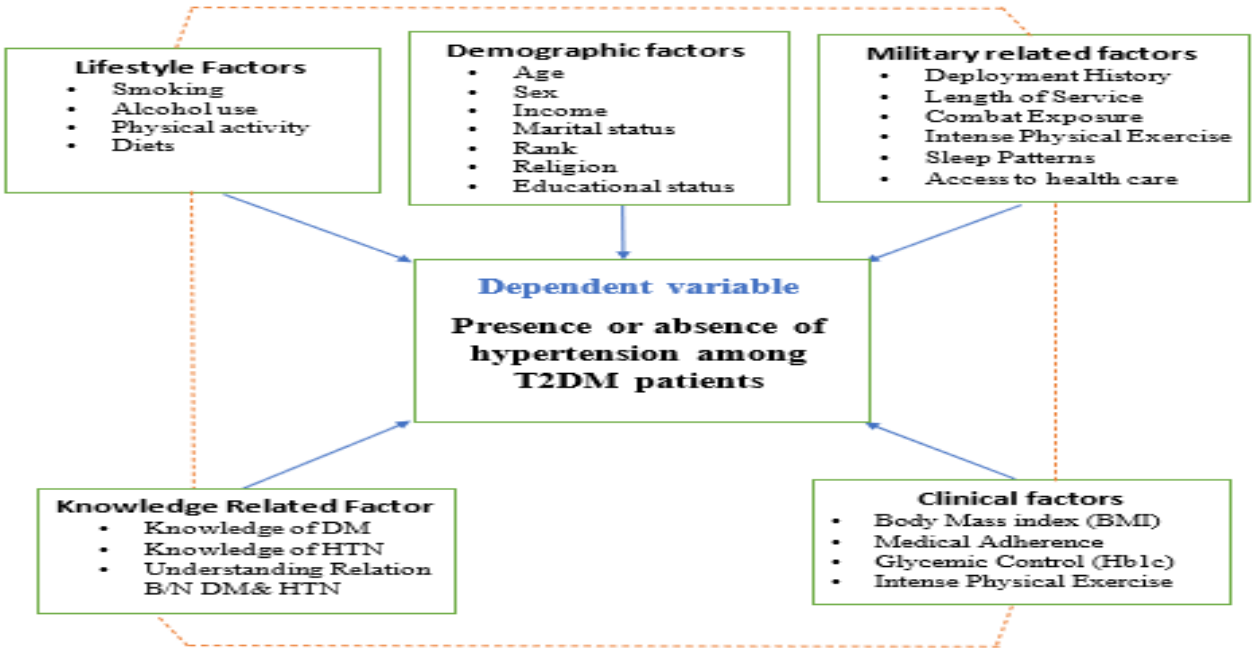


*Figure 45:Conceptual framework of the study*

### 8.1.3. Objectives

#### General Objective

To identify determinants of hypertension among military patients with Type 2 Diabetes Mellitus on follow-up at the Armed Force Comprehensive Specialized Hospital, Addis Ababa, Ethiopia, 2024

#### Specific Objectives

- To identify military service-related factors of hypertension among military patients with type 2 diabetes mellitus on follow-up at Armed Force Comprehensive Specialized Hospital, Addis Abeba, Ethiopia, 2024
- To identify socio-demographics and lifestyle-related factors of hypertension among military patients with type 2 diabetes mellitus on follow-up at Armed Force Comprehensive Specialized Hospital, Addis Ababa, Ethiopia, 2024

## 8.1.4. Methods And Materials

### Study area and period

The study was taken place at the Armed Force Comprehensive Specialized Hospital, located in Addis Ababa, Ethiopia. The Hospital is one of Ethiopia's oldest medical facilities, established by Emperor Haile Selassie I in memory of his daughter, Princess Tsehai Haile Selassie, after her demise due to childbirth complications in August 1942. Initially named "Princess Tsehai Memorial Hospital," it also operated as a nursing school and received financial support from her friends in England[72]. Following the 1974 revolution, the hospital was renamed Armed Forces General Hospital. Today, it serves as a level 4 facility, known as the "Armed Forces Comprehensive Specialized Hospital," and it is the final level referral hospital in the Ethiopian military health system, which delivers specialized medical services. It delivers high-quality healthcare mainly for the armed forces personnel and their families. This hospital offers advanced facilities and treatments. This medical center offers specialized medical care for conditions like cardiology, oncology, neurology, and orthopedics, with advanced treatments. Its emergency and trauma care services are equipped with immediate medical care and surgical procedures with modern operating theatres, advanced technologies, and a skilled team. This center offers a wide range of diagnostic services like MRI, CT scan, X-ray, pathology, and microbiology lab services, with additional maternity and pediatric services.

The study was conducted from January 8 to March 7, 2025

### Study Design

- An institution-based case-control study was conducted to identify the determinants of hypertension among type 2 diabetes in military personnel

### Source and Study Population

The source population of the study was all military personnel who came to the Armed Force Comprehensive Specialized Hospital for follow-up in the study period. Meanwhile, the study population was patients consisting of military personnel diagnosed with T2DM, who were on follow-up at an armed forces comprehensive specialized hospital.

- Cases: Military patients with type 2 diabetes mellitus who have been diagnosed with hypertension.
- Controls: Military patients with type 2 diabetes mellitus but without hypertension.

## Inclusion Criteria and Exclusion Criteria

### Inclusion criteria

- Military personnel diagnosed with T2DM.
- Patients on follow-up at the Armed Force Comprehensive Specialized Hospital.
- Aged 18 years and above.

### Exclusion Criteria:

- Patients with pre-existing hypertension before the diagnosis of T2DM.
- Military personnel not receiving regular follow-up care at the hospital.
- Military personnel who are on treatment in the inpatient service

## Sample Size Determination and Sampling Procedure

### Sample size determination

The sample size was calculated using Epi-info version 7 StatCalc program with the following assumptions: 95% confidence level, power of 80%, case to control (1: r) = 1:2, As it can be seen from Table below, the variable taken is from a study done in Tikur Anbesa hospital having a BMI of $\geq 30$ kg/m$^2$ yielded the largest sample size, with COR=2.34 to detect the effect size[73]. and the proportion of controls with an exposure of 12.9%. Considering a non-response rate of 10%, the final sample size of 390 (130 cases and 260 controls) was reached.

**Formula Used and Inputs**

1. Confidence level (Zα/2): Zα/2=1.96 (for 95% confidence interval).
2. Power (Zβ): Zβ=0.84 (for 80% power).
3. Proportion of controls exposed (p2p_2p2): 18.8% (p2=0.188)
4. Odds ratio (OR): 2.18.
5. Case-to-control ratio (r): 1:2 (r=2).

Step 1 Calculate p1 (Proportion of cases exposed)

$p1=p2\cdot OR/1+p2\cdot(OR-1)$

Step 2: Calculate q1and q2 (Proportions unexposed)

$q1=1-p1,\ \ q2=1-p2$

Step 3: Calculate p and q (Average proportions for both groups)

$p=p1+p2/2,\ q=1-p$

Step 4: Calculate n1 (Uncorrected sample size for cases)

$n1=[Z\alpha/2\cdot(r+1)\cdot p\cdot q+Z\beta\cdot r\cdot p1\cdot q1+p2\cdot q2]2/\ r\cdot(p1-p2)2$

Step 5: Adjust n1 using the Fleiss correction factor

$ncc=n1\cdot[1+14\cdot n1+(r+1)\cdot|p2-p1|4\cdot r\cdot(p1-p2)2]$

**Table 37: Sample size determination for the study**

| No | Variable/Factors | Confidence interval | Power | Exposed controls | OR | Control-to-case ratio | Sample size | | | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Control | Case | Total | |
| 1 | BMI ≥ 30 kg/m$^2$ | 95% | 80 | 12.9% | 2.34 % | 2:1 | 236 | 118 | 354 | [73] |
| 2 | Occupation(retired) | 95% | 80 | 19.4% | 2.31 % | 2:1 | 188 | 94 | 282 | [73] |
| 3 | Sedentary life(≥4hour/day) | 95% | 80 | 12.9% | 2.82 % | 2:1 | 117 | 89 | 266 | [73] |

## Sampling technique and procedure

This study employed an unmatched case-control design to investigate the determinants of hypertension among military personnel with type 2 diabetes mellitus (T2DM) at the Armed Forces Comprehensive Specialized Hospital. Participants were selected from the medical record registration room as they attended their regular follow-up appointments. The cases included T2DM patients diagnosed with hypertension, while controls were T2DM patients without hypertension, identified independently without matching.

The process of sampling involves verification of medical histories during follow-up visits to confirm participants' status for eligibility based on their hypertension status. Participants who were deemed eligible were approached to participate in the study. This process offers a strict process of selection and utilizes the routine functions of the hospital for efficiency. Sample size calculation guides the enrollment process to ensure proper representation and statistical power for assessing the determinants of hypertension among this particular population.

## Study Variables

### Dependent Variable (Outcome measures)

The dependent variable for this study is hypertension among type 2 diabetes mellitus (T2DM) military patients who are coming for follow-up at the Armed Forces Comprehensive Specialized Hospital in Addis Ababa, Ethiopia, in 2024.

Hypertension was defined as a systolic blood pressure (SBP) ≥ 140 mmHg or a diastolic blood pressure (DBP) ≥ 90 mmHg, according to the latest measurement taken during follow-up. It also encompassed those with a definite past history of hypertension diagnosed by a doctor or those already on antihypertensive drugs as noted in their files. Blood pressure was measured from the medical files to maximize accuracy and stability, according to the most recent reading available for analysis. Inconsistencies or missing values were resolved with the medical staff, or additional evaluation was

incorporated if possible. In this current study, hypertension is examined as the main outcome variable to see which socio-demographic, clinical, behavioral, and occupation-related factors play a part in its development in the context of military personnel with T2DM. The findings aim to inform targeted prevention and treatment strategies for the group.

## Independent Variables

The independent factors include the following: -

- **Socio-Demographic Factors**:
  - Age
  - Gender
  - Rank in the military (e.g., officer, non-officer)
  - Marital status
  - Educational level
  - Income level
- **Lifestyle Factors**:
  - Smoking status (current smoker, former smoker, or non-smoker)
  - Alcohol consumption (frequency and quantity)
  - Physical activity level (frequency and intensity)
  - Dietary habits (e.g., intake of salt, fruits, and vegetables)
- **Medical and Clinical Factors**:
  - Duration of diabetes diagnosis
  - Body Mass Index (BMI)
  - Family history of hypertension or cardiovascular disease
  - Current diabetes management (medication, diet, exercise)
  - Comorbidities (e.g., dyslipidemia, cardiovascular disease)
- **Military Related Factors**:
  - Length of military service
  - Work-related stress (self-reported levels)
  - Shift work (regularity and duration of night shifts)
  - Physical demands of military duty (intensity and frequency of physical tasks)
  - Exposure to combat or high-stress environments
  - Duration of sedentary posture during missions
- **Access to healthcare-related factors**
  - Frequency of Follow-Up
  - Access to primary health care
  - Access to health education
- **Knowledge-related factors**
  - Knowledge of DM
  - Knowledge of HTN
  - Understanding Relation B/N DM& HTN

## Operational Definition

**Hypertension:** A systolic blood pressure (SBP) ≥140 mmHg or diastolic blood pressure (DBP) ≥90 mmHg, or on antihypertensive medication.

**Type 2 Diabetes Mellitus (T2DM):** Diabetes characterized by insulin resistance, defined as fasting blood glucose ≥126 mg/dL, HbA1c ≥6.5%, or documented treatment for diabetes.

**Military Personnel:** Ethiopian armed forces personnel attending follow-up visits at the Armed Forces Comprehensive Specialized Hospital.

**Prevalence:** The proportion of military personnel with T2DM diagnosed with hypertension.

**Determinants of Hypertension:** Risk factors contributing to hypertension, including socio-de mographic, lifestyle, and occupational stressors.

**Occupational Stressors:** Job-related factors in the military, such as physical demands, lack of sleep, irregular shifts, and prolonged sitting, combat exposure that impact health.

**Follow-up Appointment:** Regular clinical visits made by T2DM patients to monitor health conditions, including hypertension.

**Case:** A military member with T2DM and diagnosed with hypertension.

**Control:** A military member with T2DM but without hypertension.

**Blood Pressure Measurement:** Assessed with a reliable electronic sphygmomanometer, two readings averaged to determine hypertension status.

## Data Collection Procedure and Instrument

Data collection for the present study was carried out using an interviewer-administered structured questionnaire adapted from relevant literature to ensure content validity. Data were gathered through interviews of military personnel who had visited the Armed Forces Comprehensive Specialized Hospital for follow-up in person using ODK software as a data collection tool and a KoboToolbox server to store gathered data. In addition to interview data, clinical data were collected from reviewing the participants' medical records. The questionnaire had three sections: socio-demographic details, lifestyle and occupational causes of stress, and history of diabetes and hypertension.

The data collection team is composed of two Bachelor of Science (BSc) clinical nurses and a supervisor from one BSc public health officer who have all had prior data collection experience using ODK software as a data collection tool. The crew is trained for three days on the aim of the study, data collection procedures, and adhering to procedures. Training covered appropriate usage of the questionnaire, ethical practices, and how to maintain consistency. Pre-tests of the questionnaire were conducted on 5% of the sample population at a nearby military base that was not under the primary study before full deployment. Pre-test helped decide on the questionnaire's clarity, reliability, time requirements, and cultural acceptability. Based on pre-test results, adjustments were made for clarity

and comprehension. The questionnaire was translated from English to Amharic and then back-translated to English to ensure accuracy and consistency in language.

Data regarding socio-demographic and behavioral aspects were used to gather in-person interviews by utilizing the "WHO STEPS Instrument for Chronic Disease Risk Factor Surveillance"[74]. To evaluate stress levels, the validated 10-item Perceived Stress Scale (PSS) developed by Cohen[75] was adapted for the study[76]. For calculating PSS scores, the responses to the four positively framed items were reversed and coded, and then the scores of all scale items were aggregated.

## Data Management and Analysis Procedure

The data collected using the ODK tool was exported to SPSS version 20 software for statistical analysis. Descriptive statistics were used to present and summarize different categorical variables by tables, graphs, and continuous variables described by mean and standard deviation. In Bivariate conditional regression analysis, crude odds ratio with 95% confidence intervals was calculated to see the association between explanatory variables and Hypertension. Variables with p-value ≤0.25 in bivariate analysis with well-known risk factors for hypertension were included in the final model of multivariable analysis. Finally, conditional logistic regression was employed to see the relationship between dependent and independent variables by controlling confounder variables. All reports with a P-value ≤0.05 were considered statistically significant.

## Data quality assurance

The quality of data was ensured by providing training for the data collectors and supervisors Before the data collection, pre-testing of the questionnaires in similar military settings on 5% of the selected participants. Appropriate modifications were made after reviewing the pre-test results by the principal investigator. Every day after data collection, questionnaires were reviewed and checked for completeness, accuracy, and clarity by the supervisors and principal investigator, and the necessary feedback was offered to data collectors the next morning. Responses were then carefully coded, verified, and checked for consistency.

## Ethical consideration

Ethical clearance was obtained from the Addis Abeba University School of Public Health Institutional Review Committee (IRB). Written informed consent was found from the study participant before the commencement of the study. Permission was obtained from the research and innovation directorate of the Armed Force Comprehensive Specialized Hospital and the Ministry of National Defense Health Main Department. The purpose and significance of the study were also described to the study participants. The questionnaire was explained to the research participants that it is for academic

purposes, and the researcher ensured their confidentiality, anonymity, and privacy as well as every respondent was asked for permission to complete the questionnaire.

## Dissemination of findings

The findings of the study were submitted to Addis Abeba University School of Public Health and also disseminated to the armed forces comprehensive specialized hospital and to the National Ministry of Defense Health Main Department, respectively, and other concerned bodies that need to utilize it and do the intervention. The findings were also prepared to be published in a reputable peer-reviewed journal.

## 8.1.5. Results

### Socio-Demographic Characteristics of Respondents

The study included 356 participants, comprising 119 cases and 237 controls. Males slightly predominated (52.0%), and they were more frequent among cases (54.6%) than controls (50.6%). Similarly, urban residents represented 51.7% of the total sample, but they were disproportionately higher among cases (57.1%) compared to controls (48.9%).

Marital status varied across groups: single participants were more common among controls (24.9%) than cases (16.8%), whereas divorced (29.4%) and widowed participants (30.3%) were more frequent among cases. Education level also differed slightly; primary school education was more prevalent among cases (40.3%) compared to controls (32.9%), while higher education was more common in controls (30.4% vs. 24.4%).

Age distribution indicated that older participants were more represented among cases. The 50–59 years group accounted for 33.6% of cases versus 21.9% of controls, and those aged 60+ years comprised 34.5% of cases compared to 22.8% of controls. Regarding income, a higher proportion of cases were in the low-income category (29.4%) relative to controls (20.7%), whereas high-income participants were more represented among controls (46.8% vs. 35.3% in cases). These patterns suggest that older age, lower income, and certain marital statuses may be associated with hypertension among military personnel with diabetes. Table 38 presents the socio-demographic profile of the 356 participants and compares cases (n = 119) and controls (n = 237).

*Table 38: Socio-demographic characteristics of respondents (n = 356)*

| Socio-Demographic Factor | Category | Cases (Yes) n (%) | Controls (No) n (%) | Total n (%) |
|---|---|---|---|---|
| **Sex** | Male | 65 (54.6) | 120 (50.6) | 185 (52.0) |
| | Female | 54 (45.4) | 117 (49.4) | 171 (48.0) |
| **Place of Residence** | Urban | 61 (51.3) | 123 (51.9) | 184 (51.7) |
| | Rural | 58 (48.7) | 114 (48.1) | 172 (48.3) |
| **Marital Status** | Single | 25 (21.0) | 54 (22.8) | 79 (22.2) |
| | Married | 37 (31.1) | 58 (24.5) | 95 (26.7) |
| | Divorced | 23 (19.3) | 65 (27.4) | 88 (24.7) |
| | Widowed | 34 (28.6) | 60 (25.3) | 94 (26.4) |
| **Highest Education Level** | Primary school | 42 (35.3) | 84 (35.4) | 126 (35.4) |
| | Secondary school | 43 (36.1) | 86 (36.3) | 129 (36.2) |
| | Higher education | 34 (28.6) | 67 (28.3) | 101 (28.4) |
| **Monthly Income** | Low income | 27 (22.7) | 57 (24.1) | 84 (23.6) |
| | Medium income | 43 (36.1) | 76 (32.1) | 119 (33.4) |
| | High income | 49 (41.2) | 104 (43.9) | 153 (43.0) |
| **Age Group** | 30–39 | 15 (12.6) | 77 (32.5) | 92 (25.8) |
| | 40–49 | 23 (19.3) | 54 (22.8) | 77 (21.6) |

| | | | | |
|---|---|---|---|---|
| | 50–59 | 40 (33.6) | 52 (21.9) | 92 (25.8) |
| | 60+ | 41 (34.5) | 54 (22.8) | 95 (26.7) |

## Military-Related Characteristics of Respondents

Military-related characteristics of the respondents are presented in Table 39. The distribution of military ranks showed variations between cases and controls. Mid- to senior-level ranks such as Major (14.3%) and Lieutenant Colonel (18.5%) were more common among cases than controls (13.1% and 12.2%, respectively). Junior ranks such as Second Lieutenant (10.1%) and Lieutenant (9.2%) appeared more frequently among controls (15.2% and 14.8%). Regarding current duty status, retired personnel represented 63.0% of cases compared with 50.6% of controls, while active-duty service members were more common among controls (49.0%) than cases (37.0%). Exposure to combat or high-stress missions differed across groups. Occasional deployments (1–3 per year) were reported by 31.9% of cases compared with 21.9% of controls, and frequent deployments (>3 per year) by 27.7% of cases compared to 17.3% of controls. Never being deployed was more common among controls (29.1%) than cases (15.1%). Work-related stress levels also varied. Very high stress was reported by 34.5% of cases compared to 19.4% of controls, while low stress levels were more frequent among controls (32.5%) than cases (18.5%). Deployment frequency per year and years of military service showed relatively similar distributions across groups, with slight variations. Shift-work frequency and sleep hours on duty were also comparable between cases and controls with no major differences.

*Table 39: Military-related characteristics of respondents (n = 356)*

| Military-Related Factor | Category | Cases (Yes) n (%) | Controls (No) n (%) | Total n (%) |
|---|---|---|---|---|
| **Military Rank** | Second lieutenant | 12 (10.1) | 36 (15.2) | 48 (13.5) |
| | Lieutenant | 11 (9.2) | 35 (14.8) | 46 (12.9) |
| | Captain | 13 (10.9) | 22 (9.3) | 35 (9.8) |
| | Major | 17 (14.3) | 31 (13.1) | 48 (13.5) |
| | Lieutenant colonel | 22 (18.5) | 29 (12.2) | 51 (14.3) |
| | Colonel | 17 (14.3) | 26 (11.0) | 43 (12.1) |
| | Others | 27 (22.7) | 58 (24.5) | 85 (23.9) |
| **Current Duty Status** | Active duty | 44 (37.0) | 117 (49.0) | 177 (49.7) |
| | Retired | 75 (63.0) | 120 (50.6) | 179 (50.3) |
| **Exposure to Combat / High-Stress Missions** | Never | 18 (15.1) | 69 (29.1) | 87 (24.4) |
| | Rarely (<1/year) | 30 (25.2) | 75 (31.6) | 105 (29.5) |
| | Occasionally (1–3/year) | 38 (31.9) | 52 (21.9) | 90 (25.3) |
| | Frequently (>3/year) | 33 (27.7) | 41 (17.3) | 74 (20.8) |
| **Work-Related Stress Level** | Low | 22 (18.5) | 77 (32.5) | 99 (27.8) |
| | Moderate | 25 (21.0) | 66 (27.8) | 91 (25.6) |
| | High | 31 (26.1) | 48 (20.3) | 79 (22.2) |
| | Very high | 41 (34.5) | 46 (19.4) | 87 (24.4) |
| | Rarely (<1/yr) | 25 (21.0) | 69 (29.1) | 94 (26.4) |

| | | | | |
|---|---|---|---|---|
| **Frequency of Deployment per Year** | Occasionally (1–3/yr) | 29 (24.4) | 63 (26.6) | 92 (25.8) |
| | Frequently (>3/yr) | 34 (28.6) | 52 (21.9) | 86 (24.2) |
| | Long-term deployment | 31 (26.1) | 53 (22.4) | 84 (23.6) |
| **Years of Military Service** | <5 years | 26 (21.8) | 70 (29.5) | 96 (27.0) |
| | 5–10 years | 29 (24.4) | 51 (21.5) | 80 (22.5) |
| | 11–20 years | 35 (29.4) | 60 (25.3) | 95 (26.7) |
| | >20 years | 29 (24.4) | 56 (23.6) | 85 (23.9) |
| **Shift Work Frequency** | Never | 37 (31.1) | 52 (21.9) | 89 (25.0) |
| | Occasionally | 24 (20.2) | 68 (28.7) | 92 (25.8) |
| | Regularly | 32 (26.9) | 62 (26.2) | 94 (26.4) |
| | Always | 26 (21.8) | 55 (23.2) | 81 (22.8) |
| **Hours of Sleep on Duty** | <4 hours | 27 (22.7) | 53 (22.4) | 80 (22.5) |
| | 4–6 hours | 35 (29.4) | 59 (24.9) | 94 (26.4) |
| | 7–8 hours | 28 (23.5) | 63 (26.6) | 91 (25.6) |
| | >8 hours | 29 (24.4) | 62 (26.2) | 91 (25.6) |

## Behavioral Characteristics of Respondents

Behavioral characteristics are summarized in Table 40. Current smoking was more frequently reported among cases (62.2%) than controls (38.0%). Alcohol consumption patterns were similar across groups, with 85.7% of cases and 82.3% of controls reporting ever drinking alcohol. Physical activity levels showed differences, with 37.8% of cases reporting low activity compared to 31.2% of controls, while moderate activity was more common in controls (50.6%). Vegetable intake frequency showed minor differences between groups, and salt consumption modification after diabetes diagnosis varied slightly, with a substantial reduction reported by 19.3% of cases versus 30.0% of controls.

*Table 40: Behavioral characteristics of respondents (n = 356)*

| Variable | Category | Cases n (%) | Controls n (%) | Total n (%) |
|---|---|---|---|---|
| **Currently Smokes Tobacco** | Yes | 74 (62.2%) | 90 (38.0%) | 164 (46.1%) |
| | No | 45 (37.8%) | 147 (62.0%) | 192 (53.9%) |
| **Ever Consumed Alcohol** | Yes | 102 (85.7%) | 195 (82.3%) | 297 (83.4%) |
| | No | 17 (14.3%) | 42 (17.7%) | 59 (16.6%) |
| **Physical Activity** | High | 20 (16.8%) | 43 (18.1%) | 63 (17.7%) |
| | Moderate | 54 (45.4%) | 120 (50.6%) | 174 (48.9%) |
| | Low | 45 (37.8%) | 74 (31.2%) | 119 (33.4%) |
| **Vegetable Intake/Week** | 0 days | 16 (13.4%) | 30 (12.7%) | 46 (12.9%) |
| | 1 day | 16 (13.4%) | 24 (10.1%) | 40 (11.2%) |
| | 2 days | 25 (21.0%) | 31 (13.1%) | 56 (15.7%) |
| | 3 days | 19 (16.0%) | 41 (17.3%) | 60 (16.9%) |
| | 4 days | 14 (11.8%) | 35 (14.8%) | 49 (13.8%) |
| | 5 days | 17 (14.3%) | 45 (19.0%) | 62 (17.4%) |
| | 6 days | 12 (10.1%) | 31 (13.1%) | 43 (12.1%) |
| **Salt Consumption Change** | No change | 37 (31.1%) | 58 (24.5%) | 95 (26.7%) |
| | Minimally | 35 (29.4%) | 57 (24.1%) | 92 (25.8%) |
| | Substantially | 23 (19.3%) | 71 (30%) | 94 (26.4%) |

| | | | | |
|---|---|---|---|---|
| | Stopped | 24 (20.2%) | 51 (21.5%) | 75 (21.1%) |

### *Clinical Characteristics of Respondents*

Clinical characteristics are presented in Table 41. Obesity (BMI ≥30) accounted for 47.1% of cases compared with 11.8% of controls, while normal BMI (<25) was more common among controls (34.6%) than cases (18.5%). Diabetes duration of more than 10 years was higher among cases (54.6%) compared to controls (41.8%). A family history of hypertension was reported by 49.6% of cases and 25.3% of controls. Mental health support, medication adherence, and glucometer ownership showed similar distributions across the two groups.

*Table 41: Clinical Factors characteristics of respondents (n = 356)*

| Variable | Category | Cases n (%) | Controls n (%) | Total n (%) |
|---|---|---|---|---|
| **BMI Category** | <25 | 22 (18.5%) | 82 (34.6%) | 104 (29.2%) |
| | 25–29.9 | 41 (34.5%) | 127 (53.6%) | 168 (47.2%) |
| | ≥30 | 56 (47.1%) | 28 (11.8%) | 84 (23.6%) |
| **Diabetes Duration** | <5 yrs | 17 (14.3%) | 63 (26.6%) | 80 (22.5%) |
| | 5–10 yrs | 37 (31.1%) | 75 (31.6%) | 112 (31.5%) |
| | >10 yrs | 65 (54.6%) | 99 (41.8%) | 164 (46.1%) |
| **Family History of Hypertension** | Yes | 59 (49.6%) | 60 (25.3%) | 119 (33.4%) |
| | No | 60 (50.4%) | 177 (74.7%) | 237 (66.6%) |
| **Received Mental Health Support** | Yes | 61 (51.3%) | 120 (50.6%) | 181 (50.8%) |
| | No | 58 (48.7%) | 117 (49.4%) | 175 (49.2%) |
| **Missed Anti-diabetic Doses** | No | 60 (50.4%) | 138 (58.2%) | 198(55.6%) |
| | Yes | 59(49.6%) | 99 (41.8%) | 158 (44.4%) |
| **Owns Glucometer** | Yes | 62 (52.1%) | 125 (52.7%) | 187 (52.5%) |
| | No | 57 (47.9%) | 112 (47.3%) | 169 (47.5%) |

### Knowledge Characteristics of Respondents

The study found most cases showed poor knowledge, with 93 individuals (78.2%) falling into this category, while only 26 cases (21.8%) demonstrated good knowledge. In contrast, controls had a more balanced distribution: 134 (56.5%) had poor knowledge, but a notable 103 (43.5%) showed good knowledge.

Overall, the pattern suggests that individuals in the case group were more likely to have a limited understanding of diabetes and hypertension compared with controls. This difference highlights the role that inadequate knowledge may play in the development or worsening of hypertension among diabetic military personnel.

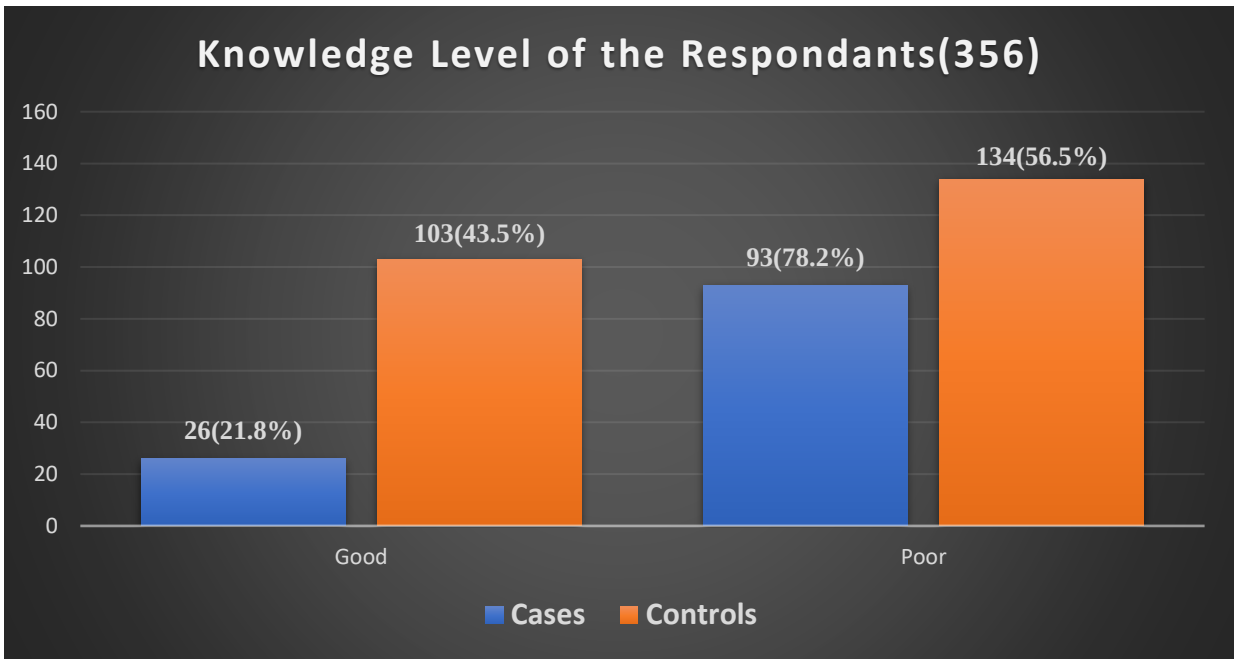


*Figure 46: Knowledge Level of the study participants about hypertension and diabetes*

## Determinants of Hypertension Among Military Patients with Type 2 Diabetes Mellitus

In the bivariable logistic regression analysis, several variables showed significant associations with hypertension among military patients with type 2 diabetes mellitus. Variables with a p-value less than 0.25 were considered candidates for inclusion in the multivariable model, following the recommended purposeful selection strategy for logistic regression. Based on this criterion, the following factors were selected for multivariable analysis: age group, duration of diabetes, hypertension knowledge level, exposure to combat/high-stress missions, self-reported work-related stress, duty status, current tobacco smoking, family history of hypertension, missed anti-diabetic medication doses, and BMI category.

After adjusting for potential confounders in the multivariable logistic regression model, several variables remained independently and significantly associated with hypertension. After adjusting for other variables, age, diabetes duration, knowledge level, exposure to combat/high-stress missions, self-reported work-related stress, current tobacco smoking, family history of hypertension, and BMI were significantly associated with the odds of having hypertension

Patients aged 50–59 years had over three times higher odds of hypertension compared to those aged 30–39 years [AOR = 3.43, 95% CI: 1.43–8.22, p = 0.006], while patients ≥60 years had similar increased odds [AOR = 3.41, 95% CI: 1.41–8.27, p = 0.007]. Individuals with diabetes >10 years were nearly four times more likely to have hypertension compared to those with <5 years duration [AOR = 3.82, 95% CI: 1.70–8.60, p = 0.001]. Patients with poor knowledge of hypertension had over three times the odds of being hypertensive compared to those with good knowledge [AOR = 3.68, 95% CI: 1.94–6.98, p < 0.001]. Occasional exposure (1–3 times/year) to combat/high-stress mission

was associated with a threefold increase in hypertension odds compared to those with no exposure [AOR = 3.13, 95% CI: 1.35–7.27, p = 0.008], and frequent exposure (>3 times/year) had similar increased odds [AOR = 3.02, 95% CI: 1.29–7.06, p = 0.011]. Very high self-reported stress doubled the odds of hypertension compared to low stress [AOR = 2.35, 95% CI: 1.07–5.16, p = 0.033]. Current smokers had three times higher odds of hypertension than non-smokers [AOR = 3.00, 95% CI: 1.67–5.37, p < 0.001]. Having a family history nearly doubled the risk of hypertension compared to those with no family history [AOR = 1.97, 95% CI: 1.09–3.55, p = 0.024]. Obese patients (BMI ≥30) were over six times more likely to have hypertension compared to those with BMI <25 [AOR = 6.36, 95% CI: 2.90–13.93, p < 0.001].

***Table 42: Bivariable and Multivariable Logistic Regression Analysis of Determinants of Hypertension Among Military Patients with Type 2 Diabetes Mellitus***

| Variable | Category | Cases n (%) | Controls n (%) | COR (95% CI) | AOR (95% CI) | P-value |
|---|---|---|---|---|---|---|
| **Age(years)** | **30–39** | 15(12.6) | 77 (32.5) | 1 | 1 | |
| | **40–49** | 23 (19.3) | 54 (22.8) | 2.19 (1.05–4.57) | 2.04 (0.81–5.14) | 0.128 |
| | **50–59** | 40 (33.6) | 52 (21.9) | 3.95 (1.99–7.87) | 3.43 (1.43–8.22) | .006* |
| | **≥60** | 41 (34.5) | 54 (22.8) | 3.90 (1.96–7.74) | 3.41 (1.41–8.27) | .007* |
| **DM duration** | **<5 years** | 17 (14.3) | 63 (26.6) | 1 | 1 | |
| | **5–10 years** | 37 (31.1) | 75 (31.6) | 1.83 (0.94–3.55) | 2.19 (0.93–5.17) | 0.074 |
| | **>10 years** | 65 (54.6) | 99 (41.8) | 2.43 (1.30–4.52) | 3.82 (1.70–8.60) | .001* |
| **Knowledge Level** | **Good** | 26 (21.8) | 103 (43.5) | 1 | 1 | |
| | **Poor** | 93 (78.2) | 134 (56.5) | 2.75 (1.66–4.56) | 3.68 (1.94–6.98) | <.001* |
| **Combat exposure** | **Never** | 18 (15.1) | 69 (29.1) | 1 | 1 | |
| | **<1/year)** | 30 (25.2) | 75 (31.6) | 1.53 (0.79–2.99) | 1.37 (0.59–3.14) | 0.465 |
| | **1–3/year** | 38 (31.9) | 52 (21.9) | 2.80 (1.44–5.46) | 3.13 (1.35–7.27) | .008* |
| | **>3/year** | 33 (27.7) | 41 (17.3) | 3.09 (1.54–6.17) | 3.02 (1.29–7.06) | .011* |
| **Stress** | **Low** | 22 (18.5) | 77 (32.5) | 1 | 1 | |
| | **Moderate** | 25 (21.0) | 66 (27.8) | 1.33 (0.69–2.57) | 1.53 (0.69–3.42) | 0.297 |
| | **High** | 31 (26.1) | 48 (20.3) | 2.26 (1.18–4.35) | 1.57 (0.70–3.53) | 0.274 |
| | **Very High** | 41 (34.5) | 46 (19.4) | 3.12 (1.66–5.88) | 2.35 (1.07–5.16) | .033* |
| **Duty status** | **Active** | 44(37.0) | 117 (49.4) | 1 | 1 | |
| | **Retired** | 75 (63.0) | 120 (50.6) | 1.66 (1.06–2.61) | 1.11 (0.62–1.98) | 0.725 |
| **Tobacco smoking** | **No** | 45 (37.8) | 147 (62.0) | 1 | 1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Yes** | 74 (62.2) | 90 (38.0) | 2.69 (1.71–4.23) | 3.00 (1.67–5.37) | <.001* |
| **Family history** | **No** | 60 (50.4) | 177 (74.7) | 1 | 1 | |
| | **Yes** | 59 (49.6) | 60 (25.3) | 2.90 (1.83–4.61) | 1.97 (1.09–3.55) | .024* |
| **Missed anti-diabetic Doses** | **No** | 60(50.4) | 138 (58.2) | 1 | 1 | |
| | **Yes** | 59 (49.6) | 99 (41.8) | 1.37 (0.88–2.13) | 1.22 (0.69–2.14) | 0.497 |
| **BMI** | **<25** | 22 (18.5) | 82 (34.6) | 1 | 1 | |
| | **25–29.9** | 41 (34.5) | 127 (57.6) | 1.20 (.67-2.17) | 0.99 (0.50–1.98) | 0.975 |
| | **≥30** | 56 (47.1) | 28 (11.8) | 7.45 (3.88-14.33) | 6.36 (2.90–13.93) | <.001* |

**Note. COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval. *Significant at p < 0.05.**

### 8.1.6. Discussion

This study examined the determinants of hypertension among military patients with Type 2 Diabetes Mellitus (T2DM) in Addis Ababa, Ethiopia. This research presents extremely significant insights into the specific risk factors affecting a specific and typically medically underserved population. The multivariable logistic model applied in this study indicated several strong predictors of hypertension among this unique population: older age, longer duration of diabetes, poor knowledge of hypertension, exposure to combat/mission under high stress, very high self-reported levels of work-related stress, active tobacco smoking, hypertension family history, and BMI.

The study identified advanced age as a predictor of hypertension among military patients with T2DM in Addis Ababa. This is consistent with an internationally established epidemiological trend. The association between high age and hypertension is a globally documented phenomenon, which largely reflects intrinsic physiological cardiovascular alterations, such as arterial stiffness and endothelial dysfunction, which occur during aging[77].

Research involving military veterans consistently validates this trend by age. For example, a UK national study comparing non-veterans with veterans indicated that the prevalence of hypertension increased steeply with age in veterans. The most prevalent age groups were the older ones, at 43.4% in the 88–96 age group and 29.4% in the 78–87 age group, with statistically significant differences among age groups ($p<0.01$)[78]. Similarly, research among diabetic veterans revealed that the presence of ischemic heart disease (IHD), an illness strongly linked to hypertension, was significantly more prevalent among those who were older (mean age 65 years) than those diabetic veterans without IHD (mean age 62 years)[79]. This suggests that the combined effects of aging, perhaps compounded by military service-related conditions, explain higher hypertension among older veterans.

This hypertension-age relationship is similarly highly relevant in the general African and Ethiopian populations. According to community-based cross-sectional studies conducted in Addis Ababa, the city where the current study was done, odds for hypertension were found to rise dramatically with age. Adults aged 40–54 years had an Adjusted Odds Ratio (AOR) of 8.97, and adults aged 55–64 years had an even higher AOR of 19.28, compared to adults aged 18–24 years[77]. Further results from Addis Ababa reported a remarkably high rate of hypertension at 58.69% in individuals aged ≥50 years, compared starkly with 12.86% for the 18–29 years age group[80]. Older age ranges (60–69 years and 70–74 years) were the strong independent predictors of elevated 10-year cardiovascular disease (CVD) risk in patients with hypertension in Eastern Ethiopia[81]. Another study from Dessie, Ethiopia, also reiterated the role of age as the key predictor of the onset of hypertension[82]. However, one section of the Dessie study presented a contradictory AOR of 0.5 for individuals over 60 years, which would suggest a protective effect[82]. Such specific outlier could represent unique

characteristics of that particular subgroup or methodological differences not clearly spelt out in the available information, which warrant careful interpretation.

The consistent observation of older age as a significant determinant in global military, overall African, and some Ethiopian populations attest to its role as a central, immutable biological variable in the etiology of hypertension. Such pervasive effect attests that while military service introduces unique occupational stressors, the physiological effects of aging itself remain the predominant cause of hypertension. For service members, particularly those with preexistent disease such as T2DM, advancing age is an amplified risk category that mandates increased alertness. The strong age-related gradient in the burden of hypertension repeatedly demonstrated in the literature underscores the necessity for stratified screening practices along with more aggressive, proactive care for older service members and veterans. This is particularly relevant in patients with co-morbidities like T2DM, whose cardiovascular complications are already at higher risk. The "regular CVD risk screening for older patients" guideline is another rationale for adopting this aggressive approach, in the aim of identifying and treating risk early in this high-risk population[81].

The longer diabetes duration was identified by the study as an independent predictor of hypertension in military T2DM patients. This is a reminder of the complicated and often synergistic relationship between these two long-term conditions. Diabetes mellitus is itself an independent risk factor for CVD, and studies have indicated that diabetes doubles risk for CVD, and 75% and all of diabetic fatalities are caused by coronary artery disease[83]. Hypertension is a central part of this risk of elevated CVD.

In troops, the comorbidity of T2DM and hypertension is highly significant. Veterans are at greater statistical risk for developing both hypertension and T2DM compared to non-veterans[78]. A large proportion of male and female veterans (27% and 23%, respectively) both have both conditions diagnosed[78]. Other research indicates the optimal possible cardiovascular risk factor control, including for blood pressure, typically is more of an exception than a norm for diabetic veterans, the challenge in the management of these interrelated conditions being apparent[79].

The pathophysiologic relationship between the duration of diabetes and hypertension is well established. Long-term hyperglycemia, a characteristic of poorly controlled diabetes, leads to end-organ injury to vessels in the body and vessels in the kidneys. This impaired renal function subsequently causes fluid and waste retention, which in turn directly plays a role in increased blood pressure, establishing a "vicious cycle"[84]. The more extensive the diabetic history, the more severe this vascular and renal impairment. The most common long-term complications of diabetes are in fact microvascular and macrovascular damage-related[83]. Diabetes with hypertension also significantly accelerates renal damage and doubles the risk of other serious complications, such as retinopathy and metabolic syndrome[85].

That the duration of diabetes correlates with hypertension is a critical observation of the synergistic pathophysiological interaction between the two diseases. It implies that chronic hyperglycemia, over a period of time, plays a direct role in inducing progressive vascular and renal damage, thereby predisposing the patient to hypertension or exacerbating those with previously existing hypertension. This is not an association but a clear cause-and-effect phenomenon in which diabetic injury builds up and raises blood pressure. In T2DM patients in the military, the combined harm of diabetes-related vascular damage and the unique military-specific stressors (discussed in the next section) likely adds their risk for the development and suboptimal management of hypertension. This requires a combined active and intensive management of the two conditions together, rather than managing them independently.

Poor hypertension awareness was also found to be one of the major predictors in the research, suggesting that poor knowledge about the condition is able to hamper proper control and management. Lack of knowledge and awareness regarding hypertension, its signs and symptoms, as well as the available treatments is also recognized as a reason for poor treatment results[86]. The most important areas of knowledge deficiency are shared, with most patients unaware that after diagnosis, hypertension is a long-term condition or that it can lead to severe complications such as renal disease[87].

Most prominently, research demonstrates a causal effect between knowledge and health behavior: low hypertension knowledge has been found to be related to decreased likelihood of adopting a healthy way of life, including limiting salt intake in diet and weight loss [87]. Conversely, a statistically significant positive correlation was established between knowledge and compliance with drugs, highlighting the importance of well-informed patient involvement[86]. For instance, in one study, just 10.3% of the patients possessed high knowledge regarding hypertension, and there were significant knowledge gaps regarding drug compliance[86]. Level of education and source of information in Dessie, Ethiopia, were predictors of the incidence of hypertension, in that improved education and exposure to quality information can lead to greater health benefits[82].

However, the relationship between knowledge and prevalence can be complex. In one study of policemen in Ibadan, Nigeria, while nearly half of the respondents claimed fair knowledge of hypertension, good knowledge was statistically not found to be associated with hypertension prevalence[88]. That would mean that in certain environments, for example, high-stress occupations, it may not be sufficient to halt and treat hypertension based on knowledge alone because other factors may dominate the impact of awareness.

The finding that poor knowledge is a barrier to the management of hypertension, and the Nigerian police study observation that simply possessing "good knowledge" does not automatically translate into lower prevalence, marks a wide "knowledge-to-action" gap[88]. This gap is particularly apt in

high-pressure work environments like in the military. It suggests that barriers in the environment, such as demanding work schedules, unhealthy foods being available only at certain times, chronic stress, or self-perceived efficacy, might deter application of health-promoting behaviors even if people are aware of the hazards and evidence-based methods. The precise knowledge deficits, such as identification of hypertension as a chronic disease, complications, and importance of drug compliance, provide clear, actionable targets for educational programs[86]. In military members, these programs must be tailored not only to address these knowledge deficits but also to identify and help deal with the strange occupational difficulties and the potential barriers to medication taking that such members will face.

Combat/high-stress mission exposure and very high self-reported work-related stress were both identified as significant predictors of hypertension in the research. This highlights the extreme impacts of work-related exposures unique to military service. Exposures to military service, including combat exposure, and their sequelae, such as psychiatric disorders (PD) and traumatic brain injury (TBI), are well associated with hypertension[89]. Specifically, veterans with PD and/or TBI, which in most instances follow combat, had a greater than 1.35 times higher probability of having hypertension compared to non-veterans and other combat/non-combat veterans without PD/TBI[89].

Prospective studies are compelling evidence for the association. Large cohort study demonstrated that deployers from the military with repeated stressful exposure to combat were 1.33 times more likely to newly diagnose hypertension than were deployers not in combat[90]. This suggests a simple causal relationship, although previously some older cross-sectional studies had shown no relationship, possibly due to the transient nature of the acute stress response or hypertension resolution before examination[90]. Physiological mechanisms underpinning the relationship between stress and hypertension are clearly understood, including secretion of stress hormones like corticoids, changes in neurotransmitters like dopamine, and changes in electrolyte balance[90]. Chronic stress may cause chronic elevation of blood pressure, with related long-term risk[90].

Experiences of emergency service personnel, such as police officers, offer an immediate analogy to military personnel. These occupations involve strenuous labor, long hours of work, uneven and high-stress incidents, and sleep deprivation, all of which contribute to hypertension[88]. Post-Traumatic Stress Disorder (PTSD), a common result of war, is also a recognized risk factor for hypertension among these populations[88]. Furthermore, a civilian study demonstrated that an extended occupation of a combat area negatively impacted the course of both hypertension and T2DM, leading to more advanced and uncontrolled conditions, directly linked to chronic wartime stress[91]. This indicates the direct negative impact of a war environment on chronic disease process.

In particular, in the direct opposite of the current study's military-specific results and general global military literature, even a typically-populated Addis Ababa study in the same context as the current

study found no significant association between total psychological stress and hypertension in its multivariable logistic regression analysis[77]. This finding stands in direct opposite to the current study's military-specific results and general global military literature. This difference strongly emphasizes the unusual and extreme nature of military occupational stress. Combat and high-stress operations involve stressors, such as immediate threat to life, exposure to violence, extended state of alertness, sleep loss, and development of chronic conditions like PTSD, that are qualitatively and quantitatively different from common civilian mental stress[88]. This distinction is significant in explaining the distinctive pathogenesis of hypertension in military troops. This finding categorically justifies that military service, especially with combat or stressful tasks, has immense and often long-term health impacts aside from the usual immediate bodily harm. This specifically accounts for the increased risk for long-term conditions like hypertension. This demands energetic and concerted efforts by military medical systems, such as robust mental health treatment, stress reduction programs, and post-deployment medical screening during the period of military service and into veteran existence. These actions are not just for mental health but are straight-out approaches to disease prevention and management of chronic ailments.

This study concluded that tobacco smoking was a strong predictor of hypertension, which is consistent with public health evidence on a global level. Tobacco smoking has been known and well-established as a modifiable risk factor for hypertension and cardiovascular disease (CVD) in general around the world. It has been extensively documented as detrimental to vascular health. In military veterans, smoking prevalence is high. In one study, 11.8% of veterans were smokers versus 10.6% of non-veterans[78]. Although the absolute difference in smoking prevalence was not always statistically significant, smoking was associated significantly with hypertension in veterans[78]. A second study also presented current smoking status data for various veteran populations[89]. In emergency responders such as police officers, tobacco smoking was found to be part of a cluster of negative preventive behaviors, including excessive alcohol and unhealthy food intake[88].

The effect of smoking is also seen in the local context. In Eastern Ethiopia, smoking was found to be a significant independent predictor of 10-year CVD risk in hypertensive patients, with an Adjusted Odds Ratio (AOR) of 3.44[81]. Current smoking was found in 4.2% of participants in Addis Ababa, with a significantly higher hypertension prevalence of 34.67% among smokers versus non-smokers[80]. The ongoing rapid epidemiological transition in low- and middle-income countries (LMICs) such as Ethiopia, with a drift towards non-communicable diseases (NCDs), is partially explained by the rising prevalence of risk factors including tobacco use[77]. One study on the general adult population of Addis Ababa did not, however, find smoking to be significantly associated with hypertension in its multivariable logistic regression analysis, perhaps due to small differences or low sample size[77]. This suggests that although smoking is an established risk factor, whether or not

smoking is statistically significant in a multi-variable model may depend on other strong covariates or population-level characteristics.

The consistent finding of current tobacco smoking as a major determinant across global, military, and Ethiopian contexts identifies current tobacco smoking as a persistent modifiable risk factor for hype rtension that is significant. This makes the presence of strong tobacco cessation programs in the Ethiopian military not only urgent but also constantly necessary. Though there are awareness campaigns, smoking is one of the unhealthy behaviors that is still prevalent in different populations, including military and emergency response populations[78]. This is indicative of the ongoing difficulty of controlling behavioral risk factors.

Family history of hypertension was also seen as an important predictor in this study, suggesting a genetic or inherited susceptibility to the disease. Family history of hypertension is generally accepted as a non-modifiable risk factor for hypertension in various populations worldwide[82]. It indicates the effect of genetic factors that predispose the individual to elevated blood pressure. Consistently, a study of police officers in Ibadan, Nigeria demonstrated that participants with a family history of hypertension had a much higher risk of hypertension. This boarder sample was 9 times more likely to be hypertensive than participants without family history of hypertension[88]. This notable association illustrates the investigational merit of examining genetic susceptibility even within a cohort of occupational health.

Likewise, in Dessie, Ethiopia, family history of hypertension was also directly recognized as a predictor for the presence of hypertension (AOR 2.3)[82]. The consideration of hypertension in Black populations also emphasizes intricate genetics, with particular mutations (CACNA1D, KCNJ[81]) and an increased prevalence of bilateral adrenal hyperplasia in Primary Aldosteronism (PA), a prevalent cause of secondary hypertension[92]. This suggests a genetic factor that is likely to be of particular significance in African populations.

The finding of family history as a consistent predictor in the present study and other African settings strengthens the fundamental role of genetic predisposition in the development of hypertension. This has direct relevance to early risk stratification and prevention. Military personnel and recruits with a positive family history of hypertension need to be identified early for more intense screening and targeted preventive counseling, even prior to the development of other modifiable risk factors. With the strong genetic component, especially in African populations[92]. the identification of persons with family history enables personalized preventive measures. Being aware of a patient having a family history of hypertension should prompt more vigorous and earlier treatment of modifiable risk factors (diet, exercise, stress management, and smoking cessation)[82]. For military personnel, this potentially means more frequent blood pressure checks, more proactive lifestyle counseling, and more vigilant screening, all recognized manifestations of hypertension, which in turn, may help mitigate

both genetic and occupational risk factors. This suggests a movement toward individualizing and proactively mitigating the risk of hypertension in the healthcare of military personnel, particularly by using genomic information to identify and selectively care for at-risk service members.

Overall, findings of the study imply a multi-layered and multi-faceted interaction between universal lifestyle and biological hazard factors, specific and heavy occupational hazards of military service, and regional epidemiological and biological specifics. The similarity of findings in worldwide military populations, general African populations, and the Ethiopian context is striking. The results of the studies on older age, smoking tobacco at present, and family history of hypertension are all strongly in favor of universally recognized and consistently observed determinants of hypertension in widely varying populations[77]. This confirms that while there are some occupational factors, the root lifestyle and biological risk factors for hypertension are always identical. The profound comorbidity of hypertension and T2DM, and the harmful influence of diabetes duration on cardiovascular morbidity, are similarly consistent with global insight into chronic disease development and additive harmful effects[78]. This highlights the complex health profile of military T2DM patients.

A key element of the study's findings is the military population determinants. The independent significance and contribution of combat exposure and traumatic work-related stress is an essential determinant specific to military personnel[88]. This finding is particularly significant compared with civilian populations non-military in nature in which psychological stress does not necessarily emerge as an independent predictor[77]. This dramatic divergence is a reflection of the unique and extreme nature of military occupational hazards such as immediate life threats, prolonged periods of high-arousal states, and the resultant psychological sequelae such as PTSD. These stressors necessitate military-specific stress management and mental health interventions that are integrated into routine healthcare. Direct comparison across worldwide, military, and regional settings determines hypertension determinants are not cumulative. While some determinants like age and smoking are worldwide consistent, the military environment consists of certain compelling stressors that are qualitatively distinct from universal civilian stress. Regional lifestyle and biological variables contribute an added dimension. This means that an Ethiopian military patient with T2DM is subject to a specific group of risks demanding an extremely sensitive and interrelated health strategy.

African and Ethiopian realities provide further details. The broader regional context indicates that the Eastern Mediterranean Region (EMR), which encompasses Ethiopia, bears a higher burden of hypertensive heart disease compared to what is the case at the global level[93]. The epidemiological fact serves to underscore the heightened public health issue of hypertension for this specific geographic area. Some biological traits that are more prevalent among Black populations, such as higher incidence of primary aldosteronism and salt sensitivity, may be involved in the overall hypertension burden within Ethiopia[92]. The present study did not quantify these factors, but

elucidation of these predispositions at a genetic and physiological level is necessary to a complete, population-level representation of risk for hypertension and for purposes of creating targeted treatment protocols. Regional lifestyle conditions, such as khat chewing, identified as a risk predictor for CVD among hypertensive individuals in Eastern Ethiopia, are a unique regional priority. Although not specifically delineated as a causative determinant of hypertension in the current military sample, prevalence within the general population suggests that it may affect the general cardiovascular status of military personnel and should be the subject of further research and targeted health education. Ethiopia, as well as other low- and middle-income countries, is going through a fast epidemiological transition with increased NCD burden[77]. The reason primarily lies in factors such as economic growth, dietary changes, and growing population aging, providing a general context for increased endemicity of hypertension in the country. Persistent predictors in Addis Ababa also include male sex and obesity, which represent more general public health concerns[77].

The specification of "poor hypertension knowledge" as a determinant, along with the "knowledge-to-prevalence" gap apparent in some African environments[88], suggests that education interventions will have to be appropriately adapted to local culture and explicitly address practical barriers to behavior change. With respect to military personnel, this means that health education programs must be structured to be deliverable in the hard and sometimes constraining military environment, ensuring that knowledge is reinforced by long-term healthy habits and medication adherence.

Obese patients were by far the most likely to be hypertensive: BMI ≥30 conferred over six times the odds of hypertension compared to BMI <25. This is concordant with extensive evidence that obesity dramatically raises blood pressure. Epidemiological studies have repeatedly shown a multi-fold increase in hypertension risk with higher BMI. For instance, a study by Ibirongbe investigated the prevalence and predictors of hypertension among army personnel in Adekunle Fajuyi Military Cantonment, Ibadan, Nigeria. The results revealed a significant hypertension burden, with overweight/obesity as key risk factors. Overall, obesity may account for a majority of hypertension cases in some populations. The physiological mechanisms (increased sympathetic tone, renal sodium retention, etc.) are well described, and our finding of a ~6-fold risk fits this pattern.

## Implications and Recommendations

The findings from this study, when set in the context of the broader literature, have significant public health and clinical implications for Ethiopian military health services. Such implications call for strategic interventions in order to tackle the expanding burden of hypertension among this group.

Clinical and Public Health Implications for Ethiopian Military Health Services

T2DM patients in the military form an especially vulnerable group at risk for hypertension in Ethiopia and are exposed to the cumulative metabolic disease burden, occupation-based stress, and overall

population risk factors. The intimate interactions between duration of diabetes, hypertension, and cardiovascular complications necessitate care pathways that simultaneously treat T2DM and hypertension, departing from treatment silos[79].

The significant contribution of combat exposure and occupational stress to mental health casualties highlights the need for aggressive occupational health programs within the Ethiopian military. Stress management, routine cardiovascular screening, and mental health counseling would be mandatory interventions for all personnel, with specific attention to those with combat experience or assigned high-stress duties. Moreover, the unavailability of hypertension knowledge characterizes a prominent health literacy deficit that can sabotage optimal self-management and treatment compliance with direct implications for patient education interventions.

## Targeted Interventions and Strategies

In light of these considerations, several targeted interventions and strategies are recommended:

Early Risk Stratification and Screening: Based on the fact that hypertension is highly correlated with increasing age and family history, regular and intensified screening for hypertension must be promoted for military officers in their later years and those with a positive family history, even in the absence of any other apparent symptoms[81]. Early diagnosis and intervention may become simpler through this preventive strategy. In combat patients who are already diagnosed as having T2DM, intensive control of blood glucose and early, careful detection of hypertension are crucial. This will address the additive and synergistic effect of a greater duration of diabetes on cardiovascular risk and on the development of complications like nephropathy[83].

Comprehensive Stress Management Programs: The immense effect of combat experience and occupational stress requires the integration of robust mental health and stress management programs into military healthcare policy. These must be implemented throughout the entire spectrum of a military career, from recruitment and training through active duty and on into veterans' care. They must be designed to address the unique psychological and physiological stressors inherent in military living, including prevention and treatment of Post-Traumatic Stress Disorder (PTSD) and Traumatic Brain Injuries (TBI)[88].

Enhanced Health Education and Behavioral Change Interventions: These educational programs must be fashioned to explicitly address the determined gaps in knowledge regarding the chronicity of hypertension, its dire consequences (e.g., kidney disease, stroke, heart attack), and the stark necessity of adherence to medications and drugs[86]. These programs must also strongly promote healthful ways of life, such as comprehensive tobacco cessation programs[81], healthy diet (emphasizing reduced salt and fat intakes, and augmented vegetable intake), and exercise[80]. Above all, these interventions must be made realistic and executable in the functional realities and busy time scales of

military life. Given the prevalence of khat chewing in the area, health education regarding its potential cardiovascular risks has to be considered and incorporated in military health promotion[80].

Policy and Environmental Support: Policies in the military need to be reviewed and adjusted to actively promote healthier food environments inside barracks and during deployment, available opportunities for frequent physical activity, and adequate rest and sleep for personnel, which play a basic role in risk management for hypertension and overall health[77]. The unique occupational requirements such as shift work and prolonged hours, also need to be considered while formulating and adopting all the health promotion and disease prevention strategies[88].

## Fields for Future Study

Some fields need more study to further improve the determinants of hypertension in the current population and maximize intervention strategies:

Longitudinal Research on Military Stress: Conduct prospective, longitudinal studies among the Ethiopian military cohort to further ascertain the long-term, cumulative effects of exposure to combat and chronic occupational stress on the incidence, development, and control of hypertension, with special attention to participants with co-morbid T2DM. This would provide more evidence of causality.

Intervention Effectiveness Research: Evaluate the effectiveness rigorously of particular education interventions and longer stress management interventions specific to Ethiopian military personnel on salient outcomes such as hypertension knowledge, medication adherence, lifestyle modifications, and ultimately blood pressure control.

Genetic and Environmental Interactions: Investigate the interaction of specific genetic predispositions (e.g., salt sensitivity, primary aldosteronism in Black populations, as highlighted in [92]) with occupational and environmental determinants in causation and severity of hypertension among Ethiopian soldiers. This can be applied to adapt prevention strategies.

Khat Chewing and Hypertension: Further research is needed to directly assess the causal relation and direct impact of khat chewing on prevalence, incidence, and control of hypertension among the Ethiopian military population, due to its regional prevalence and reported cardiovascular consequences[80].

Qualitative Examinations of Barriers and Facilitators: Conduct qualitative studies to explore the lived experience of military staff regarding occupational stress, healthy lifestyle options available, and perceived facilitators and barriers to hypertension management and compliance in their individual operational setting. This would provide rich descriptions to facilitate more patient-centered interventions.

## 8.1.7. Conclusion and Recommendations

### Conclusion

The present study identified some of the most important determinants of hypertension in type 2 diabetes mellitus patients attending the Armed Forces Comprehensive Specialized Hospital in Addis Ababa. Modifiable and non-modifiable determinants were found to be significantly associated with a greater risk of hypertension among them. In particular, advanced age, longer diabetes duration, poor knowledge about hypertension, multiple combat exposures or more frequent high-stress deployments, very high work stress, active tobacco use, and family history of hypertension were all independently linked with greater odds of hypertension.

These results highlight the necessity of highly focused, intensive interventions in terms of health education to enhance the knowledge of hypertension, encouragement towards smoking cessation, and provision of psychological counseling to manage occupational stress. Furthermore, early detection and repeated screening for hypertension must be incorporated into diabetes care, especially among those with diabetes duration, older age, and combat-exposure stressors. Management of risk factors will enhance cardiovascular and all-around health outcomes in this military high-risk population.

### Recommendations

1. Enhance Hypertension Awareness and Knowledge in Military Patients

The implications of this study necessitate enhancing the awareness of hypertension in military patients with type 2 diabetes mellitus. Ignorance was strongly correlated with higher odds of having hypertension, implying that ignorance of sufficient knowledge of the disease and risk factors could be a barrier to prevention. Routine regular health education sessions should thus be incorporated into the standard diabetes care by military health centers. . Education programs need to be modified to fit military culture, given the special stressors and environmental demands of military lifestyles. Use of peer-based models of education, visual presentations, and interactive workshops may enhance motivation and long-term retention of information.

2. Foster Holistic Lifestyle and Behavior Change Programs

Reversible lifestyle risk factors of smoking and physical inactivity were the important predictors of hypertension in this study. Therefore, the military's health services need to develop and implement behavior change interventions that include these risk factors. Tobacco cessation services should be universally available, like counseling, pharmacologic therapy, and peer support groups. Physical fitness should be encouraged not just as combat fitness but also as an intrinsic way of preventing chronic diseases. Individualized nutrition counseling, group fitness classes, and healthier food choices in military dining facilities can complement these activities. Furthermore, a wellness culture

within military organizations where avoidance of health issues is prioritized an encourage the practice and sustenance of healthy behaviors among military personnel.

3. Combat Occupational and Combat-Related Stress through Integration of Mental Health

This research demonstrated a strong correlation between hypertension and both regular exposure to combat/high-stress missions and job stress as reported by the participants. Mental health support and stress management must be included in disease management for chronic diseases in military patients. Regular screening of psychological stress, burnout, and PTSD should become institutionalized. Targeted intervention, such as stress reduction workshops, training in resilience, relaxation methods (e.g., mindfulness, breathing exercises), and access to mental health experts, must be provided by military hospitals. Unit leadership and command levels must be made sensitive to the health risk of unresolved stress and encouraged to establish supportive environments where soldiers feel comfortable coming forward for assistance without stigma or risk of professional penalty.

4. Improve Risk-Based Screening and Early Identification of Hypertension

Since older age, longer diabetes duration, and family history were strongly associated with hypertension, effective screening programs must be initiated to detect persons at risk at an early stage. Risk stratification instruments may be employed to prioritize individuals for follow-up and preventive intervention. Periodic blood pressure measurement must be included in all diabetes follow-up visits, and electronic health records can be utilized to mark high-risk patients for heightened surveillance. Early control through lifestyle modification, drug treatment, and referral to specialists is capable of effectively decreasing the prevalence of severe hypertension and its complications. In addition, training for healthcare professionals in hypertension risk assessment and guidelines-directed e vidence-based treatment must be enhanced to promote evidence-based care.

5. Formulate and Execute Military-Specific Chronic Disease Management Policies

The soldiers' special work environment requires context-specific policies and procedures for managing chronic conditions like diabetes and hypertension. National defense health authorities must create context-specific guidelines incorporating diabetes and hypertension care in the context of combat exposure, stressful conditions, and constant rotations. Policies must deal with a multi-disciplinary response involving general practitioners, endocrinologists, cardiologists, mental health personnel, and unit commanders. Steps should also be employed to enhance continuity of care for frequently transferred military patients between units or regions. Health information systems should be enhanced to allow for easy sharing of information across facilities in order to offer coordinated and consistent care.

6. Encourage Additional Research on Hypertension and Associated Risk Factors within Military Environments

Although this research is beneficial, additional research should be done to enhance knowledge concerning hypertension among military populations. Longitudinal research will be able to determine causality and assess intervention effect on modifiable risk factors in the long term. Qualitative research regarding lived experience, perceived stress, and health-seeking behavior among military personnel with diabetes and hypertension can also yield insightful context for developing effective interventions. Examinations of the relationships between occupational determinants and behavioral, psychosocial, and genetic determinants will also be critical to planning prevention programs. At some point in the future, studies should attempt to recruit larger, more representative military samples across various military branches and geographic locations in order to allow for greater generalizability.

### 8.1.8. Reference


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# Annexes

## 1. Questionnaires for AWD Outbreak Investigation in Afar region, Ethiopia

| No. | Question | Classification |
|---|---|---|
| 1.1 | Status of respondent | 1. Case 2. Control |
| 1.2 | Responder name | _____ |
| 1.3 | Address | Region_____Zone_____<br>Woreda_____<br>Kebele_____Goti_____House No_____ |
| 1.4 | GPS coordinate of the house | Latitude_____Longitude_____ |
| 1.5 | Ethnicity | 1. Oromo 2. Somale 3. Tigre<br>4. Gurage 5. Amhara 6. Walayita<br>8. Other(Specify)_____ |
| 1.6 | Age | _____Year (s) _____Month(s) |
| 1.7 | Sex | 2. Male 2. Female |
| 2.1 | Occupation | 1. Farmer 2. Merchant 3. Student 4. House wife<br>5. Unemployed 6. Pastoralist 7. Gov't Employee<br>8. Private Employee 9. Daily Laborer<br>10. Not applicable<br>11. Other_____ |
| 2.2 | What is your religious | 1. Orthodox 2. Protestant 3. Muslim<br>4. Catholic 5. other_____ |
| 2.3 | What is your marital status? | 1. Single 2. Married 3. Widowed 4. Divorced 5. NA |
| 2.4 | Level of Education | 1. Illiterate 2. Read and writing only<br>3. Elementary school (1-8) 4. Secondary School(9-12)<br>5. Tertiary School (college+) 6. NA |
| 2.5 | How many family members residing with you? | _____ |
| 2.6 | Do you know transmission means of AWD? | 1. Yes 2. No |
| 2.7 | How do you think acute watery diarrheas transmit from person to persons (none proving)? | 1. Contaminated food 2. Contaminated water<br>3. Contact with patient 4. Other(specify) _____ |
| 2.8 | What are you doing when you face acute watery diarrhea (none proving)? | 1. Go to health facility 2. Seek traditional healer 3. Use ORS 4. Use holy water 5. Stay at home 6. Other(specify) |
| 2.9 | Do you think AWD treatment center is source of infection/possible risk factor for AWD transmission? | 1. Yes 2. No 3. I don't know |
| 2.10 | Do you think AWD is preventable disease? | 1. Yes 2. No 3. I don't know |
| 2.11 | How do you prevent AWD (none proving)? | 1. Using toilet 2. Eating cooked food 3. Using purified water<br>4. Hand washing 5. Vaccine 6. Other(specify) _____ |
| 2.12 | How often do you wash your hands in a day? | 1. Before eating 2. After visiting latrine 3. After washing child's defecation 4. After contact with dirty materials<br>5. others |
| 2.13 | Have you ever been sick of AWD? | 1. Yes 2. No |
| 2.14 | How many times you were sick of AWD in the last one year? | 1. Once 2. Twice<br>3. More than two times |

| | | |
|---|---|---|
| 2.15 | Date and year of last sickness with AWD? | _____dd/mm/yyyy I don‘t know |
| 2.16 | Where did you get treatment (none proving)? | 1. At health facility 2. At home 3. At holy water site 4. Traditional healer 5. Others,_____ |
| 2.17 | How long you were sick of the diseases? | _____days |
| 2.18 | Was there sick family member of AWD in the past 5 years with the same complaints? | 1. Yes 2. No 3. Not Applicable |
| 2.19 | Age and sex of family members affected. | 1.___M/F ___2 __M/F____3.__M/F_____4. __M/F _____ 5.__M/F _____ |
| 2.20 | Was there death in your family due to AWD in the past 5 years? | 3. Yes 2. No |
| 3.1 | Do you have history of acute watery diarrheal disease recently? | 1. Yes 2. No |
| 3.2 | When did the symptoms begin? | _____dd/mm/yyy _____hour |
| 3.3 | Frequency of defecation per day | _____times |
| 3.4 | Do you have the following symptoms? | 1. Watery diarrhea 2. Vomiting 3. General body weakness 4. Loss of consciousness 5. Muscle cramp 6. Other(specify)_____ |
| 3.5 | Have you been treated with antibiotic for your recent complaints? | 1. Yes 2. No |
| | What antibiotics did you take? | 1. _____ 2. I don‘t know |
| | Where did you take the antibiotics? | _____ |
| | Where did you admit | 1. CTC 2. Hospital 3. Private clinic 4. Others (specify), _____ |
| | Is there any sick other person in your house? | 1. Yes 2. No |
| | If yes, is that before or after your symptoms began? | 1. Before, 2. After 3. At the same time |
| | Is there AWD sick person in your village? | 1. Yes 2. No 3. I don‘t know |
| | Did you have contact history with the same compliant in the past 5days before your symptoms onset | 1. Yes 2. No |
| 2. | **Travel and Exposure History** | |
| | Did you travel in the past 5 days outside of your village before your symptoms onset? | 1. Yes 2. No |
| | If, yes where | |

| | | |
|---|---|---|
| | | _____ |
| | Did you participate in funeral ceremony of AWD death | 1. Yes 2. No |
| | When did you participate in funeral ceremony of AWD death | _____dd/mm/yyy |
| | Where did you participate in funeral ceremony of AWD death | _____ |
| | Did you attend other public ceremonies /events(weeding, religious, bather , telethon) | 1. Yes 2. No |
| | h. What kind of food did you served at the ceremonies/ event? | |
| | What kind of drink did you served at the ceremonies/ event? (if water, mention sources) | _____ |
| | Where do you defecate? | 1. Toilet 2. Open field |
| | If answer to Q6.1 is ―otilet‖ who own it? | 1. Private `2. Communal 3. Public |
| | show me the toilet | 1. Clean 2. Unclean<br>3. Ventilated 4. Sign of utilization |
| | If the answer to question number 6.1 is OFD, can you tell me the reason? | 1. No toilet 2. Culture 3. Bad odor<br>4. Fear of falling down 5. Too far from my house<br>6. Physically damaged (toilet) 7. Other(specify)_____ |
| | Is there facility to wash your hand after defecation near toilet? | 1. Yes 2. No |
| | When do you wash your hand (none proving)? | 1. After toilet 2. Before food 3. After cleansing child<br>4. Before preparing food 5. Before feeding child<br>6. Other(specify) _____ |
| | What items are you using for hand washing? | 1. Plain water 2. Soap 3. Ash<br>4. Other(specify)_____ |
| | What is the water source for your house hold for drinking purpose? | 1. Pipe water 2. Spring 3. Hand dug well 4. Deep well<br>5. Pond 6. River 7. Lake 8. Bottled water<br>9. Other(specify) ____ |
| | What is the water source for your house hold for washing utensils? | 1. Pipe water 2. Spring 3. Hand dug well<br>4. Deep well 5. Pond 6. River 7. Lake<br>8. Other(specify)__ |
| | What is the water source for your house hold for cooking food? | 1. Pipe water 2. Spring 3. Hand dug well<br>4. Deep well 5. Pond 6. River 7. Lake<br>8. Other(specify) _____ |

| | | |
|---|---|---|
| | How many hours/minutes will take you or your family to fetch water from the water source? | _____hours _____minute I cannot estimate |
| | What type of container are you using to fetch water from the source? | 1. Jerry cane 2. Bucket 3. Ensira (Gan) 4. Other(specify) _____ |
| | What type of water container are you/your family is using in your house for storage? | 1. Jerry cane 2. Bucket 3. Ensira (Gan) 4. Rotto 5. Other(specify) _____ |
| | How was the water accessed from the storage container? | 1. Pour 2. Dip with cup 3. Other specify____ |
| | Does the container have cover/lid (observe)? | 1. Yes 2. No |
| | Do you clean your water containers regularly? | 1. Yes 2. No |
| | What materials do you use to wash your water containers? | 1. Soap 2. Only water 3. Ash 4. Other(specify) _ |
| | How often do you wash your water containers? | 1. Every day 2. Every other day 3. Once per week 4. Other(specify) _____ |
| | Do you think the water you are using is safe? | 1. Yes 2. No |
| | Could you purify the water? | 1. Yes 2. No |
| | What methods of water purification do you use (none proving)? | 1. Boiling 2. Filtration 3. Sedimentation 4. Water chemicals 5. Other specify_____ |
| | For what purposes do you purify water (none proving)? | 1. For drinking 2. For cooking 3. For washing hand 4. For cleaning food utensils 5. Other(specify)_____ |
| | Is there water purification chemical available in your community? | 1. Yes 2. No |
| | What is the cultural food in your area? | 1. Rice 2. Enjera with wot 3. Porridge 4. Bread 5. Other(specify) _____ |
| | Do you eat raw/uncooked food? | 1. Yes 2. No |
| | In the past 5 days of your symptoms onset what kind of uncooked food did you eat? | 1. Raw meat 4. Raw green vegetables 2. Raw tomato 5. Raw fish meat 3. Raw milk 6. Other(specify) ____ |
| | What kind of cooked food did you eat in the past 5 days of your symptoms onset? | 1. Enjera with wot 2. Roasted meat 3. Other(specify) ___ |
| | Do you re-heat cooked food if not eaten immediately? | 1. Yes 2. No |
| | Where do you keep the cooked food? | 1. Room temperature 2. Refrigerator 3. Other(specify)_____ |
| | What are you doing with the leftover foods (none proving)? | 1. Reheat and eat 2. For domestic animals 3. Giving for beggars 4. Street children 5. Dump in waste substance 6. Other(specify) _____ |
| | Is there fish supply in your village? | 1. Yes 2. No |
| | Do you eat raw fish? | 1. Yes 2. No |
| | Did you eat food from other house in the past 5 days of your symptoms | 1. Yes 2. No |

## 2. Questionnaire of NCD surveillance system evaluation in NifasSilk Lafto Sub-city, Addis Ababa, Ethiopia

**PART ONE:**

**A. Communication and reporting system assessment**

1. Which communication material did you have? □E-mail □wired phone □mobile □radio □Fax □, Other----------

2. Did you have the address of the Health Center PHEM officers? □Yes □No

3. How frequently do you communicate with the Health Center PHEM officers on emergencies and NCD daily activities? □Daily □weekly □every 2 weeks □monthly □quarterly □every 6 months □yearly □others----------

4. When are you expected to send the weekly report to the zonal PHEM unit? □Monday □Tuesday □Wednesday □Thursday □Friday □Saturday □Sunday

5. When are you expected to receive the weekly report from HCs? □Monday □Tuesday □Wednesday □Thursday □Friday □Saturday □Sunday

6. How is the zonal PHEM communicating the woreda PHEM officers in case of immediately reportable diseases? □by e-mail □by phone □by fax □regular weekly report □others

7. Did you send a summary or short report to the administrative /program leaders or other responsible organs on planning, prevention, and control activities addressing Important issues at the community level that have arisen through the surveillance system? □□Yes □□No

8. If the answer to Q7 is yes, to whom did you send? ----------

**Section A: Stakeholder Engagement**

Are you involved in any aspect of the NCD surveillance system? (Yes / No)

What is your primary role in the system? (Health worker / Data manager / Supervisor / Other)

Have you ever participated in a meeting or training related to NCD surveillance? (Yes / No)

How often are stakeholders consulted in NCD surveillance activities? (Frequently / Occasionally / Rarely / Never)

Is your feedback considered in improving the surveillance system? (Always / Sometimes / Rarely / Never)

**Section B: System Description and Design**

6. Are there written objectives for the NCD surveillance system? (Yes / No)

7. Are the data collection tools standardized across facilities? (Yes / No)

8. What methods are used for reporting NCD cases? (Paper-based / Electronic / Both)

9. Are clear case definitions used for reporting NCDs? (Yes / No / Not sure)

10. Are the NCDs under surveillance clearly defined by the system? (Yes / No)

**Section C: Usefulness**

11. Have the data been used to plan or modify NCD programs? (Yes / No)

12. Are surveillance data used for decision-making at your level? (Yes / No / Not sure)

13. Has the surveillance system contributed to reducing the NCD burden in the area? (Yes / No / Not sure)

14. Do you believe the data collected is useful for intervention planning? (Yes / No / Somewhat)

15. Are data ever used to monitor health inequities across different groups? (Yes / No / Not sure)

**Section D: Simplicity**

16. How easy is it to complete a reporting form? (Very easy / Moderate / Difficult)

17. How long does it take to complete a single report? (<5 min / 5–10 min / >10 min)

18. Do staff require special training to understand the reporting forms? (Yes / No)

19. Is the process of case identification and reporting clear? (Yes / No / Partially)

20. How many levels are involved in forwarding reports? (1 / 2 / More than 2)

**Section E: Flexibility**

21. Can the system incorporate new NCD conditions easily? (Yes / No / Not sure)

22. Has the system ever adapted to new reporting requirements? (Yes / No / Not sure)

23. Is the system capable of integrating with other surveillance platforms? (Yes / No / Not sure)

24. Have there been modifications in the case definitions or data elements? (Yes / No)

25. Are you confident the system can handle emergency health threats? (Yes / No / Not sure)

**Section F: Data Quality**

26. How often are all fields on the report forms completed? (Always / Sometimes / Rarely / Never)

27. Are there quality checks in place before data are submitted? (Yes / No / Not sure)

28. Are blank or missing fields common in submitted reports? (Often / Rarely / Never)

29. Is the data consistent across all health facilities? (Yes / No / Not sure)

30. Is feedback provided to facilities when errors are found in reports? (Yes / No / Not sure)

**Section G: Acceptability**

31. Do most health professionals willingly participate in the system? (Yes / No / Not sure)

32. Is reporting viewed as a valuable activity by staff? (Yes / No / Mixed opinion)

33. Is there any incentive to participate in reporting? (Yes / No)
34. Are stakeholders satisfied with the current surveillance system? (Yes / No / Not sure)
35. Are there any known complaints about the reporting process? (Yes / No)

**Section H: Sensitivity**

36. Are all diagnosed cases of NCDs being reported? (Yes / No / Not sure)
37. Are missed cases ever identified through data review or audits? (Frequently / Occasionally / Never)
38. Are all reporting units (e.g., clinics, hospitals) included in surveillance? (Yes / No / Not sure)
39. Has the system successfully detected clusters or patterns of NCDs? (Yes / No / Not sure)
40. How effective is the system in detecting new or emerging NCD cases? (Very effective / Somewhat / Not effective)

**Section I: Predictive Value Positive (PVP)**

41. Are reported cases later confirmed as true NCD cases? (Always / Sometimes / Rarely / Never)
42. Are diagnostic criteria used consistently across reporting sites? (Yes / No / Not sure)
43. Is there evidence of over-reporting (false positives)? (Yes / No / Not sure)

**Section J: Representativeness**

44. Does the system capture data from all key population groups? (Yes / No / Not sure)
45. Are both males and females equally represented in the data? (Yes / No / Not sure)
46. Are data disaggregated by age, sex, and location? (Yes / No / Not sure)

**Section K: Timeliness**

47. Are NCD reports submitted within the required timeframe? (Always / Sometimes / Rarely / Never)
48. Is feedback from surveillance data analysis delivered on time? (Always / Sometimes / Rarely / Never)

**Section L: Stability**

49. Has the system had any interruptions in the last 6 months? (Yes / No)
50. Does the system operate consistently without data loss or failure? (Yes / No / Not sure)

**Unstructured (Open-Ended) Questions**

What do you think is the greatest strength of the current NCD surveillance system?
What are the main challenges you face when collecting or reporting NCD data?
Can you describe how surveillance data has been used in public health decisions?

What improvements would you suggest to simplify the reporting process?

Are there NCDs you think should be added or removed from the current system?

How is patient privacy maintained during data collection and reporting?

What type of support (training, resources, tools) would enhance your performance?

How reliable is the technology used in the surveillance system?

Are there areas or populations that are not well-covered by the surveillance system?

What are the common causes of data delays or non-reporting?

Describe the communication flow after data submission—who follows up and how?

Have you seen any tangible public health impact from the NCD data collected?

If you could change one thing about the current surveillance system, what would it be?

## 3. Questionnaire for Health profile description in Daltie Woreda, Oromia region

**1. Historical Aspects of the area (Culture and tourism office)**

1.1. District Name_____
1.2. How and why the name given_____
1.3. How and when the district was formed_____
1.4. Any other historical aspects of the district_____

**2. Geography and Climate.**

2.1. District map_____
2.2. Location (distance) _____direction) _____
2.3. Surface area of woreda_____ $KM^2$ (_____%from the zone)
2.4. Altitude_____
2.5. Town _____rural_____ (land)
2.6. Geographical coordinate
Latitude_____longitude_____
2.7. Annual rainfall (average) _____, annual temp (average) _____
Climatic zones_____ (%) _____ (%)_____(%)

**3. Political and Administrative Organization**

Total number of kebeles: _____
Rural kebeles _____
Urban kebeles _____

**4. Population and Population structures**

4.1 Demographic data
Total population _____Male_____ Female _____sex ratio_____
1. Urban Total _____Male _____Female_____
2. Rural Total _____Male _____Female_____
3. Population under 1yrs_____
4. Population under five year's _____
5. Population<15years_____
6. Population>64years_____
7. Women15_49yearsofage_____
8. Total population by kebele (each kebele population)_____
9. Population enumerated by H.E.Ws_____

Table1: Population data by age and sex

| Population data by age and sex | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Male | <1 | 1-4 | 5-10 | 11-24 | 25-34 | 35-49 | 50-64 | >65 |
| | | | | | | | | |
| Female | <1 | 1-4 | 5-10 | 11-24 | 25-34 | 35-49 | 50-64 | >65 |
| | | | | | | | | |

4.2. Ethnicity/language
Oromo _____(_____%)Hadiya_____(_____%),
Amara_____(_____%)Kanbata_____(____%)
Tigre_____(_____%)Others_____(_____%)
4.3.Religion
Orthodox_____(_____%),Muslim_____(_____%),

Protestant_____(_____%)Other_____(_____%)

**5. Economy (main stay of the economy, average income levels etc.)**

5.1. Main income sources

- Agriculture

- Cultivated area_____
- Grazing area_____
- Cropping seasons_____

- Livestock
- Trourism
- Trade
- Other business

**5.2. House hold income source**

1. Agriculture_____
2. NGO----------
3. Government Employer_____
4. Private Employer_____
5. Daily Labourer_____
6. Different business_____
7. Jobless_____

5.3. Average Income_____

**6. Education and school Health**

**6.1. Number of educational institution**

1. K.G._____
2. Primarily School (1-8) _____
3. Secondary School (9-10) _____
4. Preparatory School (11-12) _____
5. College/University_____
6. TVET_____
7. Total School Age Children (target population)_____
8. Total Enrolment _____Male _____Female_____

School dropout in 6months or yea r2023(2015E.C)_____

6.2. School health activities:

a) Water supply :Schools with water supply_____

: Schools without water supply_____

b) Latrine: schools with functional latrines_____

Male and female in separate wall: yes _____no_____

Hand washing facility with soap: yes _____no_____

Urinal facility for male students: yes _____no_____

Schools with anti HIV/AIDS clubs_____

Schools with primary eye care clubs_____

Schools with sanitation and hygiene clubs_____

**7. Facilities**

Accessibility (main roads) _____

Type of road_____

How many kebeles have access to transportation _____

Flow of transportation per day_____

How many people have access to fixed telephone? _____

How many people have access to mobile phone? (Coverage)_____

How many people get power supply_____?

Total no of kebeles: Rural _____Urban_____ District boundaries

North_____South_____

East_____West_____

**7.1. Infrastructure for health Facilities**

Transportation: Health facilities with all-weather roads_____
Health facilities with seasonal roads_____
Health facilities without road accessibility_____
Telecommunication: Health facilities with fixed telephone_____
Health facilities with access to mobile phone_____
Health facilities with internet access_____
Power supply: Health facilities with 24 hours power supply _____
Health facilities with solar power supply _____
Health facilities with generator power supply _____
Water supply: Health facilities with water supply in the premises(building)
_____
How many of the health posts have access to:
Transportation_____ (____ %), Telecommunication_____ (____ %),
Electric power_____ (____ %), Water supply_____ (____ %)
How many of the health centres have access to:
Transportation_____ (____ %), Telecommunication_____ (____ %),
Electric power_____ (____ %), Water supply_____ (____ %)

**7.2. Safe water coverage**

Kebeles getting safe water
a) Urban_____ (_____ %)
b) Rural_____ (_____ %)

Population getting safe water_____(_____%)
Table2: Main source of water

| Types of available water point | number | Kebeles it present |
|---|---|---|
| Treatment plant | | |
| Hand dug well | | |
| Shallow well | | |
| Borrow well | | |
| Medium spring | | |
| Small spring | | |

**Functionality of pipe line**

a) Functional--------
b) Not Functional--------
c) Under construction--------

**8. Disaster situation in the woreda**

Was there any disaster (natural or manmade)in the woreda in the last one year?_____
Any recent disease outbreak/other public health emergency_____
If yes, cases_____ and deaths_____

**9. Vital Statistics and Health Indicators**

Infant Mortality Rate (IMR) _____ (total<1yrdeathsthis2004yr_____
Child Mortality Rate_____ this year's total<15yrdeaths_____
Crude Birth Rate_____
Crude Death Rate_____ totaldeaths2004yr____
Maternal Mortality Rate_____2013 total maternal deaths_____
Contraceptive Prevalence rate_____

Contraceptive acceptance rate_____
ANC rate (how many of the total expected pregnancies attended 1st ANC)

_____
ANC rate (how many of the total expected pregnancies attended 4th ANC)

_____
Percentage of deliveries attended by skilled birth attendants_____
Percentage of deliveries attended by HEWs_____
Percentage of deliveries attended by TBA_____

**10. Health delivery system**

10.1. District Health Structure

10.2. Health Facilities

Table3: Available Health Facilities in the woreda

| Type | | number | Total number of bed |
|---|---|---|---|
| Gov.t hospital | | | |
| Gov.t health canter | Type A | | |
| | Type B | | |
| | Type C | | |
| Private health facilities | Clinic all type | | |
| | Diagnostic lab | | |
| | Drug stor | | |
| | pharmacy | | |
| Gov.t Health post | | | |
| NGOs | Health post | | |
| | Health centre | | |
| | Hospital | | |
| | clinics | | |

Health institution to population ratio:
Hospital: Pop_____ HC: Pop_____
HP: Pop_____ Health service coverage_____%

Table4: Human resources for health sector

| Types of Health professional | No. | Remark |
|---|---|---|
| Specialist | | |
| G.P | | |
| HO | | |
| Nurses(Degree and Diploma) | | |
| Midwife(Degree and Diploma | | |
| Laboratory(Degree and Diploma | | |
| Pharmacy(Degree and Diploma | | |
| Environmental Health(Degree and Diploma) | | |
| HIT | | |
| Health education | | |
| HEWs<br>a)Urban-------- | | |

| | | |
|---|---|---|
| b)Rural-------- | | |
| Supportive staffs | | |

Nurse: pop. Ratio_____ Mid. Wife: pop. Ratio _____HEW: pop. ratio_____
Top causes of morbidity
Table5: Top ten leading causes of OPD visit (morbidity)

| Sr. No | Diseases | **Adult** | | Total of cases | **%** | Sr. No | Diseases | Paediatrics/< 5year | | Total of cases | **%** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **male** | **female** | | | | | **male** | **female** | | |
| **1** | | | | | | **1** | | | | | |
| **2** | | | | | | **2** | | | | | |
| **3** | | | | | | **3** | | | | | |
| **4** | | | | | | **4** | | | | | |
| **5** | | | | | | **5** | | | | | |
| **6** | | | | | | | | | | | |
| **7** | | | | | | | | | | | |
| **8** | | | | | | | | | | | |
| **9** | | | | | | | | | | | |
| **10** | | | | | | | | | | | |
| **other** | | | | | | | | | | | |
| **total** | | | | | | | | | | | |

Immunization Coverage (for children and Women in child bearing age)

BCG P=----------A=--------%=----
OPV1 P=----------A=--------%=-----
OPV3 P=----------A=--------%=------
IPV P=----------A=--------%=-------
Measles1 P=----------A=--------%=------
Measles2 P=----------A=--------%=------
Penta1 P=----------A=--------%=------
Penta2 P=----------A=--------%=------
Penta3 P=----------A=--------%=------
PCV1 P=----------A=--------%=------
PCV3 P=----------A=--------%=-------
TT2+P.W P=----------A=--------%=-------
TT2+N.P.W P=----------A=--------%=------
HP offering ICCM----------

**Health budget allocation:**
Government
Total budget allocated for the district_____
Total budget allocated for health_____ (____ %)
Health care financing generated by health centres
HC1 (2023) P_____A_____%_____
HC2 (2023) P_____A_____%_____
HC3 (2023) P_____A_____%_____
Auditing of HC budget

HC1 (2023) P_____A_____%_____
HC2 (2023) P_____A_____%_____
HC3 (2023) P_____A_____%_____
HC4 (2023) P_____A_____%_____
Funds from NGO
Total_____ (purpose/programs) _____

**11. Community Health Services;**
Status of services provided by community health workers namely

No. of TBAs/TTBA _____and the irresponsibility
_____
No. of CHWs/CHPs _____and the irresponsibility
_____
ResponsibilityofHEWs_____

**12. Status of Primary Health Care Components–with focus on the eight PHC Elements**
**Delivery service**
a)Attended by skilled birth attendants_____
b) HCS providing BEMONC---------
c) Kebele declared home delivery free----------
d) PLW tested for HIV----------
**ANC service**
a) 1st p=----------A=--------%-------
b) 4th p=----------A=--------%-------
**PNC service**
a) Early p=----------A=--------%-------
b) Late p=----------A=--------%------
**FP (Methods)**
a) Short acting P=----------A---------%---------
b) Long acting P=----------A=---------%=---------
**EPI**
I) Service provision sites
a) Static site---------
b) Outreach site----------
II) Cold chain status
a) Health centre with functional refrigerator----------
b) Health centre without functional refrigerator--------
c) Health post with functional refrigerator------
d) Health post without functional refrigerator-------
III) Vaccine availability
a) Available vaccine----------
b) Not available vaccine----------
Environmental Health and sanitation
Latrine coverage:
a) Improved p=----------A=--------%-------and
b) Unimproved p=----------A=--------%-------
Kebele declared “open defecation free”----------
Communal latrine p=----------A=--------%-------
others_____
Health Education (what, when, where, how and who conducted health education)
_____

_____

Endemic diseases:
Common endemic diseases----------
---

**Malaria:**
5 years malaria data to see trends----------
Total malarias kebeles_____and Pop at risk_____
ITNs coverage (including current distribution)_____is there IRS this year(No of kebeles)_____
Total cases/yr OPD ------IPD------- deaths/yr_____, <5yr cases_____ deaths_____

Table6: Five years trends of malaria starting from 2011-2015/2019-2023

| S.No | Year | OPD Case | IPD case | Death | Remar |
|---|---|---|---|---|---|
| **1** | **2019** | | | | |
| **2** | **2020** | | | | |
| **3** | **2021** | | | | |
| **4** | **2022** | | | | |
| **5** | **2023** | | | | |
| | **Total** | | | | |

Malaria supplies (Coartem,RDT,etc)shortage_____
Other issues_____

**TB/Leprosy**
Total TB cases p=----------A=--------%-------
PTB positive p=----------A=--------%-------
Extra PTB p=----------A=--------%-------
TB detection rate p=----------A=--------%-------
TBRx completion rate p=----------A=--------%-------
TB cure rate p=----------A=--------%-------
TBRx success rate p=----------A=--------%-------
TB defaulter p=----------A=--------%-------
Death on TBRx p=----------A=--------%-------
Total TB patients screened for HIV p=----------A=--------%-------
Total Leprosy cases p=----------A=--------%-------on Rx_____

**HIV/AIDS;**
Total peoples screened for HIV (last one year)_____
VCTP=----------A=---------%=---------
PITCP=----------A=---------%=---------
PMTCTP=----------A=---------%=---------
HIV prevalence_____
HIV Incidence (new cases/yr)_____
Total PLWHA_____
On ART_____
On Pre-ART_____
Other HIV prevention activities_____
Nutrition (malnutrition related OTPs, SC, TSF, CBN and PSNP activities)/HOand Early warning
Total OTP sites_____, total admissions to OTP/yr_____
Total SC sites, _____, newly opened/yr_____, total admissions to SC/yr_____

Is there TSF (targeted supplementary feeding) program in the woreda _____
CBN program _____ PSNP _____other_____
General food security condition_____
Essential drugs (shortage):-_____

**13. CBHI coverage in the woreda**

Total HHs paid for CBHI_____ coverage _____
Total CBHI ID cared received _____ coverage _____

**14. High performing primary health care units**

HC1 (2019) P_____A_____%_____
HC2 (2020) P_____A_____%_____
HC3 (2021) P_____A_____%_____
HC4 (2022) P_____A_____%_____
HC4 (2022) P_____A_____%_____

15. Discussion of the high lights and the main findings of the health profile
Assessment and description----------
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16. Problem Identification and Priority Setting– set priority health problems based on the public health importance, magnitude, seriousness, community concern, feasibility etc.
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## 4. Questionnaire for Determinants of hypertension among military patients with type 2 diabetes mellitus on follow-up at Armed Force Comprehensive Specialized Hospital, Addis Ababa, Ethiopia, 2024: A case-control study

### *A. English version*

Date of interview_____ Participant's Unique ID_____Name of data collector_____

| Sr.No | Questions | Response and coding | Skip |
|---|---|---|---|
| | **Section I: Socio-demographic factors** | | |
| 1 | How old are you? | _____yrs | |
| 2 | Sex | 1. Male<br>2. Female | |
| 3 | Where is your residence? | 1. Urban<br>2. Rural | |
| 104 | What is your current marital status? | 1. Single<br>2. Married<br>3. Divorced<br>4. Widowed | |
| 105 | What is your military rank? | 1. Second lieutenant<br>2. Lieutenant<br>3. Capitan<br>4. Major<br>5. Lieutenant colonel<br>6. Colonel<br>7. General<br>8. Others (specify)……. | |
| 6 | What is your level of education? | 1. Primary school<br>2. Secondary school<br>3. Higher education | |
| 7 | What is your average household monthly income? | _____(Birr) | |
| **Section II: Clinical factors** | | | |
| 2.1 | Date of DM diagnosis | Dd____mm_____yyyy_____ | ✓ |
| 2.2 | For how long have you been diabetic? | _____yr | |
| 2.3 | Indicate the date of start for only those medications you ever used out of the following antidiabetic medications? | 1. Metformin_____<br>2. Glibenclamide_____<br>3. Insulin_____ | ✓ |

| | | | |
|---|---|---|---|
| | | 4. Other, _____<br>5. Specify other_____ | |
| 2.4 | How long have you been using the drugs you described above? Please Indicate the date you stopped taking the medicine for each of the followings that is applicable to you. | 1. Metformin_____<br>2. Glibenclamide_____<br>3. Insulin_____<br>4. Other _____<br>5. Specify other_____ | ✓ |
| 2.5 | How frequently are you ordered by your doctor to take anti-diabetic drug per day? | _____times/day | ✓ |
| 2.6 | Have you ever missed any of the doses that was ordered by your doctor? | 1. Yes____<br>2. No___ | 208 |
| 2.7 | If yes to question 2.4, how many doses have you missed in the last month? | _____doses/month | |
| 2.8 | Were there anytime that you have quitted your anti-diabetic medication? | 1. Yes____<br>2. No___ | 210 |
| 2.9 | If yes to question no. 2.6, for how long have you quitted? | _____week | |
| 2.10 | Are you on regular follow up for diabetes? | 0. Yes____<br>1. No___ | |
| 2.11 | Do you attend diabetic education session? | 0. Yes____<br>1. No___ | |
| 2.12 | Are you a member of diabetes association? | 0. Yes____<br>1. No___ | |
| 2.13 | Do you have glucometer at home? | 0. Yes____<br>1. No___ | |
| 2.14 | On how many of the last SEVEN DAYS did you test your blood sugar? | 0 1 2 3 4 5 6 7 | |
| 2.15 | Do you have family history of hypertension? | 1. Yes____<br>2. No___<br>3. I don't know | |
| 2.16 | Have you ever seen a traditional healer for diabetes or raised blood sugar? | 1. Yes____<br>2. No___ | 218 |

| | | | |
|---|---|---|---|
| 2.17 | If yes to question no. 2.16, Are you currently taking any herbal or traditional remedy for your diabetes? | 1. Yes____<br>2. No___ | |
| 2.18 | Do you have comorbidity confirmed by physician other than hypertension? | 1. Yes____<br>2. No___ | |
| 2.19 | If yes to 2.18, what is the diagnosis?<br>(RECORD ALL with date of diagnosis) | _____<br>_____ | ✓ |
| **Section III: Lifestyle and behavioral factors**<br>Now I am going to ask you some questions about various health behaviors. This includes things like smoking, drinking alcohol, diet and physical activity. Let's start with tobacco. | | | |
| 3.1 | Have you ever smoked any tobacco products, such as cigarettes, cigars or pipes? | 1. Yes____<br>0. No___ go to 307 | |
| 3.2 | Do you currently smoke tobacco products daily? | 1. Yes____<br>0. No___ | |
| 3.3 | How old were you when you first started smoking daily? DON'T KNOW 77 | _____years. If known, go to 305 | |
| 3.4 | Do you remember how long ago it was? (RECORD ONLY 1, NOT ALL 3) DON'T KNOW 77 | _____yrs OR _____months OR____wks | |
| 3.5 | On average, how many of the following do you smoke each day?<br>RECORD FOR EACH TYPE | Manufactured cigarettes_____<br>Hand-rolled cigarettes_____<br>Pipes full of tobacco_____<br>Cigars, cheroots, cigarillos_____<br>Other_____<br>Please specify other_____ | |
| 3.6 | How old were you when you stopped (if any) smoking daily? | _____years.<br>Don't know, how long ago it was____ | |
| **The next questions ask about the consumption of ALCOHOL.** | | | |

| | | | |
|---|---|---|---|
| 3.7 | Have you ever consumed an alcoholic drink such as beer, wine, spirits, fermented cider or tejj, tella, areke? | 1. Yes____<br>0. No___ go to 312 | |
| 3.8 | During the past 12 months, how frequently have you had at least one alcoholic drink? | 1. Daily<br>2. 5-6 days per week<br>3. 1-4 days per week<br>4. 1-3 days per month<br>5. Less than once a month<br>6. Never | |
| 3.9 | When you drank alcohol, on average, how many standard alcoholic drinks did you have during one drinking occasion? | _____drinks | |
| 3.10 | What was the largest number of standard alcoholic drinks you had on a single occasion, counting all types of alcoholic drinks together? | Largest no. _____<br>Don't Know 77 | |
| 3.11 | In a typical month, how many times did you have **for men: five or more**<br>**for women: four or more** standard alcoholic drinks in a single drinking occasion? | _____ times<br>Don't Know 77 | |
| **DIET**: The next questions ask about diet that you usually eat. As you answer these questions, please think of a typical week in the last year. | | | |
| 3.12 | In a typical week, on how many days do you **eat fruit**? | _____days/wk | |
| 3.13 | How many **servings** of fruit do you eat on **one** of those days? | _____ servings/day | |
| 3.14 | In a typical week, on how many days do you eat vegetables? | _____days/wk | |
| 3.15 | How many servings of vegetables do you eat on one of those days? | _____ servings/day | |
| 3.16 | What type of oil or fat is most often used for meal preparation in your household? | 1. Vegetable oil<br>2. Cholestrol oil<br>3. Butter or ghee | |

| | | | |
|---|---|---|---|
| | | 4. Other specify…… | |
| 3.17 | On average, how many meals per week do you eat that were not prepared at a home? By meal, I mean breakfast, lunch and dinner. | _____meals /wk | |
| 3.18 | How is your salt consumption after DM diagnosis? | 1. No change from prediabetic period<br>2. Minimally decreased<br>3. Substantially decreased<br>4. Stopped at all | |
| **Physical Activity:** Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person. Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. | | | |
| 3.19 | Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously? | 1.Yes____<br>2.No___ | 322 |
| 3.20 | In a typical week, on how many days do you do vigorous-intensity activities as part of your work? | _____days | |
| 3.21 | How much time do you spend doing vigorous-intensity activities at work on a typical day? | ____:____Hr:min /day | |
| 3.22 | Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously? | 0. Yes____<br>1. No___ | 325 |
| 3.23 | In a typical week, on how many days do you do moderate-intensity activities as part of your work? | _____days | |
| 3.24 | How much time do you spend doing moderate-intensity activities at work on a typical day? | ____:_____Hr:min /day | |

| | | | |
|---|---|---|---|
| The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you **travel to and from places**. For example to work, for shopping, to market, to place of worship, to taxi station | | | |
| 3.25 | Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places? | 0. Yes____<br>1. No___ | 328 |
| 3.26 | In a typical week, on how many days do you walk or use a pedal cycle for at least 10 minutes continuously to get to and from places?? | _____days | |
| 3.27 | How much time do you spend walking or bicycling for travel on a typical day? | ____:_____Hr:min /day | |
| The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and **recreational activities** (leisure) | | | |
| 3.28 | Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like [running or football or lifting weight] for at least 10 minutes continuously? | 0. Yes____<br>1. No___ | 331 |
| 3.29 | In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities? | _____days | |
| 3.30 | How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day? | ____:_____Hr:min /day | |
| 331 | Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate such as brisk walking, [cycling, swimming, volleyball] for at least 10 minutes continuously? | 0. Yes____<br>1. No___ | 334 |
| 332 | In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities? | _____days | |

| | | | |
|---|---|---|---|
| 333 | How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day? | ____:_____Hr:min | |
| The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling in car, bus, train, reading, playing cards or watching television, but do not include time spent sleeping. | | | |
| 334 | How much time do you usually spend sitting or reclining on a typical day? (Sedentary behavior) | ____:_____Hr:min | |
| 335 | How many hours of actual sleep do you get in a 24-hour period? | _____hr | |
| **PERCEIVED STRESS SCALE:** The following questions will ask you about your feelings and thoughts in the last month.<br>0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often | | | |
| No. | Questions | Score | |
| 336 | In the last month, how often have you been upset because of something that happened unexpectedly? | 0 1 2 3 4 | |
| 337 | In the last month, how often have you felt that you were unable to control the important things in your life? | 0 1 2 3 4 | |
| 338 | In the last month, how often have you felt nervous and "stressed"? | 0 1 2 3 4 | |
| 339 | In the last month, how often have you felt confident about your ability to handle your personal problems? | 0 1 2 3 4 | |
| 341 | In the last month, how often have you felt that things were going your way? | 0 1 2 3 4 | |
| 342 | In the last month, how often have you found that you could not cope with all the things that you had to do? | 0 1 2 3 4 | |
| 343 | In the last month, how often have you been able to control irritations in your life? | 0 1 2 3 4 | |
| 344 | In the last month, how often have you felt that you were on top of things? | 0 1 2 3 4 | |

| | | | |
|---|---|---|---|
| 345 | In the last month, how often have you been angered because of things that were outside of your control? | 0 1 2 3 4 | |
| 346 | In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? | 0 1 2 3 4 | |

✓ ***Indicates information to be extracted from record***

**The knowledge level will be measured based on the level of correct responses to the 10 knowledge-measuring questions.**

1) Is blood pressure inherited?

2) Is a blood pressure level above 140/90mmhg considered normal?

3) Is a blood pressure less than 120/80 considered high?

4) Does smoking cigarettes hurt persons with hypertension?

5) Does drinking alcohol harm persons with hypertension?

6) Does untreated cholesterol increase blood pressure?

7) Does untreated high blood pressure affect the heart

8) When to take pressure medicine?

9) Does the hypertensive patient should not be fed a spicy and salty diet?

10) did you think Hypertension and diabetes are related?

The 10 questions contained a total of nine highest points, with a correct response scoring one (1) point and a wrong response scoring zero (0) points. Finally, to categorize the knowledge level, we used modified Bloom's taxonomy cut-off point with a score of >75 % as good and ≤75 % as poor.

## Military-Related Factors Questionnaire

**1.** Service Details

1.1 What is your current rank in the military?

- ☐ Private
- ☐ Corporal
- ☐ Sergeant
- ☐ Warrant Officer
- ☐ Officer (Specify rank: _____)

1.2 How many years have you served in the military (length of military service)?

- ☐ Less than 5 years
- ☐ 5–10 years
- ☐ 11–20 years
- ☐ More than 20 years

1.3 What is your current duty status?

- ☐ Active duty (full-time service)
- ☐ Retired

1.4 What type of assignment are you currently on?

- ☐ Combat-related assignment
- ☐ Administrative/office duty
- ☐ Medical/health services
- ☐ Technical/engineering services
- ☐ Other (Specify: _____)

***2. Work Environment and Lifestyle***

2.1 How often are you deployed away from your base or family?

- ☐ Rarely (less than once a year)
- ☐ Occasionally (1–3 times a year)
- ☐ Frequently (more than 3 times a year)
- ☐ Currently on long-term deployment

2.2 How many hours do you work on an average day?

- ☐ Less than 8 hours
- ☐ 8–10 hours
- ☐ 11–12 hours
- ☐ More than 12 hours

2.3 How frequently do you engage in shift work or night shifts?

- ☐ Never
- ☐ Occasionally (1–3 times a month)
- ☐ Regularly (4 or more times a month)
- ☐ Always (rotational shifts/night duty every week)

2.4 How long do your night shifts typically last?

- ☐ Less than 6 hours
- ☐ 6–8 hours
- ☐ More than 8 hours

2.5 How would you describe the physical demands of your military duties?

- ☐ Low (mostly sedentary work)
- ☐ Moderate (occasional physical tasks)
- ☐ High (frequent physical tasks)
- ☐ Very high (intense physical tasks regularly)

2.6 How often do you engage in intense physical tasks (e.g., drills, exercises, combat training)?

- ☐ Rarely (less than once a week)
- ☐ Occasionally (1–3 times a week)
- ☐ Frequently (more than 3 times a week)
- ☐ Daily

2.7 How long do you spend in a sedentary posture (e.g., sitting, standing still) during missions or work shifts?

- ☐ Less than 2 hours per shift
- ☐ 2–4 hours per shift
- ☐ 5–6 hours per shift
- ☐ More than 6 hours per shift

*3. Access to Healthcare and Healthy Diet*

3.1 Do you have access to healthcare services during deployments?

- ☐ Yes, always
- ☐ Yes, but limited
- ☐ No

3.2 How often do you receive medical check-ups for your diabetes/hypertension while on duty?

- ☐ Regularly (at least once a month)
- ☐ Occasionally (once every few months)
- ☐ Rarely (less than once a year)
- ☐ Never

3.3 How would you rate your access to a healthy, balanced diet while on base?

- ☐ Excellent
- ☐ Good
- ☐ Fair
- ☐ Poor

**4. Stress and Mental Health**

4.1 How would you describe your overall stress level due to military duties (self-reported levels of work-related stress)?

- ☐ Low
- ☐ Moderate
- ☐ High
- ☐ Very high

4.3 How often are you exposed to combat or high-stress environments (e.g., conflict zones, emergency missions)?

- ☐ Never
- ☐ Rarely (less than once a year)
- ☐ Occasionally (1–3 times a year)
- ☐ Frequently (more than 3 times a year)

4.4 Have you received any mental health support related to stress management while in service?

- ☐ Yes
- ☐ No

**5. Sleep and Rest**

5.1 How many hours of sleep do you get on average per night while on duty?

- ☐ Less than 4 hours
- ☐ 4–6 hours
- ☐ 7–8 hours
- ☐ More than 8 hours

5.3 How often do you experience sleep disturbances due to military duties (e.g., night shifts, irregular work hours)?

- ☐ Never
- ☐ Rarely
- ☐ Occasionally
- ☐ Frequently

## B. የአማርኛ መጠይቅ

የተጠየቀው ቀን_____የጥናቱ ተሳታፊ ኮድ_____መረጃውን የሰበሰበው ስም_____

| ተ.ቁ | ጥያቄዎች | መልስ እና ምስጢር ቁጥር | ዝለል |
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| **100** | **ክፍል I: አጠቃላይ መረጃ** | | |
| 101 | ዕድሜዎ ስንት ነው? | _____ዓመት | |
| 102 | ጾታ (በማየት ይመዝግቡ) | 1. ወንድ<br>2. ሴት | |
| 103 | መኖሪያዎ የት ነው? | 1. ከተማ<br>2. ገጠር | |
| 104 | የአሁኑ የጋብቻ ሁኔታዎ ምንድነው? | 1. ያላገባ/ች<br>2. ያገባ/ች<br>3. የተፋታ/ች<br>4. ባል/ሚስት የሞተበት | |
| 105 | የሥራዎ ሁኔታ ባለፉት 12 ወራት ምንድን ነበር? | 1. የመንግስት ሠራተኛ<br>2. የግል ሥራ<br>3. የቤት እመቤት<br>4. ሥራ-አጥ<br>5. ሌላ (ጥቀስ)_____ | |
| 106 | የትምህርት ደረጃዎት ምንድን ነው? | 1. አልተማርኩም<br>2. የመጀመርያ ደረጃ<br>3. ሁለተኛ ደረጃ<br>4. ከፍተኛ ትምህርት | |
| 107 | የቤታችሁ አማካይ የወር ገቢ ምን ያህል ነው? | _____ ብር በወር | |
| **ክፍል II፡ ከጤና ጋር የተያያዙ መረጃዎች** | | | |
| **201** | የስኳር በሽታ እንዳለብዎት ያወቁበት ቀን | ቀን____ወር_____ዓ/ም_____<br>ከታወቀ ወደ ቁ203 | ✓ |
| 202 | የስኳር በሽታ እንዳለብዎት ካወቁ ወዲህ ምን ያክል ጊዜ ሆነ? | _____ዓመት | |

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| 203 | ከሚከተሉት የስኪር መድኃኒቶች ተጠቅመው ለሚያውቁት ብቻ የጀመሩበትን ቀን ይግለጹ? | 1. ሜትፎርሚን_____<br>2. ዳኦኒል/ግሌብንክላማይድ-_____<br>3. እንሱሊን_____<br>4. ሌላ_____ | ✓ |
| 204 | ከላይ እንደጀመሩ የገለጹትን መድኃኒቶች እስከመቼ ድረስ ተጠቀሙ (እየተጠቀሙ ነው)? (እባክዎን እርስዎን ለሚመለከት ለእያንዳንዱ ተከታይ መድሃኒት መውሰድ ያቆሙበትን ቀን ያመልክቱ) | 1. ሜትፎርሚን_____<br>2. ግሌብንክላማይድ_____<br>3. እንሱሊን_____<br>4. ሌላ_____ | ✓ |
| 205 | ዶክተርዎ የስኪር መድሀኒትዎን በቀን ስንቴ እንዲወስዱ አዘዝዎት? | _____ ጊዜ በቀን | |
| 206 | ከታዘዙት መጠን ማንኛውንም ጊዜ ቢሆን ሳይወስዱ ቀርተው ያውቃሉ ? | 1. አዎን____<br>0. አላውቅም___ | |
| 207 | ለቁጥር 206 መልስዎ አዎ ከሆነ ባለፈው ወር ሳይወስዱ ያለፈብዎት የስንት ጊዜ ይሆናል? (ሁሉንም ይቁጠሩ) | _____ ጊዜ በወር | |
| 208 | የስኪር በሽታ መድሐኒት አቁርጠው ያውቃሉ ? | 0. አዎን____<br>0. አላውቅም___ | 210 |
| 209 | ለቁጥር 208 መልስዎ አዎ ከሆነ ለምን ያህል ግዜ? | ለ____ ሳምንት | |
| 210 | ለስኪር በሽታ መደበኛ ክትትል ላይ ኖት? | 0. አዎን____<br>1. አይደለሁም___ | |
| 211 | በስኪር በሽታ ትምህርት ክፍለ ጊዜ ላይ ይሳተፋሉ? | 0. አዎን 1. አልሳተፍም | |
| 212 | የስኪር ህመም ማህበር አባል ነዎት? | 0. አዎን 1. አይደለሁም___ | |
| 213 | የስኪር መጠን መለክያ በቤትዎ አለዎት? | 0. አዎን 1. አይደለም | |
| 214 | ባለፈው ሰባት ቀናት ውስጥ የስኪርዎን መጠን ስንቴ ለኩ? | 0 1 2 3 4 5 6 7 | |
| 215 | በቤተሰብዎ ታሪክ የደም ግፊት ያለበት ሰው አለ? | 1. አዎን | |

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| | | 2. የለም<br>3. አላውቅም | |
| 216 | ለስኳር በሽታዎ የባህል ሃኪም ጋር ሄደው ያዉቃሉ? | 1. አዎን 2. አይደለም | 218 |
| 217 | ለቁጥር 216 መልስዎ አዎ ከሆነ አሁን ለስኳር በሽታዎ የባህል ወይም የልምድ መድሃኒት ይወስዳሉ? | 1. አዎን 2. አይደለም | |
| 218 | ከደም ግፊት ሌላ በሀኪም የተረጋገጠ ተደራቢ በሽታ አለብዎት? | 1. አዎን 2. የለም___ | ✓ |
| 219 | ለቁጥር 218 መልስዎ አዎ ከሆነ የምርመራው ውጤት ምን ነበር? ( የምርመራ ውጤት እና የተመረመሩበት ቀን ይመዝገብ) | _____<br>_____ | ✓ |
| **300** | **ክፍል III: የህይወት ዘይቤ እና የባህሪ ምክንያቶች**<br>አሁን ስለ የተለያዩ የጤና ጠባይ አንዳንድ ጥያቄዎችን ልጠይቅዎት እፈልጋለሁ ። ይህ እንደ ማጨስ ፣ አልኮልን መጠጣት ፣ አመጋገብ እና የአካል እንቅስቃሴ ያሉ ነገሮችን ያጠቃልላል። ከትንባሆ እንጀምር ፡ ፡ | | |
| 301 | እንደ ሲጋራና የመሳሰሉ ማናቸውንም ዓይነት የትምባሆ ምርቶች አጭሰው ያውቃሉ? | 1. አዎን<br>0. አይደለም- (ወደ 307 ይሂዱ) | |
| 302 | በአሁኑ ጊዜ የትምባሆ ምርቶችን በየቀኑ ያጨሳሉ? | 1. አዎን<br>0. አይደለም | |
| 303 | በየቀኑ ማጨስ ሲጀምሩ ዕድሜዎ ስንት ነበር? | _____ዓመት። ምታወቅ ከሆነ ወደ 305 | |
| 304 | ማጨስ የጀመርከው ከምን ያክል ጊዜ በፊት እንደነበር ታስታውሳለህ? | _____ | |
| 305 | በአማካይ በየቀኑ ከሚከተሉት ውስጥ ምን ያህል ያጨሳሉ?<br>የትኞችን የትንባሆ ዓይነት ከሆነ (ከአንድ በላይ መመለስ ይቻላል) | በፋብሪካ የተመረቱ ሲጋራዎች_<br>በእጅ የተጠቀለሉ ሲጋራዎች___<br>ጋያ_____<br>ሌላ_____ | |

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| | | እባክዎ ሌላ ከሆነ ስሙን ይጥቀሱ_____ | |
| 306 | ማጨስ አቁመው ከሆነ ያቆሙት በስንት ዓመትዎ ነበር?<br>ማጨስ ስያቆሙ ዕድሜዎ ስንት እንደነበረ ካላወቁ ማጨስ ካቆሙ ምን ያክል ጊዜ ሆነው____ | _____ዓመት<br>ካላወቁ ምን ያክል ጊዜ ሆነው____ | |
| **አልኮሆል:** የሚቀጥሉት ጥያቄዎች ስለ አልኮሆል ፍጆታ ይጠይቃሉ ። | | | |
| 307 | የአልኮል መጠጥ ጠጥተው ያውቃሉ? ( ቢራ ፣ ወይን ፣ ጠላ፣ጠጅ፣ አረቄ...) | 1. አዎን<br>0. አይደለም | 312 |
| 308 | በአለፉት 12 ወራት ውስጥ ቢያንስ አንድ የአልኮል መጠጥ የሚጠጡት ስንት ጊዜ ነበር? | 1. በየቀኑ<br>2. 5-6 ቀናት በሳምንት<br>3. 1-4 ቀናት በሳምንት<br>4. 1-3 ቀናት በወር<br>5. በወር ከአንዴ በታች<br>6. ጠጥቼ አላውቅም | |
| 309 | የአልኮል መጠጥ በሚጠጡበት ጊዜ በአማካይ ስንት አልኮሆል መጠጦች በአንድ የመጠጥ ጊዜ ውስጥ ይጠጣሉ? | _____ | |
| 310 | በአንድ የመጠጥ ጊዜ ትልቁ የጠጣሃቸው የአልኮል መጠጦች ሁሉንም የአልኮል መጠጦችን በመቁጠር ስንት ነበሩ? | ትልቁ የጠጣሁት_____ | |
| 311 | በተለመደ ወር ውስጥ **ወንድ 5እና ከዚያ በላይ**<br>***ሴት 4እና ከዚያ በላይ*** የአልኮሆል መጠጥ በአንድ የመጠጥ ጊዜ የወሰዱት ምን ያህል ጊዜ ነው? | | |
| **አመጋገብ፡** የሚቀጥሉ ጥያቄዎች አብዛኛውን ጊዜ ስለሚመገቡት የፍራፍሬና የአትክትልት አመጋገብ ይጠይቅዎታል። እባክዎን መልስዎን ሲመልሱ ባለፈው ዓመት ውስጥ የእርስዎን አመጋገብ ስለሚወክለው ሳምንት ያስቡ። | | | |
| 312 | በተለመደው ሳምንት ምን ያክል ቀን ፍራፍሬ ትመገባለህ? (እባክዎን ካርድ ያሳዩ) | _____ቀን | |

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| 313 | ከእነኚህ ቀናቶች በአንዱ ላይ ምን ያክል የፍራፍሬ ገበታ ይመገባሉ? (እባክዎን ካርድ ያሳዩ) | _____ | |
| 314 | በተለመደው ሳምንት ምን ያክል ቀን አትክልት ትመገባለህ? (እባክዎን ካርድ ያሳዩ) | _____ቀን | |
| 315 | ከእነኚህ ቀናቶች አንዱ ላይ ምን ያክል የአትክልት ገበታ ይመገባሉ? (እባክዎን ካርድ ያሳዩ) | _____ | |
| 316 | ብዙ ጊዜ ምግብ ለማብሰል ምን አይነት ዘይት ነው የምትጠቀሙት? | 1. የአትክልት ዘይት<br>2. የምረታ ዘይት<br>3. ቂቤ<br>4. ሌላ…… | |
| 317 | በሳምንት ከቤት ውጪ በአማካይ ምን ያክል ጊዜ ይመገባሉ? ቁርስ፣ምሳና እራት ተቆጥረው ተቆጥረው ማለቴ ነው | _____ጊዜ በሳምንት | |
| 318 | የስኪር በሽታ እንዳለብዎት ከተነገርዎት በኋላ የጨው ፍጆታዎ እንዴት ነው? | 1. በፊት ከሚጠቀሙት መጠን ለውጥ የለውም<br>2. በጥቂቱ ቀንሰዋል<br>3. በጣም ቀንሰዋል<br>4. መጠቀም አቁመዋል | |
| **የአካል ብቃት እንቅስቃሴ-** ቀጣይ በተለመደ ሳምንት ውስጥ የተለያዩ የአካል ብቃት እንቅስቃሴ ዓይነቶችን በመሥራት ያሳለፉትን ጊዜ እጠይቅዎታለሁ ። ምንም እንኳን እርስዎ አካላዊ እንቅስቃሴ የሚያደርጉ ሰው ባይሆኑም እባክዎን እነዚህን ጥያቄዎች ይመልሱ ። ሥራን ስለሚሰሩበት ጊዜ በመጀመሪያ ያስቡ ። እንደ ደመወዝ ወይም ያልተከፈለ ሥራ ፣ ጥናት / ስልጠና ፣ የቤት ውስጥ ሥራዎች ፣ ምግብ / ሰብሎች መሰብሰብ ፣ ዓሳ ማጥመድ ወይም ምግብ መፈለግ ላይ እንደመሰማራት ያሉ መሥራት ያለብዎት ነገሮችን ያስቡ ። | | | |
| 319 | ሥራዎ አተነፋፈስዎን ወይንም ልብ ምትዎን በጣም ሊጨምር የሚችል ከባድ እንቅስቃሴን ለምሳሌ እንደመሸከም ከባድ ነገርን እንደማንሳት ወይንም እንደ ግንባታ ሥራ ቢያንስ ለ10 ደቂቃ ያለማቋረጥ መስራትን ያካትታል? | 0. አዎን ____<br>1. አይደለም___ | 322 |
| 320 | እንዲህ አይነት ከባድ ስራዎችን በሳምንት ምን ያክል ቀን ይሰራሉ? | ____ቀን | |
| 321 | በሥራዎ ውስጥ በአንድ በተለመደ ቀን ከባድ እንቅስቃሴዎችን በመከወን ምን ያህል ጊዜ ያሳልፋሉ? | _____:_____<br>(እባክዎን በደቂቃ ቀይረው ይመዝግቡ) | |

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| 322 | ሥራዎ የመተንፈስ ወይም የልብ ምት በትንሹ የሚጨሚሩ መካከለኛ እንቅስቃሴን እንደ [ፈጣን እርምጃ ወይም ቀላል ጭነቶችን እንደመሸከም] ያሉ እንቅስቃሴን ያለማቋረጥ ቢያንስ ለ 10 ደቂቃዎች መሥራትን ያካትታል? | 1. አዎን<br>2. አይደለም | 325 |
| 323 | በተለመደው ሳምንት ውስጥ እንደስራዎ አንድ ክፍል እንዲህ አይነት መካከለኛ-እንቅስቃሴዎችን ስንት ቀናት ያደርጋሉ? | ____ቀን | |
| 324 | በሥራዎ ውስጥ በአንድ በተለመደ ቀን መካከለኛ እንቅስቃሴዎችን በመከወን ምን ያህል ጊዜ ያሳልፋሉ? | _____:_____ | |
| የሚቀጥሉት ጥያቄዎች ቀደም ሲል እርስዎ የገለፁትን በስራ ላይ ያሉትን የአካል ብቃት እንቅስቃሴዎችን አያካትቱም ። አሁን ወደ **ቦታዎች ለመሄድና እና ከቦታዎች ለመመለስ** ስለሚጓዙበት የተለመደ ጉዞ ልጠይቅዎ እፈልጋለሁ ። ለምሳሌ ለመስራት ፣ ዕቃ ለመግዛት ፣ ለገበያ ፣ ለአምልኮ ቦታ ፣ ለታክሲ መያዣ...ወዘተ | | | |
| 325 | ወደ ቦታዎች ለመሄድ እና ለመመለስ ብስክሌትን ወይንም የእግር ጉዞን ያለማቋረጥ ቢያንስ ለ 10 ደቂቃዎች ይጠቀማሉ? | 1. አዎን<br>2. አይደለም | 328 |
| 326 | በተለመደው ሳምንት ወደ ቦታዎች ለመሄድ እና ለመመለስ ብስክሌትን ወይንም የእግር ጉዞን ያለማቋረጥ ቢያንስ ለ 10 ደቂቃዎች ስንት ቀን ይጠቀማሉ? | ____ቀን | |
| 327 | በተለመደው ቀን ለጉዞ ብስክሌትን በመንዳት ወይንም የእግር ጉዞን በመጓዝ ምን ያህል ጊዜ ያሳልፋሉ? | _____:_____ | |
| የሚቀጥሉት ጥያቄዎች እርስዎ ቀደም ሲል የጠቀሷቸውን የሥራ እና የትራንስፖርት እንቅስቃሴዎችን አያካትቱም ። አሁን ስለ ስፖርት ፣ የአካል ብቃት እና **የመዝናኛ እንቅስቃሴዎች (መዝናኛ)** ልጠይቅዎት እፈልጋለሁ ። | | | |
| 328 | ቢያንስ ለ 10 ደቂቃዎች ያለማቋረጥ እንደ ሩጫ ወይም እግር ኳስ ወይም ክብደት ማንሳት ያሉ አተነፋፈስ ወይም የልብ ምት በከፍተኛ የሚጨምሩ ጠንካራ | 1. አዎን<br>2. አይደለም | 331 |

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| | የስፖርት ፣ የአካል ብቃት ወይም የመዝናኛ እንቅስቃሴዎችን ያደርጋሉ? | | |
| 329 | በተለመደው ሳምንት ውስጥ ጠንካራ ስፖርት ፣ የአካል ብቃት ወይም የመዝናኛ እንቅስቃሴዎችን ስንት ቀናት ያደርጋሉ? | ____ቀን | |
| 330 | በተለመደው ቀን ጠንካራ የስፖርት ፣ የአካል ብቃት እንቅስቃሴ ወይም የመዝናኛ እንቅስቃሴዎችን በማድረግ ምን ያህል ጊዜ ያሳልፋሉ? | _____:_____ | |
| 331 | ቢያንስ ለ 10 ደቂቃዎች ያለማቋረጥ እንደ ብስክሌት መንዳት ፣ መዋኘት ፣ የእጅ (የመረብ) ኳስ ያሉ አተነፋፈስ ወይም የልብ ምት በትንሹ የሚጨምሩ መጠነኛ የስፖርት ፣ የአካል ብቃት ወይም የመዝናኛ እንቅስቃሴዎችን ያደርጋሉ? | 1. አዎን<br>2. አይደለም | 334 |
| 332 | በተለመደ ሳምንት ፣ መጠነኛ ስፖርቶችን ፣ የአካል ብቃት እንቅስቃሴን ወይም የመዝናኛ እንቅስቃሴዎችን ስንት ቀናት ያደርጋሉ? | ____ቀን | |
| 333 | በተለመደ ቀን መጠነኛ-ስፖርቶችን ፣ የአካል ብቃት እንቅስቃሴን ወይም የመዝናኛ እንቅስቃሴዎችን በማከናወን ምን ያህል ጊዜ ያሳልፋሉ? | _____:_____ | |
| የሚከተለው ጥያቄ በስራ ላይ ሆነው፣ በቤት ውስጥ፣ ከጓደኞች ጋር ፣ መኪና ውስጥ በመጓዝ ፣ በአውቶቡስ ፣ በባቡር ፣ በማንበብ ፣ ካርዶችን በመጫወት ወይም ቴሌቪዥን በመመለከት ተቀምጠው ስለሚያሳልፉ ጊዜ ነው ። ነገር ግን የመተኛት ጊዜን አይጨምርም። | | | |
| 334 | በተለመደው ቀን ለመቀመጥ ወይም ለማረፍ ምን ያህል ጊዜ ያሳልፋሉ? | ____: _____ ሰዓት: ደቂቃ | |
| 335 | በ 24 ሰዓታት ውስጥ በአማካይ ምን ያህል ሰዓት ትክክለኛ እንቅልፍ ያገኛሉ? | ____: _____ ሰዓት: ደቂቃ | |
| **የተገነዘቡት ወይንም የተስተዋለ የውጥረት ልክ፡** የሚቀጥሉ ጥያቄዎች ባለፈው ወር ውስጥ ስለተማዎት ስሜቶችዎ እና ሀሳቦችዎ ይጠይቅዎታል ።<br>**ውጤት 0=በጭራሽ 1=በጣም ጥቂት ጊዜ 2=አንድአንዴ 3=አብዛኛውን ጊዜ 4=ዘውትር** | | | |
| 1 | በሕይወትዎ ያልተጠበቀ ነገር በመከሰቱ ባለፈው ወር ውስጥ ምን ያህል ጊዜ ተበሳጭተዋል? | 0 1 2 3 4 | |

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| 2 | በሕይወትዎ ውስጥ አስፈላጊ የሆኑትን ነገሮች መቆጣጠር እንዳልቻሉ ባለፈውወር ውስጥ ምን ያህል ጊዜ ተሰምቶት ያውቃል? | 0 | 1 | 2 | 3 | 4 | |
| 3 | ባለፈው ወር ውስጥ የመጨነቅ እና የመረበሽ ስሜት ምን ያህል ጊዜ ተሰምቶት ያውቃል? | 0 | 1 | 2 | 3 | 4 | |
| 4 | ባለፈው ወር ውስጥ የግል ችግሮችዎን በራስዎ አቅም ለመፍታት ምን ያህል ጊዜ በራስ የመተማመን ስሜት ተሰምቶልዎት ያውቃል? | 0 | 1 | 2 | 3 | 4 | |
| 5 | ባለፈው ወር ውስጥ ነገሮች እርስዎ በሚፈልጉት መንገድ እየሄዱ እንደሆኑ ምን ያህል ጊዜ ተሰምቶልዎት ያውቃል? | 0 | 1 | 2 | 3 | 4 | |
| 6 | ባለፈው ወር ውስጥ ማድረግ ያለብዎትን ነገሮች ሁሉ መቋቋም (መቆጣጠር) እንደማይችሉ ምን ያህል ጊዜ አግኝተዋል? | 0 | 1 | 2 | 3 | 4 | |
| 7 | ባለፈው ወር ውስጥ ምን ያህል ጊዜ በሕይወትዎ ብስጭትን መቆጣጠር ቻሉ? | 0 | 1 | 2 | 3 | 4 | |
| 8 | ባለፈው ወር ውስጥ እርስዎ በነገሮች ላይ የበላይ መሆንዎን ምን ያህል ጊዜ ተሰማዎት? | 0 | 1 | 2 | 3 | 4 | |
| 9 | ባለፈው ወር ውስጥ ከቁጥጥርዎ ውጭ ከሆኑ ነገሮች የተነሳ ምን ያህል ጊዜ ተቆጥተዋል? | 0 | 1 | 2 | 3 | 4 | |
| 10 | ባለፈው ወር ውስጥ ችግሮች ለማሸነፍ እስከማይችሉ ድረስ በጣም ከፍተኛ ሆነው እየመጡ እንደሆነ ምን ያህል ጊዜ ተሰማዎት? | 0 | 1 | 2 | 3 | 4 | |

✓ ***ከመዝገብ የሚወሰዱ መረጃዎች***