Mortality and Its Associated Factors among Colorectal Cancer Patients on Chemotherapy Follow up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, Eastern Ethiopia

MSc Thesis

Ibrahim Ismael (B. Pharm)

November, 2025

Haramaya University, Ethiopia

HARAMAYA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

Mortality and Its Associated Factors among Colorectal Cancer Patients on chemotherapy follow up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, Eastern Ethiopia

A Thesis Submitted to the School of Pharamacy, College of Health Sciences and Medical Sciences, School of Graduate Studies, Haramaya University, in Partial Fulfillment of the Requirements for the Degree of Master of Clinical Pharmacy.

Major Advisor: Dr. Dumessa Edessa (Ph.D)

Co-advisor: Mr. Jemal Abdela (MSc, Assistant Professor of Pharmacology)

November, 2025

Haramaya University, Ethiopia

APPROVAL SHEET

SCHOOL OF GRADUATE STUDIES

HARAMAYA UNIVERSITY

I hereby certify that I have read and evaluate the thesis entitled "Mortality and Its Associated Factors among Colorectal Cancer Patients on Chemotherapy Follow up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, Eastern Ethiopia" prepared under my guidance by Ibrahim Ismael. I recommend that it be submitted as fulfilling the thesis requirement.

Dr. Dumessa Edessa (Ph. D) _____ _____

Major Advisor Signature Date

Mr. Jemal Abdela (MSc, Assistant Professor of Pharmacology) _____ _____

Co-advisor Signature Date

As a member of the Board of Examiners of the M.Sc. Thesis Open Defense Examination, I certify that I have read and evaluated the Thesis prepared by Ibrahim Ismael and examined the candidate. I recommend that the thesis be accepted as fulfilling the thesis requirements for the degree of Masters in Clinical Pharmacy.

_____ _____ _____

Chairperson Signature Date

_____ _____ _____

Internal Examiner Signature Date

_____ _____ _____

External Examiner Signature Date

Final approval and acceptance of the thesis is contingent upon the submission of its final copy to the Council of Graduate Studies (CGS) through the Candidate's Department or School Graduate Committee (DGC or SGC).

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my own work. I have followed all ethical principles in the preparation, data collection, data analysis and completion of this thesis. All scholarly matter that is included in the thesis has been given recognition through citation. I affirm that I have cited and referenced all sources used in this document. Every serious effort has been made to avoid any plagiarism in the preparation of this thesis. This thesis is submitted in partial fulfillment of the requirement for a master degree of clinical pharmacy from the School of Graduate Studies at Haramaya University. The thesis is deposited in the Haramaya University Library and is made available to borrowers under the rules of the library. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate. Brief quotations from this thesis may be used without special permission provided that accurate and complete acknowledgement of the source is made. Requests for permission for extended quotations from, or reproduction of, this thesis in whole or in part may be granted by the Head of the School or Department or the Dean of the School of Graduate Studies when in his or her judgment the proposed use of the material is in the interest of scholarship. In all other instances, however, permission must be obtained from the author of the thesis.

Name: _____

Date: _____

School/Department: _____

Signature: _____

ACKNOWLEDGMENTS

First of all, I would like to thank the School of Pharmacy, College of Health and Medical Sciences, Haramaya University, for giving me such an opportunity to develop a thesis, and also for funding the cost of my master's degree.

Secondly, I would like to express my heartfelt gratitude to my advisors, Dr. Dumessa Edessa, Mr. Jemal Abdela and Mr. Niem Bedewi for their encouragement, guidance, and kind correspondence during the development of this thesis.

Also, I would like to express my gratitude to my friends for their support and encouragement, and to my instructors, who have taught me in some way throughout my school life.

Finally, I thank the administrators and card room staff members at HFCSH and DGH for their cooperation during data collection.

LIST OF ABBREVIATIONS AND ACRONYMS

BMI	Body Mass Index
CRC	Colorectal Cancer
CEA	Carcinoembryonic Antigen
DGH	Dilchora General Hospital
GBD	Global Burden of Disease
FMoH	Federal Ministry of Health Ethiopia
FOLFOX	5 - Flurouracil and Oxaliplatin
FOXFIRI	5 – Flurouracil and Irinotecan
HGB	Hemogloblin
HFSCH	Hiwot Fana Comprehensive Specialized Hospital
IHRERC	Institutional Health Research Ethics Review Committee
PI	Principal Investigator
TNM	Tumor Nodes Metastasis
WHO	World Health Organization
XELOX	Capcitabine and Oxaliplatin

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background: Colorectal cancer is the third most commonly diagnosed cancer and the second biggest cause of cancer-related deaths worldwide, impacting both developed and developing nations. The present research aimed to investigate mortality and its associated factors among colorectal cancer patients on chemotherapy follow up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital.

Methods: A retrospective chart review is performed, and all cases with diagnosis of colorectal cancer from (February 25, 2020–January 1, 2025) 156 at Hiwot Fana Comprehensive Specialized Hospital and (January 1, 2023–January 1, 2025) 29 at Dilchora General Hospital were included for study. For the data collection, the patients' medical charts were reviewed from March 1 and June 15, 2025. The entry and evaluation of data were conducted with Statistical Package for the Social Sciences software version 27.0. Survival probability over time was estimated using Kaplan-Meier curve and factors associated with colorectal cancer mortality were identified through a Cox proportional hazards regression model.

Result: Out of 185 participants, 101 (54.6%) were males and 103 (55.7%) were under the age of 49. An average age at admission was 46.65 years (standard deviation 12.74). Of the 185 patients treated for colorectal cancer, 139 (75.1%) died within a period of two years, with a median predicted survival time of 13.8 months. The Cox proportional hazard regression analysis found the presence of underweight (HR=1.72, 95% CI: 1.07-2.78), having carcinoembryonic antigen levels ≥ 5 ng/mL (HR=2.25, 95% CI: 1.19 - 4.26), having low hemoglobin (HR=1.62, 95% CI: 1.10 - 2.39), and having comorbid diseases (HR=1.65, 95% CI: 1.07 -2.56) were all associated with an increased mortality rate.

Conclusion: This study shows that mortality from colorectal cancer was considerably high among patients on chemotherapy follow up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital. The mortality was significantly increased among patients with anemia, malnutrition, advanced cancer stage, and comorbid conditions. Early screening, accessible first-line chemotherapy, and adherence to treatment protocols are critical for improving colorectal cancer treatment outcomes. Nutritional support and public health education should be integrated into care. These interventions may collectively reduce disease burden and mortality.

Keywords: factors, colorectal cancer, mortality, treatment outcomes, eastern Ethiopia

1. INTRODUCTION

1.1. Background

Colorectal cancer (CRC) is a malignant tumor that affects the colon or rectum. It is the third most common diagnosis and the second leading cause of mortality from cancer-related cases in the world in 2022 (Morgan *et al.,* 2023; WHO, 2023). Adenocarcinoma is the most commonly identified type of CRC, followed by carcinoid tumors, gastrointestinal stromal tumors, lymphomas, and sarcoma (Hossain *et al.,* 2022).

CRC is one of the paramount public health burdens worldwide, responsible for one in 10 cases of cancer (Bray *et al.,* 2024). GLOBOCAN 2022 estimated more than 1.9 million new cases of CRC and 904,000 deaths per year globally in 2022 (Bray *et al.,* 2024). Furthermore, the burden of CRC is projected to increase to 3.2 million new cases and 1.6 million deaths in 2040 (Morgan *et al.,* 2023).

The Union for International Cancer Control set nine goals in 2022 to beat cancer and planned to achieve them in 2025, including a 25% reduction of premature mortality from non-communicable diseases, tobacco control programs, healthy diet promotion, vaccination programs, early detection of cancer initiatives, national control plans, and improving access to essential medicines and technologies (WHO, 2022).

Incidence and mortality rates of CRCs in Europe, vary from country to country (Banach, 2022). In 2020, the highest age-standardized incidence rates were recorded in Hungary (45.3), Slovakia (43.9), Norway (41.9), the Netherlands (41), and Denmark (40.9) cases per 100,000 persons. And lower cases were recorded in Asian countries like Bangladesh (3.7) and Bhutan (3.8), (Xi and Xu, 2021).

In middle-income and low-income countries, CRC incidences and mortality were low. However, between 1990 and 2019, incidences increased from 47.3% to 62.1% and deaths from 57.1% to 69.8% (Lu *et al.,* 2021; Banach, 2022). This change is due to lifestyle changes such as increased meat eating, decreased intake of fruits and vegetables, and more sedentary behavior (Rawla *et al.,* 2019; Sung *et al.,* 2021; Lu *et al.,* 2021).

Survival rates of CRCs are higher in high-income countries than in middle- and low-income countries; for example, in Europe, the survival rates for 1, 3, and 5 years were 90%, 70%, and 63%, respectively (Majano *et al.,* 2019). In Eastern Mediterranean countries, survival rates of 1, 3, and 5 years were 88.07%, 70.67%, and 57.26%, respectively (Nikbakht *et al.,* 2020), and 78.0%, 57.7%, and 49.6% in Brunei Darussalam (Leong

et al., 2020). Similarly, in Ethiopia, the survival rate of CRC was low-82.3%, 48.8%, and 26.6% of one-, three-, and five-year survival, respectively (Aynalem *et al.,* 2024). Many factors influence the outcome of treatment among CRC patients, such as older age, low socio-economic status, multiple comorbidities, late stage, and low degree of differentiation (Siegel *et al.,* 2017; Leong *et al.,* 2020; Alyabsi *et al.,* 2021; Muhamad *et al.,* 2023; Maimard *et al.,* 2023) .

The overall incidence of CRCs in Africa was 5.25 per 100,000 (Arhin *et al.,* 2022). Incidence and mortality rates of CRCs in Africa also varies from country to country (Banach, 2022). Lowest cases were recorded in Guinea, Gambia (3.3), and Burkina Faso (3.8) (Xi and Xu, 2021). The highest incidence rate of CRC was reported in Ethiopia, 7.7 per 100,000, with 2850 people dying in 2019. In addition, the incidence rate was raised in Ethiopia by 21% between 2010 and 2019 (Awedew *et al.,* 2022).

Environmental factors (physical inactivity, smoking, and alcohol consumption), diet (high consumption of processed foods, red meats, refined carbohydrates, and low calcium diet), and genetic predisposition (hereditary cancer syndromes, such as Lynch syndrome and low-penetrance genetic variations) are contributing factors of CRC (Tabung *et al.,* 2018; Tran and Collaborators, 2019; Wong *et al.,* 2019; Hossain *et al.,* 2022).

Surgery and chemotherapy are the initial lines of treatment for many CRC patients (Hossain *et al.,* 2022). In almost all cases, surgery alone is carried out to remove the tumor (Messersmith, 2019). However, it is challenging to cure patients with surgery alone because many patients are present at a late stage (Keum and Giovannucci, 2019). Chemotherapy or radiotherapy may be used before or after surgery to help shrink or stabilize the tumor (Messersmith, 2019).

Ethiopia's National Cancer Control Plan (2025-2029) seeks to reduce total cancer mortality, particularly colorectal cancer fatalities, by improving early detection, expanding access to treatment, and decentralizing oncology services. Cancer screening integration into primary care, as well as the construction of new regional oncology and radiation clinics, are expected to promote early detection and timely intervention, all of which are critical factors in lowering colorectal cancer mortality rates. Furthermore, investments in healthcare infrastructure, personnel training, and cancer registries are critical to improving results throughout the country (FMoH, 2025).

1.2. Statement of the problem

CRC causes serious health, economic, and social consequences (Awedew *et al.*, 2022). The incidence and mortality rate of CRC were highly raised between 1990 and 2019, with rising incidences from 842 098 to 2·17 million and rising deaths from 518 126 to 1·09 million globally (Banach, 2022). In 2040, new cases of CRC and death are predicted to rise to 3.2 million and 1.6 million per year (Morgan *et al.*, 2023).

Low incidence and mortality rates had raised in high-income countries such as America (28% and 26%) and Europe (13% and 10%), while in Africa, it was raised the incidence and mortality of CRC, 48% and 41%, respectively, between 2010 and 2019 (Awedew *et al.*, 2022).

The overall incidence of CRCs in Africa was 5.25 per 100,000 (Arhin *et al.*, 2022). Ethiopia reported a higher incidence rate of CRC, 7.7 per 100,000, and 2850 people died in 2019 (Awedew *et al.*, 2022). A systematic review and meta-analysis in Ethiopia showed a 40.5% overall mortality rate among CRC patients (Aynalem *et al.*, 2024). Some studies were done in Ethiopia on treatment outcomes and associated factors of CRC, (Wong *et al.*, 2019; Atinafu *et al.*, 2020; Etissa *et al.*, 2021; Teka *et al.*, 2021; Atinafu *et al.*, 2022; Getabile *et al.*, 2022; Zingeta *et al.*, 2023). However, no studies conducted in eastern part of Ethiopia.

Colorectal cancer is a raising public health concern in eastern Ethiopia, particularly at Hiwot Fana Comprehensive Specialized Hospital the only facility offering full cancer treatment and Dilchora General Hospital, which provides only chemotherapy. In spite of the expansion of services, mortality among colorectal cacers patients remains high primarily due to advanced stage presentation, presence of comorbid disease, anemia, malnutrion and delayed diagnosis. These clinical issues are exacerbated by the region's sociocultural backdrop, including extensive khat usage and traditional health beliefs, both of which have a negative impact on health-seeking behavior and treatment adherence. Existing studies in central Ethiopia fail to capture these distinct area structures, and no previous research has examined mortality and its associated factors in these facilities. Creating baseline data in this understudied region is critical for identifying context-specific risk variables and informing initiatives to reduce colorectal cancer mortality in eastern Ethiopia.

1.3. Significance of the study

The study's findings will serve as input to Harari and Dire Dawa health bureaus to construct effective strategies, raise awareness, and develop early detection protocols to improve the survival rate of CRC patients. Also, this study may help HFCSH and DGH to allocate resources more effectively, ensuring adequate staffing, equipment, and training, and educating patients and care providers. Additionally, it may serve as a benchmark for HFCSH and DGH to compare their outcomes with those reported in studies, fostering a culture of accountability and continuous improvement. It may assist healthcare providers of HFCSH and DGH, to implement measures tailored to individual needs, potentially improving survival rates of CRC patients. This study will identify the factors contributing to mortality and identify effective treatment approaches to improve survival rates of CRC patients of HFCSH and DGH. This study could help overcome Ethiopia's data scarcity on outcomes of treatment and factors associated with mortality among CRC patients. It also serves as valuable data for another researcher to compare CRC treatment outcomes and mortality factors across different geographic regions and healthcare systems.

.

1.4. Objective

1.4.1. General objective

To assess mortality and its associated factors among colorectal cancer patients on chemothery follow up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, from March 1 to June 15, 2025.

1.4.2. Specific objectives

- To assess the mortality among CRC patients
- To identify factors associated with mortality among CRC patients

2. LITERATURE REVIEW

2.1. Overview

Firstly used the following search terms "treatment patterns" and/or "treatment outcomes" and/or "associated factors" and "colorectal cancer" or "colon cancer" or "rectal cancer" or "anal cancer" or Ethiopia " and/or East Africa" or Africa" or Global" data on the following websites: PubMed, Google Scholars and getting 30 literatures then 25 literatures retrieved and screened for the review. Finally, 13 literature were found relevant with specific objectives.

2.2. Mortality among CRC patients

A retrospective cross-sectional study done in the West Bank, which demonstrated 41.3% (104) deaths among 252 CRC patients; most of the patients died after a short time of diagnosis (Sawaid *et al.*, 2024). A cohort study done in the Southern United States demonstrates 49.8% (315 patients) of death during the 20-year follow-up period, and most of the dead patients have those diagnosed with stage IV disease or missing stage at diagnosis (Andersen *et al.,* 2019). Retrospective study in China revealed 48.2% of deaths among 310,244 patients registered with the National Central Cancer Registry between 2010 and 2014 (Liu *et al.,* 2015). A study done in Malaysia shows a death percentage, which was 44.7% among 4,501 CRC patients (Hassan *et al.*, 2016). A retrospective cohort (2009–2017) study done among 1012 CRC patients in Saudi Arabia among 1012 CRC patients has found that 27% of deaths of CRC (Alyabsi *et al.,* 2021). A national cancer registry-based cross-sectional study conducted in South Africa demonstrated 80.7% of deaths among 33,232 incident CRC cases from 2002 to 2014 (Motsuku *et al.,* 2021). A prospective cohort (2005–2010) study done in Kenya demonstrated 29.4% of deaths among 233 CRC patients with a 15.9-month mean follow-up period (Saidi *et al.*, 2011). A recent retrospective cohort (2021-2022) study in Kenya showed 22.8% of deaths among 232 CRC patients (Degu *et al.,* 2023). A prospective cohort (2020-2022) study conducted in Ethiopia at Tikur Anbessa Specialized Hospital showed 67.46% of deaths and 63.16% 1-year survival rate among 209 CRC patients (Zingeta *et al.,* 2023).

2.3. Factors associated with mortality

2.3.1. Socio-demographics factors

A retrospective study conducted in Malaysia among 5,675 CRC patients in 2022 shows an age greater than 80 years increases mortality by (HR=1.24, 95% CI= 1.14–1.36, p < 0.001) (Muhamad *et al.,* 2023). An observational study conducted among 180 CRC patients in Greenland shows that being women (HR= 1.52, 95% CI =1.04–2.22) was significantly associated with mortality among CRC patients in 2018 (Odgaard *et al.,* 2018). A longitudinal, retrospective study (2018-202) among 850 CRC patients in Colombia shows a medium socioeconomic level (HR=1.52, 95% CI=1.08–2.14) and age greater or equal to 75 years (HR= 1.83, 95% CI=1.26–2.65) had a predictor of mortality (Guzmán-Gallego *et al.,* 2023). A retrospective cohort (2013-2018) study conducted among 2,279 CRC patients in Brazil demonstrated age between 50 and 74 (HR=1.24, 95% CI =1.02–1.51) and age ≥ 75 (HR=3.02, 95% CI =2.42–3.78) had significantly associated with mortality among CRC patients (Aguiar Junior *et al.,* 2020). A prospective cohort (2005–2010) study done among 233 patients in Kenya shows being male in gender (P=0.04) was associated with mortality (Saidi *et al.,* 2011). A systematic review and meta-analysis of 7 articles, including 2,539 CRC patients done in Ethiopia, showed being older age (HR=1.89, 95% CI= 1.27- 2.82) and being married (HR= 2.53, 95% CI= 1.79-3.57) had associated with mortality among CRC patients (Aynalem *et al.,* 2024).

2.3.2. Clinical factors

A retrospective cohort (2000-2012) study conducted among 4010 of cancer patients in Taiwan demonstrated BMI effects on mortality, compared with normal-weight patients, both obese (HR = 0.676; 95% $P < 0.001$) and overweight individuals (HR = 0.84; $P < 0.001$) had a reduced risk of all-cause mortality. Conversely, underweight patients had a significantly higher risk of death from all causes (HR = 1.41; $P < 0.001$) (Tsang et al., 2016). A retrospective study conducted in Malaysia among 5,675 CRC patients in 2022 shows stage I (adjusted HR= 1.51, 95% CI= 1.05–2.16, p = 0.027), stage II (adjusted HR= 1.46, 95% CI= 1.08–1.97, p = 0.013), stage III (HR= 2.17, 95% CI= 1.64–2.87, p < 0.001), and stage IV (HR= 4.28, 95% CI= 3.26–5.62, p < 0.001) had associated factors of CRC death relative to stage 0 (Muhamad *et al.,* 2023). A retrospective cohort (2009–2017) study done among 1012 CRC patients in Saudi Arabia shows regional cancer (HR=2.51, 95% CI=2.51-4.13), distant metastasis (HR=11.43, 95% CI=7.04 - 18.55), and unknown stage (4.87, 95% CI=2.28-10.37) during diagnosis had contributor to mortality than localized patients (Alyabsi *et al.,* 2021).

An observational study done in Greenland among 180 CRC patients showed late-stage disease during diagnosis (HR=8.37, 95% CI=3.99–17.54, P=0.000) was associated with mortality (Odgaard *et al.,* 2018). Similarly, A longitudinal, retrospective study done (2018-202) among 850 CRC patients in Colombia shows stage four cancer (HR=5.71, CI =95%3.44–9.48) and stage three cancer (HR= 2.51, 95% CI=1.50–4.21) during diagnosis (Guzmán-Gallego *et al.,* 2023). A retrospective cohort (2013-2018) study conducted among 2,279 CRC patients in Brazil demonstrated rectal cancer (HR=1.37, 95%CI =1.11–1.69) was associated with mortality relative to anal cancer (Aguiar Junior *et al.,* 2020).

A prospective cohort (2005–2010) study done among 233 patients in Kenya shows a presence of co-morbidity (P=0.029), recurrence (P=0.001), curative intent (P=0.01), and disease stage (P=0.036) had associated with mortality (Saidi *et al.,* 2011). A prospective cohort (2020-2022) study conducted in Ethiopia at Tikur Anbessa Specialized Hospital showed Hgb levels less than or equal to 12.5 mg/dL were related to mortality (HR = 1.55, 95% CI: 1.06–2.25, p < .022) (Zingeta *et al.,* 2023). A systematic review and meta-analysis of 7 articles, including 2,539 CRC patients done in Ethiopia, showed having co-morbidities (HR=1.84, 95% CI=1.45-2.35), high CEA levels (HR= 2.06, CI= 1.35-3.13); being in stage II (HR= 4.13, 95% CI: 1.85- 9.22), III (AHR: 8.62, 95% CI= 3.88- 19.15), and IV (AHR= 8.06, CI= 2.89- 22.49) during diagnosis had the predictors of mortality (Aynalem *et al.,* 2024).

2.3.3. Treatment-related factors

A retrospective study conducted in Malaysia among 5,675 CRC patients in 2022 showed those who received treatment had a lower risk of death compared to those who did not receive any treatment (HR 0.66, 95% CI= 0.59–0.75, p < 0.001) and those who received a single therapy (surgery, chemotherapy, radiotherapy, or others) had a higher risk of CRC death than those who received more than one treatment modality (all p < 0.001) (Muhamad *et al.,* 2023). A retrospective cohort (2009 – 2017) study done among 1012 CRC patients in Saudi Arabia shows undergoing surgery (HR=1.36, 95% CI=1.007-1.83) and not taking any chemotherapy (HR=1.65, 95% CI=1.17- 2.33) had increased the risk of mortality (Alyabsi *et al.,* 2021). A retrospective cohort (2013-2018) study done in Brazil among 2,279 CRC patients demonstrated patients started treatment >60 days after diagnosis (HR=1.22, 95%CI =1.04–1.43) increased the risk of death (Aguiar Junior *et al.,* 2020). A prospective cohort (2005–2010) study done among 233 patients in Kenya shows taking chemotherapy (P< 0.01) was increase the risk of mortality (Saidi *et al.,* 2011).

2.4. Conceptual framework

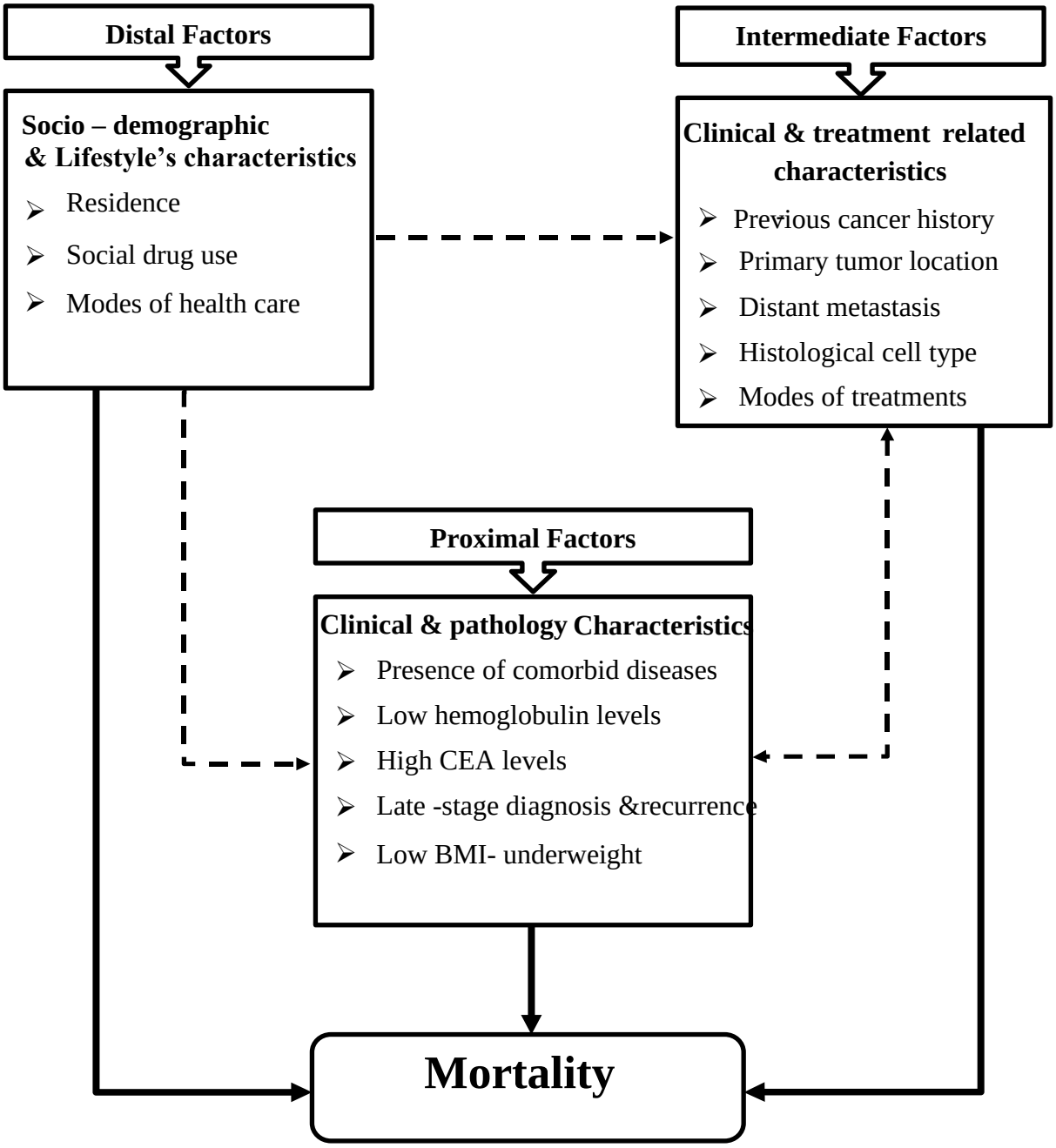

Figure 1: Conceptual framework established by reviewing multiple sources.

3. METHODS AND MATERIALS

3.1. Study area and period

This study was conducted at Hiwot Fana Comprehensive Specialized (HFCSH) and Dilchora General Hospital (DGH). Harar and Dire Dawa are cities in eastern Ethiopia and located around 526 and 505 kilometers from Addis Ababa, Ethiopia's capital city, respectively. Harari regions has 36 kebeles; 19 are in the town, while the remaining 17 are in the rural part. Whereas Dire Dawa city administration has 47 kebeles: 9 are in the city, while the remaining 38 are in the rural part.

Harar land size is around 334 km2, with an estimated 246,000 population: 50.4% males and 49.6% females. Whereas, in Dire Dawa estimated around 396,423 populations and 58% of the population live in urban whereas 42% in rural.

There are five hospitals in Harar town: three governmental hospitals and two private hospitals. Additionally, nine public health centers, thirty-two health posts, ten non-profit private clinics, and sixteen profit-making private clinics are present in Harar town. Also, Dire Dawa has four governmental and four private hospitals, 16 health centers, five higher clinics, 12 medium clinics, and 31 Health posts.

HFCSH was established in 1948 G.C and became a university hospital in 2010 G.C. It has six wards: medical, surgical, obstetrics, gynecology, psychiatry, and pediatric. Additionally, it provides services for malnutrition, neonates, ophthalmology, dentistry, orthopedics, plastic surgery, pediatric outpatients, adult outpatients, pediatric emergencies, adult emergencies, pathology, ICU, ANC follow-up, and chronic follow-up. The Oncology Center has been one of the services provided by this hospital since 2020.

DGH was established in 1952. It has five wards: medical, surgical, obstetrics and gynecology, psychiatry, and pediatrics. In addition, it offers services for malnutrition, newborns, ophthalmology, dentistry, orthopedics, plastic surgery, pediatric outpatients, adult outpatients, pediatric and adult emergencies, pathology, ICU, ANC follow-up, and chronic follow-up. The Oncology service has been one of the services provided by this hospital since 2023.

This study was conducted among CRC patients rigestered form February 25, 2020 upto January 1, 2025 and January 1, 2023 upto January 1, 2025, at HFCSH and DGH respectively, during data collection period of March 1 to June 15, 2025.

3.2. Study design

A retrospective chart review was used, and medical records of the patients were reviewed retrospectively from the time of diagnosis until the censoring or event of interest time.

3.3. Population

3.3.1. Source of population

All CRC patients registered form February 25, 2020 upto January 1, 2025 and January 1, 2023 upto January 1, 2025 in HFCSUH and DRH respectively, was population sources.

3.3.2. Study of population

Patients diagnosed with CRC and had treated from February 25, 2020 upto January 1, 2025 and January 1, 2023 upto January 1, 2025 in HFCSUH and DRH respectively, fulfilled the inclusion criteria, from March 1 to June 15, 2025.

3.4. Inclusion and exclusion criteria

3.4.1. Inclusion criteria

CRC patients with biopsy confirmed diagnosis of malignant tumors in the large bowel, and had at least one treatment strategy initiated were considered for the study.

3.4.2. Exclusion criteria

- CRC patients with Incomplete medical records (e.g., missing histology, cancer stage diagnosis, and treatment regimen)
- Colorectal patients with Non-malignant tumors.
- Pregnant women and pediatric population.

3.5. Sample size determination

All patients treated for CRC who fulfilled the inclusion criteria were included for the study and their medical charts for registry in the past five years were retrospectively reviewed. Overall, there were 211 patients with CRC who visited oncology unit of HFCSH and DGH from form February 25, 2020 upto January 1, 2025 for HFCSH and January 1, 2023 upto January 1, 2025 for DGH. However, 185 of the CRC patients fulfilled the inclusion criteria and hence were included in the study (see Figure 2 below).

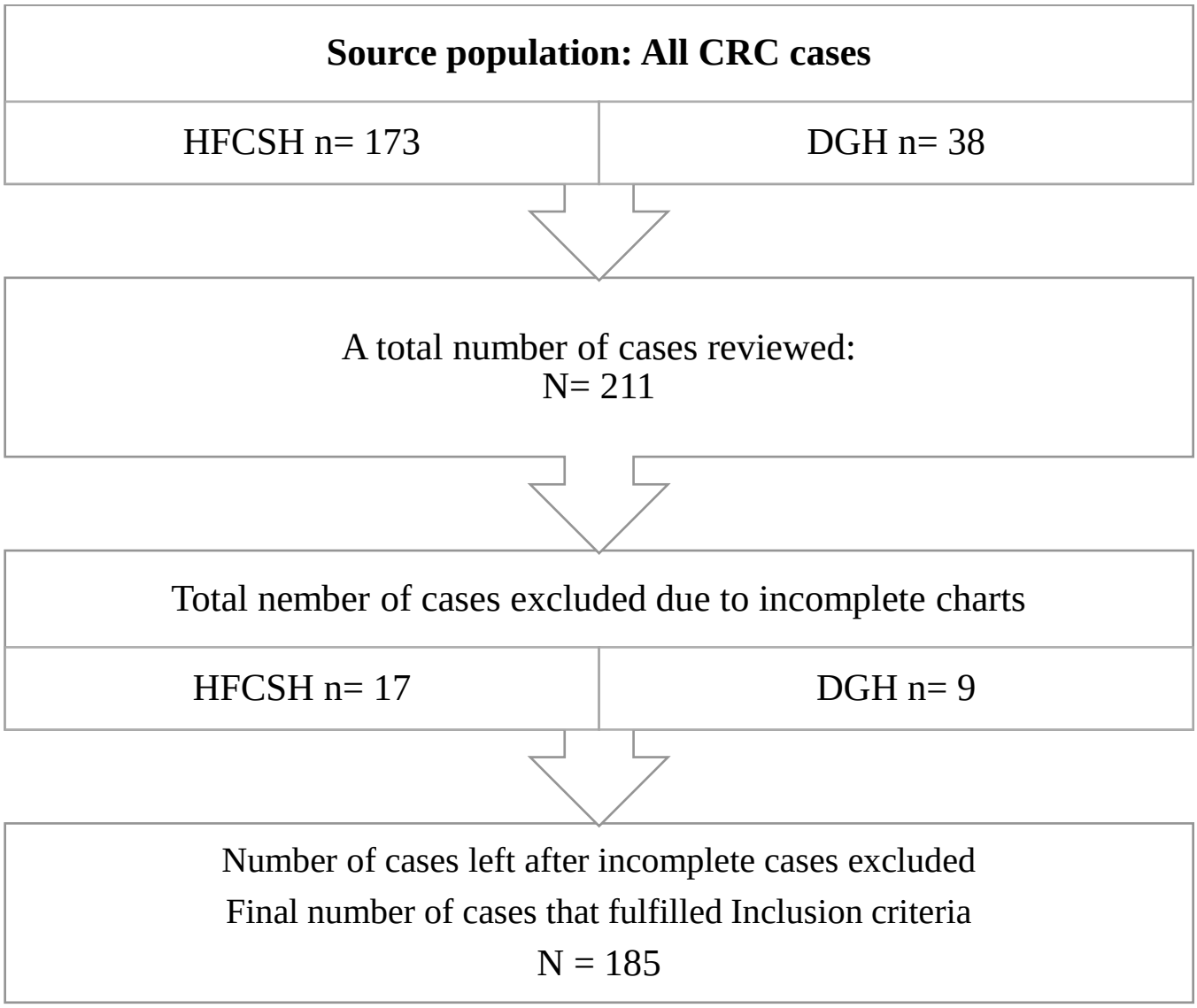

Figure 2: Sampling size determination and its sampling procedure

3.6. Sampling technique

All colorectal cancer patients treated at HFCSH and DGH were sampled and purposive sampling technique was used.

3.7. Data collection methods

3.7.1. Data collection instruments

Data abstraction format was developed after reveiwing relevant literature (Saidi *et al.,* 2011; Odgaard *et al.,* 2018; Aguiar Junior *et al.,* 2020; Alyabsi *et al.,* 2021; Guzmán-Gallego *et al.,* 2023; Muhamad *et al.,* 2023;Aynalem *et al.,* 2024). The data abstraction format was prepared in English. It containedclosed-ended questions. The data abstraction format socio-demographics, lifestyle, clinical factors clinical and treatment-related factors.

3.7.2. Data collectors and supervisors

Two pharmacists from an oncology pharmacy and two oncology nurses gathered the data. Additionally, two clinical pharmacists supervised the data collection.

3.7.3. Data collection procedure

The registration books of the oncology departments were reviewed to identify the medical record numbers of patients treated with CRC during the study period from February 25, 2020 up to January 1, 2025 for HFCSH and January 1, 2023 up to January 1, 2025 for DGH. Following identification, the corresponding medical charts were retrieved from the oncology unit archives and documentation offices of HFCSH and DGH. Data were collected retrospectively by reviewing the medical records of CRC patients who received treatment at these institutions. Using a structured data abstraction format, information was extracted from each chart covering a five-years period starting from the patient's initial visit. The collected data included sociodemographic characteristics (age, sex, residence, marital status, and health coverage), lifestyle factors (tobacco use, alcohol consumption, and khat use), clinical features (medical history, comorbidities, and disease stage), and treatment-related variables (type of chemotherapy, treatment initiation dates, and treatment adherence). Both baseline and follow-up information were systematically captured to enable a complete analysis of patient outcomes. This approach allowed for the identification of mortality events during the study

period and facilitated the investigation of factors associated with mortality among CRC patients undergoing treatment.

Data were collected by two trained pharmacists and two nurses who had a training prior to data collection on how to collect data using the data abstraction format at each institution.

3.8. Variables

3.8.1. Dependent variable

- Survival status (death or alive)

3.8.2. Independent variables

- **Socio-demographic** (age, sex, residence, marital status, and mode of health coverage)
- **Lifestyle characteristics** (tobacco use, alcohol use, and khat use)
- **Clinical factors: medical history** (previous cancer history, family history of cancer, comorbidities, and comorbid disease) and **Clinical and pathological characteristics** (primary tumor location, histological cell type, level of histological differentiation, body mass index (BMI), hemoglobin, tumor-node-metastasis (TNM) stage at diagnosis, clinical stage at diagnosis, starting time of management after confirmed diagnosis, depth of tumor invasion, regional lymph node involvement, distant metastasis, and baseline carcinoembryonic antigen)
- **Treatment-related factors** (surgery, the timing of surgery, chemotherapy, chemotherapy, completed the prescribed cycles of chemotherapy, radiotherapy and chemotherapy and/or surgery)

3.9. Definition of terms

Body Mass Index (BMI) is a measure of weight in relation to height. It is the most practical way to estimate if a person is underweight, at a healthy weight, overweight, or obese. The interpretations are: Underweight (BMI < 18.5), Normal (BMI ≥ 18.5 and < 25), Overweight (BMI ≥ 25 and < 30), and Obese (BMI ≥ 30). These indexes were taken at the time of diagnosisof CRC (Boyle et al., 2013).

Carcinoembryonic antigen is a glycoprotein, a protein that has carbohydrate groups attached to it, which is involved in cell adhesion. It is a substance that can be found in the blood and other body fluids and is used as a tumor marker, particularly for cancers of the colon and rectum.

Comorbidities: Comorbidities can be defined as other chronic episodic disorders like asthma (i.e., acute episodes of signs and symptoms that can come and go for years) or chronic progressive conditions like cardiovascular disease (Caito and Aschner, 2015). Any distinct additional entity that has existed or may occur during the clinical course of a patient who has the index disease under study. Diseases that are "not directly related in either pathogenesis or management and do not share an underlying predisposing factor" (e.g., type 2 diabetes mellitus and irritable bowelsyndrome) (Valderas et al., 2009). In this study, it refers to any chronic medical disease except malignancies.

Hemoglobin is a protein found inside red blood cells that is responsible for transporting oxygen in the blood.

Mortality: It refers to the condition of being a living thing that is subject to death and will not live forever.

Treatment outcomes: It refers to the status of the patient after starting treatment until the end of the study period. Death and live are the two treatment outcomes considered.

3.10. Data quality control

Before data collection, a pretest was done on 5% of the sample size at the same places, because there was no near setup which provide oncology services. Pretest data ws excluded to avoid bias introduced by changes made to the data abstraction format after the pretest.. After that, the data abstraction format was rearranged as necessary. Before starting data collection, appropriate orientation was given to the data collectors on the data abstraction format and the purpose of the data. The principal investigator was closely supervise the data collection process throughout the data collection period. To ensure data quality, the principal investigator conducted daily reviews of the collected data for completeness and internal consistency by randomly selecting and cross-checking patient charts.

3.11. Data analysis

The collected data was coded, edited, cleaned and analyzed using Statistical Package for the Social Sciences (SPSS) software version 27.0. Descriptive analysis was used to describe the pattern of each independent variable. Categorical variables were summarized as percentages, and continuous variables were summarized as means, standard deviations (SDs), and medians. Survival proability over time was estimated using Kaplan Meier curve and factors associated with mortality were determined using Cox regression model. Univariate Cox-regression analysis was used to determine the association of different variables with mortality. However, Univariate cox regression does not consider the effect of confounding factors which may affect the relationship between dependent and independent variables. Then multivariable analysis was performed using cox proportional hazards – regression model, on variables that have a p-value of <0.25 at the univariate analysis, to determine the independent factors associated with mortality. Estimation of hazard ratio (HR) at a 95% confidence level was done using the Cox regression model. Proportional hazard (PH) assumptions, as one of cox model assumptions were initially tested using log-log plots. Convergence, divergence, or crossing of log-log plots violates PH assumptions. The lines of the log-log plots were parallel. So, proportional hazard assumptions were satisfied. A *p*-value of less than 0.05 was considered statistically significant.

3.12. Ethical considerations

The study was ethically approved by the Institutional Health Research Ethics Review Committee (IHRERC) of the College of Health and Medical Sciences (Reference numbere:- IHRERC /049 /2025). Supportive letters was written for HFCSH and DGH from the School of Pharmacy and was submitted to the concerned bodies of HFCSH and DGH. Informed, voluntary written, and signed consent was obtained from head of hospitals. Ethical conduct was maintained throughout the study. The privacy and confidentiality of each patient was ensured.

3.13. Plan for dissemination of the findings

The final result will be presented to the School of Pharmacy, College of Health and Medical Sciences, Haramaya University, and copies will be given to the oncology center department, HFCSH, DGH, Harari Health Bureau and Dire Dawa Health Bureau. Also, the result of this study will be published for the scientific community.

4. RESULT

4.1 Socio-demographic characteristics of patients

A total of 185 patient's medical records with a diagnosis of CRC were reviewed for the study. Out of the 185 study participants, males comprised (101, 54.6%). The majority (103, 55.7 %) of the study participants were under 49 years old. The mean age at the time of diagnosis was (46.65, (SD± 12.736) years. The majority (156, 84.3%) of the patients were from HFCSH, and being married accounted for the highest proportion (178, 96.2%). No formal education was the highest level of education that the study participant was undergone (145, 78.4%) and majority of the patient's mode of health care coverage was out of their pocket (96, 51.9%) (Table 1).

Table 1: Socio-Demographic Characteristics of CRC Patients in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, eastern Ethiopia, 2020 – 2025

Variables	Category	Frequency	Percent(%)
Sex	Male	101	54.6
	Female	84	45.4
Age (year)	49 and below	103	55.7
	50 – 74	80	43.2
	75 and above	2	1.1
Site of Admission	HFCSH	156	84.3
	DGH	29	15.7
Marital status	Married	178	96.2
	Not married	7	3.8
Religion	Muslim	113	61.1
	Orthodox	60	32.4
	Protestant	12	6.5
Education status	No formal education	145	78.4
	Primary education	30	16.2
	Secondary education	8	4.3
	Tertiaryeducaton(e.g., Diploma	2	1.1
Mode of health care	Out of pocket	96	51.9
	Paid insurance	89	48.1

4.2. Social drug use status of patients

Regarding social drug use status history, 48 (25.9 %) of the patients had a known history of tobaccouse, 43 (23.2%) drunk alcohol, and 106 (57.3 %) of them chew khat (Figure 3)

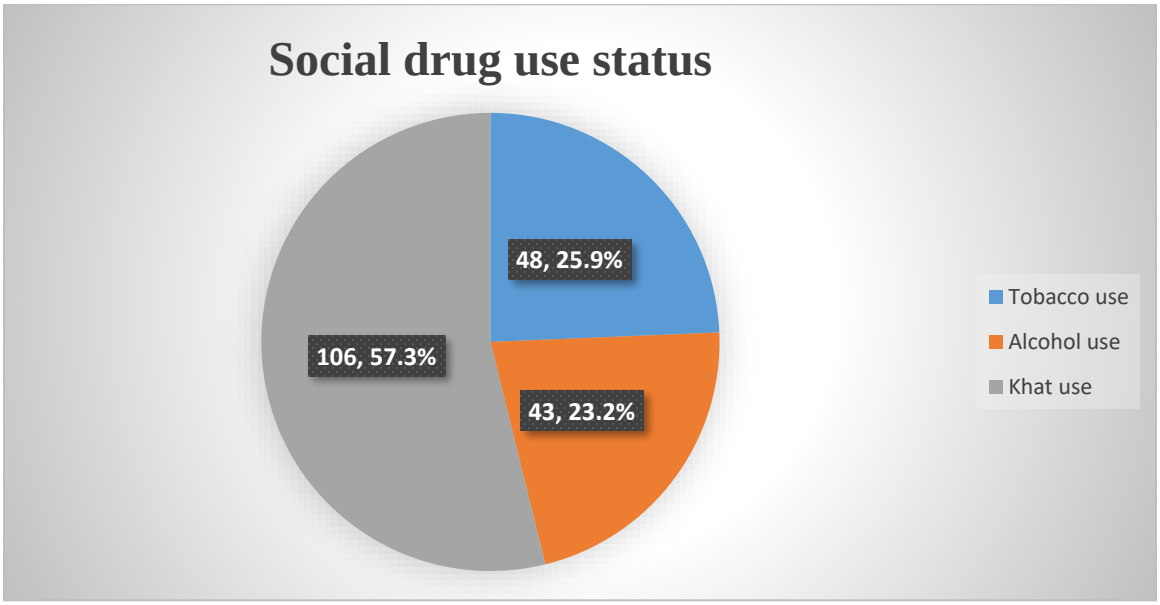

Figure 3: Social drug use status of CRC Patients in Hiwot Fana Specialized University Hospital and Dilchora Referral Hospital eastern Ethiopia, 2020 – 2025

4.3. Medical history

Regarding the medical history, 40 (21.6%) of the study participants had a known previous cancer history. More than half, 107 (57.8%) of the study participants had a history of comorbid diseases and hypertension accounted for the highest percentage 24 (13%) **(**Table 2).

Table 2: Medical History of CRC Patients in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, eastern Ethiopia, 2020 – 2025

Variables	Category	Frequency	Percent(%)
Previous cancer history	No	145	78.4
	Yes	40	21.6
Comorbidities	No	78	42.2
	Yes	107	57.8
Comorbid disease	Hypertension	24	13
	DM	12	6.5
	Heart Failure	9	4.9
	Asthma	7	3.8
	Epilepsy	7	3.8
Under comorbid others	RVI	7	3.8
	Gastritis	7	3.8
	Kidney disease	5	2.7
	COPD	4	2.2
	Abdominal infections, anemia, BPH, DVT, Hemorrhoid	3	1.6
	Sinus	2	1.1
	Psychosis, LBO, IBD, cervical and breast etc.		

Note: DM-diabetes melitus , RVI- retroviral infection, COPD-chronic obstructive pulmonary disease, BPH-benign prostatic hyperplasia, DVT-deep vein thrombosis, LBO-large bowel obstruction, IBD-inflamatory bowel disease.

4.4. Clinical and pathological characteristics

As shown in Table 3 more than half of the study participants were diagnosed with rectal cancer 99 (53.5%). Higher proportions of the patients were diagnosed with a histological cell type of adenocarcinoma 159 (85.9%). With regard to the level of histological cell differentiation 93 (50.3%) were moderately differentiated. A BMI 134 (72.4%) and hemoglobulin 94 (50.8%) of the study participants was calculated and majorities, of them were in the normal BMI range and low hemoglobulin. Stage III – 97 (52.4 %) and T3- 97(52.4%) was the major TNM stage and depth tumor invasion presented during diagnosis.

Table 3: Clinical and Pathological Characteristics of CRC Patients in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, easren Ethiopia, 2020 – 2025

Variables	Category	Frequency	Percent(%)
Location of tumor	Rectal	99	53.5
	Colonic	75	40.5
	Both	11	6
Histological cell type	Adenocarcinoma	159	85.9
	Mucinous or signet – ring cell carcinoma	26	14.1
Level of histological differentiation	Well differentiated	28	15.1
	Moderately differentiated	93	50.3
	Poorly differentiated	54	29.2
	Undifferentiated	9	4.9
BMI	Normal	134	72.4
	Underweight	38	20.5
	Overweight	9	4.9
	Obese	4	2.2
Hemoglobulin	Normal	91	49.2
	Low	94	50.8
TNM stage	Stage I	17	9.2
	Stage II	57	30.8
	Stage III	97	52.4
	Stage IV	14	7.6

Depth tumor invasion	T1	18	9.7
	T2	58	31.4
	T3	97	52.4
	T4	12	7.6
Region of lymph node involvement	N0	73	39.5
	N 1	106	57.3
	N 2	6	3.2
Distant metastasis	M 0	73	39.5
	M 2	112	60.5
CEA	Not elevated	169	91.4
	Elevated	16	8.6

Note: BMI-body mass index, TNM- tumor-node-metastasis, CEA- carcineoembrionic antigen

4.5. Treatment-related characteristics

With regard to treatment modalities used for the treatment of CRC, a combination of chemotherapy and surgery was the primary mode of 52 (28.1 %) followed by a combination of chemotherapy, surgery, and radiotherapy 44 (23.8%) and both chemotherapy alone and surgery alone 34 (18.4%). Xelox was the most common chemotherapy regimen used by the study participants in the study 72 (38.9%) followed by capecitabine 29 (15.7%). (Figure 4 and Table 4).

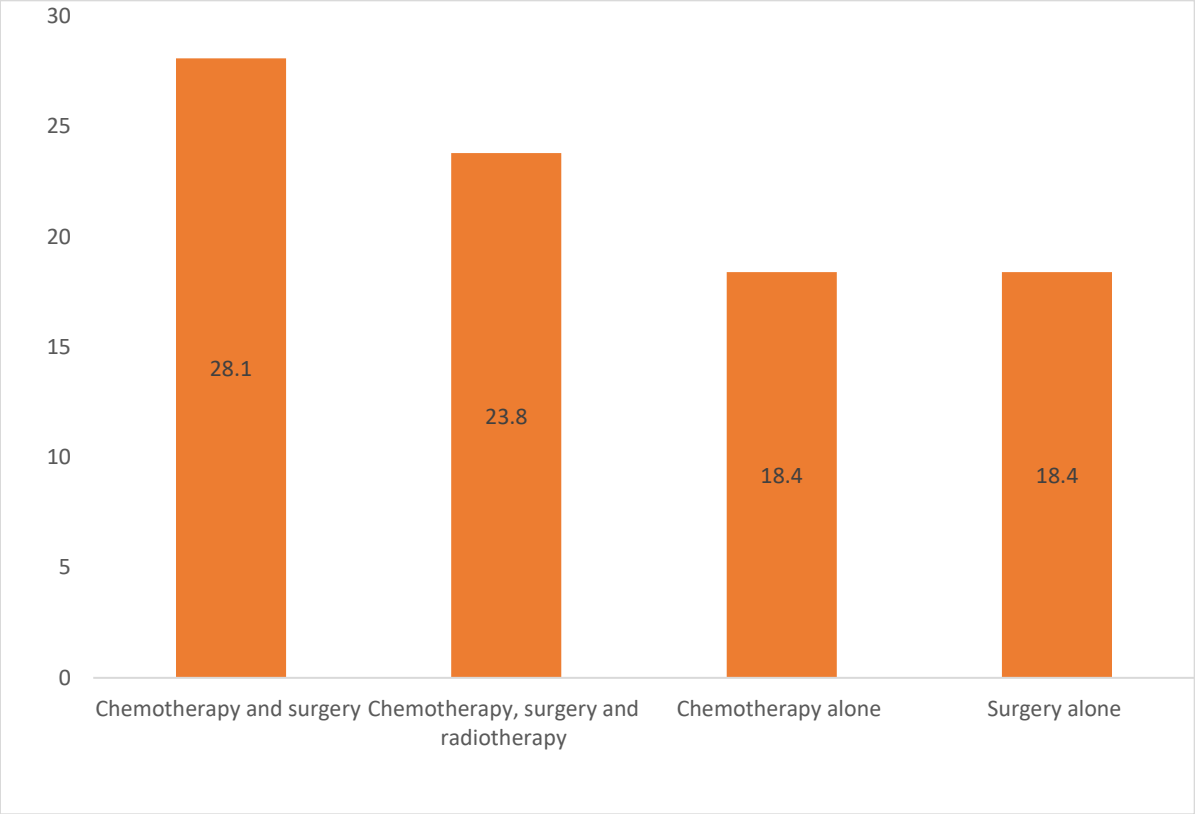

Figure :- 4 Modes of tretment for CRC Patients in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, eastern Ethiopia, 2020 – 2025

Table 4: Chemotherapy regimen, surgery and radiotherapy for CRC Patients in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, eastern Ethiopia, 2020 – 2025

Variables	Variables Category	Frequency	Percent (%)
Chemotherapy regimen	XELOX	72	38.9
	Capecitabine	29	15.7
	FOLFOX	21	11.4
	FOXFIRI	15	8.1
	Cisplatin	4	2.2
	Fluorouracil	2	1.1
Other chemo regimen (each)	Oxaliplatin, paclitaxel, vincristine	1	0.5
Complete chemo cycle	No	131	89.7
	Yes	15	10.3
Chemotherapy used for	Adjuvant	104	56.2
	Neoadjuvant	25	13.5
	Palliative	17	9.2
	Planned and done	133	71.9
Surgery	Not planned	52	28.1
Type of surgery	Elective	130	97.7
	Emergency	3	2.3
Radiotherapy	Planned and given	65	35.1
	Not planned	116	62.7

Note:XELOX – capcitabine and oxaliplatin, FOLFOX-5-flurouracil and oxaliplatin, FOXFIRI- 5-flurouracil and irinotecan

4.5. Magnitude and factors associated with mortality

According to the Cox regression analysis of 3.2 years follow up data from a total of 185 colorectal cancer patients treated at HFCSH and DGH, 139 (75.1%) patients experienced the event of interest (death), while 46 (24.9%) patients were censored and survival probabilities were 84 % at one year and 24.9% at 3.2 years.

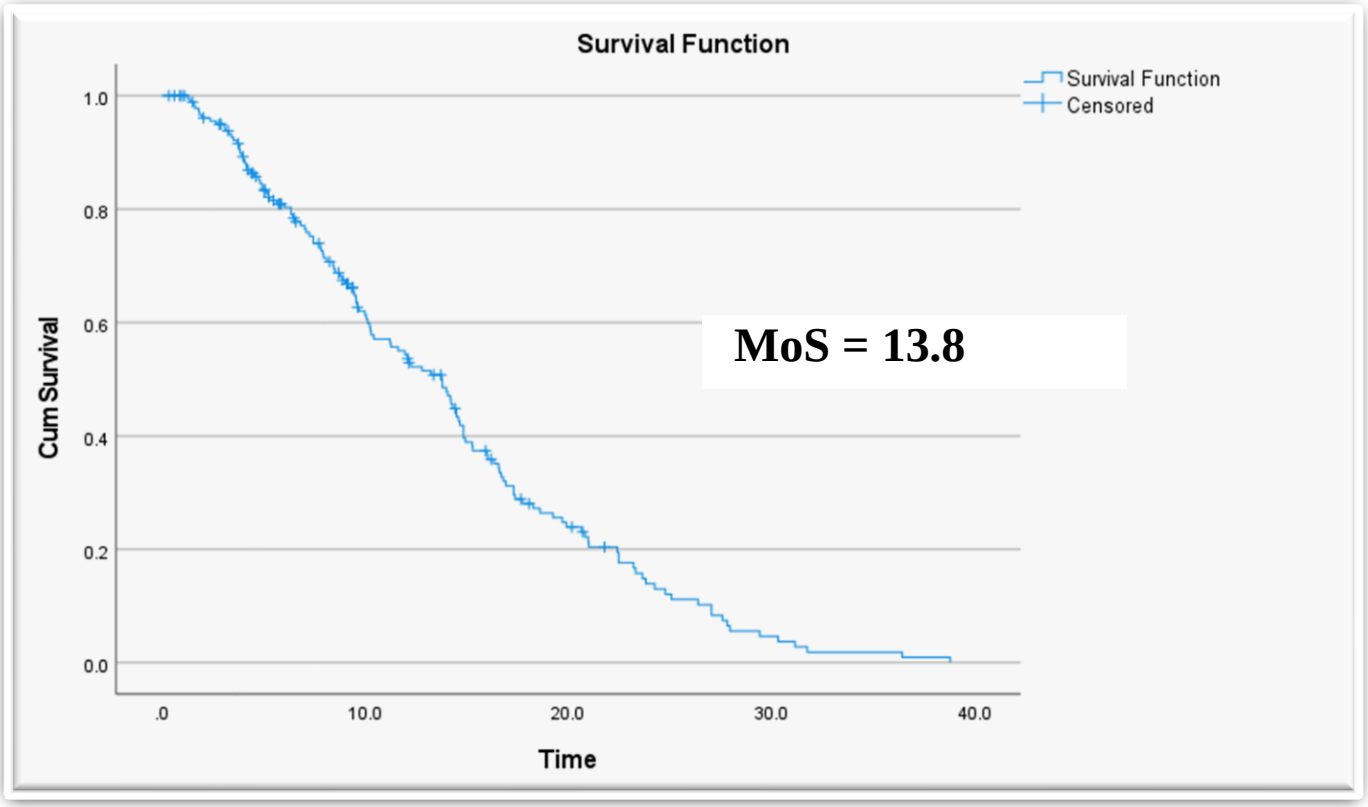

Figure :- 5 Kaplan Meier overall survival function of CRC patient in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital Ethiopia 2020 – 2025

Among the colorectal cancer patients, 99 were diagnosed with rectal cancer, of whom 72 (72.7%) experienced the event of death and 27 (27.3%) were censored. Among the 75 patients with colon cancer, 57 (76.0%) experienced the event of death, while 18 (24.0%) were censored. Additionally, 11 patients had both colon and rectal cancer, with 10 (90.9%) experiencing the event of death and 1 (9.1%) censored.

The univariate Cox proportional hazards analysis conducted at this stage, several sociodemographic, behavioral, and clinical variables were assessed for their association with mortality. These variables includeds body mass index (BMI) (p = 0.001), carcinoembryonic antigen (CEA) levels (p = 0.044), presence of comorbid diseases (p = 0.012), hemoglobin levels (p = 0.005), previous history of cancer (p = 0.006), age (p = 0.152), sex (p = 0.81), alcohol use (p = 0.207), khat use (p = 0.574), marital status (p = 0.083), tobacco use (p = 0.242), presence of distant metastasis (p = 0.254), and were undergone univariate relationship with mortality. Variables with p-values less than 0.25 were selected for further evaluation in the multivariate Cox proportional hazards model**.**

Based on univariate cox regression analysis, variables that have a p-value of < 0.25 were used in multivariate analysis. Hence, Age (p=0.152), alcohol use (p=0.207), BMI (P= 0.001), CEA (p=0.044), presence of comorbidity(p=0.012), hemoglobin levels (p=0.005), marital status (p= 0.083), tobacco use (p= 0.242), previous cancer history (p= 0.006), were included in the multivariate cox regression analysis.

Table 5: Bivariate associations of categorical Variables with mortality of CRC Patients in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, eastern Ethiopia, 2020 – 2025

Variable	Category	CHR 95 % CI	P – value
Sex	Female	1	
	Male	1.04 (0.74 - 1.460)	0.812
Age	49 and below	1	
	50 – 74	1.28 (0.912 – 1.085)	0.152
	75 and above	5.63 (1.352 – 23.452)	0.018
Marital status	Not married	1	
	Married	0.410 (0.149 – 1.123)	0.083
Tobacco use	No	1	
	Yes	0.805 (0.559 – 1.158)	0.242
Alcohol use	No	1	
	Yes	0.779 (0.529 – 1.148)	0.207
Khat use	No	1	
	Yes	1.106 (0.779 – 1.569)	0.574
Previous cancer history	No	1	
	Yes	1.699 (1.162 – 2.485)	0.006
Comorbidity	No	1	
	Yes	1.671 (1.118 – 2.498)	0.012
BMI	Normal	1	
	Underweight	2.026 (1.312– 3.129)	0.001
	Overweight	1.095 (0.522 – 2.298)	0.810
Hemoglobulin	Normal	1	
	Low	1.631 (1.162- 2.289)	0.005
CEA	Not elevated	1	

	Elevated	1.855 (1.018 – 3.379)	0.044
Distant metastasis	No	1	
	Yes	1.245 (0.854 – 1.816)	0.254

Note:- CHR: Crude Hazard Ratio; CI, confidence interval, BMI- Body mass index, CEA-carcinoembroinc antigen.

After controlling different demographic, clinical, pathologic, and other factors; BMI of underweight (AHR 1.72, 95% CI (1.07 – 2.78) p=0.026), elevated CEA (AHR 2.25, 95% CI (1.19– 4.26) p=0.012), low hemoglobin (AHR 1.62, 95% CI (1.10 – 2.39) p=0.014), presence of comorbid diseases (AHR 1.65, 95% CI (1.07 – 2.56) p=0.023), were significantly associated with mortality. Whereas, factors like age (AHR= 1.25, 95% CI (0.87 – 1.79) p=0.233), alcohol (AHR= 0.77, 95% CI (0.50 – 1.18) p=0.224), marital status (AHR=0.54, 95%CI (0.19 - 1.55), p=0.249), previous cancer history (AHR= 1.14, 95% CI (0.71 – 1.84) p=0.584), tobacco use (AHR= 0.80, 95% CI (0.54 – 1.19) p=0.277) were not significantly associated with CRC mortality.

On multivariate Cox regression patients who had aged 50 – 74 has an increased hazard ratio (AHR 1.25, 95% CI (0.87 – 1.79) p=0.233), and patients who had aged 75 and above has an increased hazard ratio (AHR 2.57, 95% CI (0.57 – 12.02) p= 0.205) but this was not statistically significant on multivariable analysis. (Table 6).

Table 6: Multivariate association of categorical Variables with Survival of CRC Patients in Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, eastern Ethiopia, 2020 – 2025

Variable	Variable category	AHR 95 % CI	P – value
Age	49 and below	1	
	50 – 74	1.245 (0.868– 1.787)	0.233
	75 and above	2.565 (0.568 – 12.02)	0.205
Marital status	Not married	1	
	Married	0.536 (0.186 – 1.549)	0.249
Tobacco use	No	1	
	Yes	0.803 (0.541 – 1.192)	0.277
Alcohol use	No	1	
	Yes	0.765 (0.497 – 1.178)	0.224
Hemoglobulin	Normal	1	
	Low	1.621 (1.101 – 2.388)	**0.014**
Comorbidity	No	1	
	Yes	1.654 (1.071– 2.556)	**0.023**
Previous cancer history	No	1	
	Yes	1.143 (0.709 – 1.843)	0.584
CEA	Not elevated	1	
	Elevated	2.253 (1.192– 4.258)	**0.012**
BMI	Normal	1	
	Underweight	1.724 (1.068 – 2.783)	**0.026**
	Overweight	0.690 (0.302 – 1.574)	0.378

Note :- AHR: Adjusted Hazard Ratio; CI, confidence interval BMI- Body mass index, CEA-carcinoembroinc antigen

5. DISCUSSION

The present study conducted at Hiwot Fana Comprehensive Specialized Hospital and Dilcora General hospital reveal a mortality rate of 75.1% among patients with colorectal cancer. The factors significantly associated with this mortality were underweight , elevated carcinoembryonic antigen, low hemoglobin levels, and the presence of comorbid diseases.

The observed mortality rate among colorectal cancer patients was 75.1%, which is higher than rates reported in other studies: a cohort study in the Southern United States found a rate of 49.8% (Andersen et al., 2019), a study in West Bank reported 41.3% (Sawaid et al., 2024), and research in China showed 48.2% (Liu et al., 2015). Factors such as limited resources, insufficient cancer screening programs, and difficulties in early diagnosis and treatment may contribute to increased mortality rates. Conversely, this rate is lower than that found in a cross-sectional study in South Africa, which documented an 80.7% death rate among 33,232 incident colorectal cancer cases from 2002 to 2014 (Motsuku et al., 2021). While both African studies reported elevated mortality rates, the sample size in the South Africa study was larger than those at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital.

There have been conflicting findings on the association between higher BMI and colorectal cancer mortality. Studies linking higher BMI- to increase risk of mortality by promoting tumor growth through insulin resistance and elevated levels of insulin-like growth factors (Demark-Wahnefried et al., 2012), while others, like (Badrick et al., 2017), suggest higher BMI may decrease risk of mortality. This study found that being underweight was significantly associated with increased mortality. A similar finding was reported by (Tsang et al., 2016), who observed that lower BMI was associated with increased mortality among colorectal cancer patients. Based on these results, maintaining a normal body weight is advised for patients with CRC. In this study, 2.2% of participants were classified as obese, a prevalence comparable to that reported in Taiwan (3.8%) (Tsang et al., 2016) and but significantly lower than the 29.4% reported in Australia by Australia (29.4%) (Boakye et al., 2018), which may be attributed to socio-economic differences.

Carcinoembryonic antigen (CEA) serves as a significant prognostic indicator in colorectal cancer patients, with elevated levels being correlated with adverse patient outcomes. Based on the results

shown in this study, patients with CEA levels ≥ 5ng/mL during diagnosis had a 2.3-fold increased risk of mortality (AHR: 2.25; 95% CI: 1.19- 4.26, p=0.012) when compared to individuals with CEA levels below 5ng/ml. A systematic review and meta-analysis of seven publications, involving 2,539 CRC patients, conducted in Ethiopia, found that this observed relationship is consistent with the findings (Aynalem et al., 2024), and the COLOFOL clinical study (Egenvall et al., 2021), which showed that elevated serum CEA levels before and after surgery were associated with increased overall and cancer-specific mortality (Aguiar Junior et al., 2020).

Similarly, research by (Baqar et al. (2019) identified a 62% greater hazard of death in patients with elevated CEA levels (Aguiar Junior et al., 2020). This is likely attributable to the fact that higher preoperative concentrations are indicative of poorer response to treatment, diminished survival rates, more advanced stage of cancer, and the presence of nodal metastasis (Li Destri et al., 2015; Hall et al., 2019), all of which elevate the risk of death related to colorectal cancer.

The presence of comorbidities is a significant adverse prognostic factor in patients with colorectal cancer. Patients with comorbidities had a 1.7-fold higher risk of death (AHR: 1.65**,** 95% CI: 1.07–2.56, p=0.023) compared to those without comorbidities. A systematic review and meta-analysis of 7 articles, including 2,539 CRC patients done in Ethiopia and countries such as Germany, Spain, Australia, and the Netherlands (Aynalem et al., 2024), (Pule et al., 2019; Michalopoulou et al., 2021; Luque-Fernandez et al., 2020; Boakye et al., 2018), also identified that comorbidities such as hypertension, diabetes, congestive heart failure, and asthma were potent predictors of mortality among patients with colorectal cancer. Similarly, prior research by (Saidi *et al. (*2011) reported a 20% increased hazard of death among patients with comorbid disease. It has been found that the majority of CRC patients have at least one other health condition. This elevated likelihood of mortality has several fundamental causes. It can be described as comorbidities that can directly influence the biological characteristics of the tumor, including its morphology, histologic features, cellular differentiation, and proliferation rate (Søgaard et al., 2013; Panigrahi and Ambs, 2021). Furthermore, these preexisting conditions can compromise the host immune system and complicate the administration and tolerance of oncologic therapies, thereby contributing to an increased risk of mortality (Michalopoulou et al., 2021; Aguiar Junior et al., 2020)

Anemia, defined by low hemoglobin levels, is a common complication in cancer patients on treatment and is linked to higher mortality risk. According to this study, patients with hemoglobin concentrations of 12.5 mg/dl or less had a 1.6-fold greater risk of mortality compared to individuals with higher hemoglobin levels (AHR: 1.62, 95% CI: 1.10 –2.39, p=0.014). These findings are consistent with research from Ethiopia (HR = 1.55, 95% CI: 1.06–2.25, p < .022) (Zingeta *et al.*, 2023) and Finland (HR = 1.61, 95% CI: 1.07–2.42, p < .023). (Väyrynen et al., 2018). Notably, the prognostic significance of lower Hgb is particularly exacerbated among black African American patients. (Wallace et al., 2020)**.** This may result from genetic factors.

Limitations of the study

This study included data from all patients diagnosed and treated at HFCSH and DGH, ensuring comprehensive use of the available information. However, due to the small sample size, the findings may not fully capture the experiences of a larger, more diverse population. Although every case was carefully analyzed, the limited number of participants makes it challenging to generalize the results to broader settings. The retrospective nature of the study posed additional challenges, as some patient charts with CRC may have been missed, and several medical records lacked complete documentation. This limited access to important variables such as family history, substance use, radiation exposure, adverse drug reactions (ADRs), and surgical complications, factors that may be associated with CRC mortality. Therefore, conclusions related to these variables should be interpreted with some consideration. Nonetheless, study offers important findings and practical recommendations for those working to reduce CRC related mortality.

6. CONCLUSION AND RECOMMENDATION

6.1. Conclusions

This study revealed that mortality from colorectal cancer was significantly high among patients receiving chemotherapy follow-up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital. Mortality was significantly associated with the presence of anemia, malnutrition, advanced-stage disease at diagnosis, and comorbid conditions. These findings indicate that clinical and nutritional status at the time of treatment initiation play a critical role in patient outcomes. The results highlight the substantial burden of colorectal cancer and emphasize the impact of disease severity and overall health status on mortality.

.6.2. Recommendations

The study offers the following recommendations:

For Hospitals: - HFCSH and DGH

- Strengthen early detection and timely treatment: The hospitals should enhance early screening and diagnostic services for colorectal cancer, while also ensuring the consistent availability of first-line chemotherapy drugs. These efforts are essential to minimize treatment delays and reduce CRC related mortality.
- Improve patient support and treatment adherence**:** Implementing robust follow-up systems and offering patient counseling can significantly improve treatment adherence. Since poor adherence was associated with higher mortality in this study, supporting patients throughout their treatment period is critical for improving outcomes.

For Health institutions: - Harari region health bureau , Dire Dawa city administration health bureau, Oromia region health bureau, Somali region health bureau and FMoH,

- Increase funding and strengthen cancer care services: Greater investment in colorectal cancer care is urgently needed to expand access to early diagnosis, timely treatment, and

comprehensive supportive services including nutrition support and management of comorbidities.

- Enhance public education and awareness: Community education initiatives should be strengthened to raise awareness about colorectal cancer symptoms and risk factors. Promoting early health seeking behavior can help reduce late-stage diagnoses and improve survival outcomes.

Future researcher should employ prospective or mixed study designs to better identify factors associated with colorectal cancer mortality. Interventional research on nutritional support is also recommended to explore its potential in reducing mortality and improving patient outcomes.

7. REFERENCES

AGUIAR JUNIOR, S., OLIVEIRA, M., SILVA, D., MELLO, C., CALSAVARA, V., & CURADO, M. 2020. Sobrevida de pacientes com câncer colorretal em um Cancer Center. *Arquivos de Gastroenterologia,* 57**,** 172-177.

ALYABSI, M., SABATIN, F., RAMADAN, M. & JAZIEH, A. R. 2021. Colorectal cancer survival among Ministry of National Guard-Health Affairs (MNG-HA) population 2009–2017: retrospective study. *BMC cancer,* 21**,** 1-11.

ANDERSEN, S., BLOT, W., LIPWORTH, L., STEINWANDEL, M., MURFF, H., & ZHENG, W. 2019. Association of race and socioeconomic status with colorectal cancer screening, colorectal cancer risk, and mortality in southern US adults. *JAMA network open,* 2**,** e1917995-e1917995.

ARHIN, N., SSENTONGO, P., TAYLOR, M., OLECKI, E., PAMEIJER, C., SHEN, C., *et al.* 2022. Age-standardised incidence rate and epidemiology of colorectal cancer in Africa: a systematic review and meta-analysis. *BMJ open,* 12**,** e052376.

ATINAFU, B., BULTI, F., & DEMELEW, T., 2020. Survival status and predictors of mortality among colorectal cancer patients in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: a retrospective followup study. *Journal of cancer prevention,* 25**,** 38.

ATINAFU, B., KEBEDE, W., DEMLEW, T., AYNALEM, Y., SHIFERAW, W., TAREKEGN, F. *et al.* 2022. Mortality rate and its determinants among colorectal cancer patients in comprehensive specialized hospitals, Ethiopia: a retrospective cohort study. *PAMJ-One Health,* 7.

AWEDEW, A., ASEFA, Z., & BELAY, W. 2022. National Burden and Trend of Cancer in Ethiopia, 2010–2019: a systemic analysis for Global burden of disease study. *Scientific Reports,* 12**,** 12736.

AYNALEM, Z., ADAL, A., AYELE, T., BAYEH, G., YESHIWAS, A., DESSIE, T. *et al.* 2024. Mortality rate and predictors of colorectal cancer patients in Ethiopia: a systematic review and meta-analysis. *BMC cancer,* 24**,** 821.

BADRICK, E., SPERRIN, M., BUCHAN, I. E. & RENEHAN, A. G. 2017. Obesity paradox and mortality in adults with and without incident type 2 diabetes: a matched population-level cohort study. BMJ open diabetes research & care, 5.

BANACH, M. 2022. Global, regional, and national burden of colorectal cancer and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. GBD 2019 Colorectal Cancer Collaborators. *The Lancet Gastroenterology and Hepatology,* 7.

BAQAR, A. R., WILKINS, S., STAPLES, M., LEE, C. H. A., OLIVA, K. & MCMURRICK, P. 2019. The role of preoperative CEA in the management of colorectal cancer: A cohort study from two cancer centres. International Journal of Surgery, 64, 10-15.

BOAKYE, D., RILLMANN, B., WALTER, V., JANSEN, L., HOFFMEISTER, M. & BRENNER, H. 2018. Impact of comorbidity and frailty on prognosis in colorectal cancer patients: a systematic review and meta-analysis. Cancer treatment reviews, 64, 30-39.

BOYLE, T., FRITSCHI, L., PLATELL, C. & HEYWORTH, J. 2013. Lifestyle factors associated with survival after colorectal cancer diagnosis. British journal of cancer, 109, 814-822.

BRAY, F., LAVERSANNE, M., SUNG, H., FERLAY, J., SIEGEL, R., SOERJOMATARAM, I. *et al.* 2024. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for clinicians,* 74**,** 229-263.

CAITO, S. & ASCHNER, M. 2015. Neurotoxicity of metals. Handbook of clinical neurology, 131, 169-189.

CDC 2024. About Body Mass Index (BMI). (https://www.cdc.gov/bmi/about/index.html). Accessed on October 25, 2024.

CHEN, S., CAO, Z., PRETTNER, K., KUHN, M., YANG, J., JIAO, L., *et al.* 2023. Estimates and projections of the global economic cost of 29 cancers in 204 countries and territories from 2020 to 2050. *JAMA oncology,* 9**,** 465-472.

DEGU, A., KARIMI, P., OPANGA, S., & NYAMU, D. 2023. Survival outcomes among colorectal cancer patients at Kenyatta National Hospital: A retrospective cohort study. *Cancer Reports,* 6**,** e1743.

DEMARK-WAHNEFRIED, W., PLATZ, E. A., LIGIBEL, J. A., BLAIR, C. K., COURNEYA, K. S., MEYERHARDT, J. A *et al.* 2012. The role of obesity in cancer survival and recurrence. Cancer Epidemiology, Biomarkers & Prevention, 21, 1244-1259.

ETISSA, E., ASSEFA, M., & AYELE, B. 2021. Prognosis of colorectal cancer in Tikur Anbessa Specialized Hospital, the only oncology center in Ethiopia. *PLoS One,* 16**,** e0246424.

EGENVALL, M., MARTLING, A., VERES, K., HORVÁTH-PUHÓ, E., WILLE-JØRGENSEN, P., PETERSEN, S. H., *et al*. 2021. No benefit of more intense follow-up after surgery for colorectal cancer in the risk group with elevated CEA levels–An analysis within the COLOFOL randomized clinical trial. European Journal of Surgical Oncology, 47, 2053-2059.

FMoH. 2025. *NATIONAL CANCER CONTROL PLAN OF ETHIOPIA 2025-2029* [Online]. Available: https://www.iccp-portal.org/sites/default/files/plans/NCCP%20Ethiopia%20Final%20%20Submitted%20%20PDF_1.pdf [Accessed August 22 2025].

GETABILE, F., ENAWGAW, Y. & SHIBIRU, W. 2022. Time to death and associated factors of Colorectal Cancer Patients in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. *Journal of Positive School Psychology***,** 6138-6147.

GUZMÁN-GALLEGO, E., ARIAS-ORTIZ, N., & RODRÍGUEZ-BETANCOURT, J. 2023. Supervivencia al cáncer colorrectal en Manizales, Colombia, 2008-2017: un estudio de base poblacional. *Revista Brasileira de Epidemiologia,* 26**,** e230040.

HALL, C., CLARKE, L., PAL, A., BUCHWALD, P., EGLINTON, T., WAKEMAN, C. & FRIZELLE, F. 2019. A review of the role of carcinoembryonic antigen in clinical practice. Annals of Coloproctology, 35, 294.

HASSAN, M., ISMAIL, I., SUAN, M., AHMAD, F., KHAZIM, W.,Othman, Z. *et al.* 2016. Incidence and mortality rates of colorectal cancer in Malaysia. *Epidemiology and health,* 38.

HOSSAIN, M., KARUNIAWATI, H., JAIROUN, A., URBI, Z., OOI, D., JOHN, A., *et al.* 2022. Colorectal cancer: a review of carcinogenesis, global epidemiology, current challenges, risk factors, preventive and treatment strategies. *Cancers,* 14**,** 1732.

KEUM, N. & GIOVANNUCCI, E. 2019. Global burden of colorectal cancer: emerging trends, risk factors and prevention strategies. *Nature reviews Gastroenterology & hepatology,* 16**,** 713-732.

LEONG, E., ONG, S., MADLI, F., TAN, A., LAI, D., BASIR, N., *et al.* 2020. Survival rates and associated factors of colorectal cancer patients in Brunei Darussalam. *Asian Pacific journal of cancer prevention: APJCP,* 21**,** 259.

LI DESTRI, G., RUBINO, A. S., LATINO, R., GIANNONE, F., LANTERI, R., SCILLETTA, B. & DI CATALDO, A. 2015. Preoperative carcinoembryonic antigen and prognosis of colorectal cancer. An independent prognostic factor is still reliable. International Surgery, 100, 617-625.

LIU, S., ZHENG, R., ZHANG, M., ZHANG, S., SUN, X. & CHEN, W. 2015. Incidence and mortality of colorectal cancer in China, 2011. *Chin J Cancer Res,* 27**,** 22-8.

LU, B., LI, N., LUO, C., CAI, J., LU, M., ZHANG, Y.-H., *et al.* 2021. Colorectal cancer incidence and mortality: the current status, temporal trends and their attributable risk factors in 60 countries in 2000–2019. *Chinese medical journal,* 134**,** 1941-1951.

LUQUE-FERNANDEZ, M. A., GONÇALVES, K., SALAMANCA-FERNÁNDEZ, E., REDONDO-SANCHEZ, D., LEE, S. F., RODRÍGUEZ-BARRANCO, M., *et al.* 2020. Multimorbidity and short-term overall mortality among colorectal cancer patients in Spain: A population-based cohort study. European Journal of Cancer, 129, 4-14.

MAIMARD, Y., WORADET, S. & CHAIMAY, B. 2023. Factors Associated with Mortality among Patients with Colorectal Cancer at the Secondary Care Hospital in Southern Thailand: Hospital-Based Retrospective Cohort Study. *International Journal of Preventive Medicine,* 14**,** 13.

MAJANO, S., DI GIROLAMO, C., RACHET, B., MARINGE, C., GUREN, M. G., GLIMELIUS, B., *et al.* 2019. Surgical treatment and survival from colorectal cancer in Denmark, England, Norway, and Sweden: a population-based study. *The lancet oncology,* 20**,** 74-87.

MESSERSMITH, W. A. 2019. NCCN guidelines updates: management of metastatic colorectal cancer. *Journal of the National Comprehensive Cancer Network,* 17**,** 599-601.

MICHALOPOULOU, E., MATTHES, K. L., KARAVASILOGLOU, N., WANNER, M., LIMAM, M., KOROL, D., *et al.* 2021. Impact of comorbidities at diagnosis on the 10-year colorectal cancer net survival: A population-based study. Cancer Epidemiology, 73, 101962.

MORGAN, E., ARNOLD, M., GINI, A., LORENZONI, V., CABASAG, C., LAVERSANNE, M. *et al*. 2023. Global burden of colorectal cancer in 2020 and 2040: incidence and mortality estimates from GLOBOCAN. *Gut,* 72**,** 338-344.

MOTSUKU, L., CHEN, W., MUCHENGETI, M., NAIDOO, M., QUENE, T., KELLETT, P. *et al.* 2021. Colorectal cancer incidence and mortality trends by sex and population group in South Africa: 2002–2014. *BMC cancer,* 21**,** 1-11.

MUHAMAD, N., MA'AMOR, N., ROSLI, I., LEMAN, F., ABDUL MUTALIP, M., CHAN, H., *et al.* 2023. Colorectal cancer survival among Malaysia population: data from the Malaysian National Cancer Registry. *Frontiers in Oncology,* 13**,** 1132417.

NIKBAKHT, H., HASSANIPOUR, S., SHOJAIE, L., VALI, M., GHAFFARI-FAM, S., GHELICHI-GHOJOGH, M., *et al.* 2020. Survival rate of colorectal cancer in eastern mediterranean region countries: A systematic review and meta-analysis. *Cancer Control,* 27**,** 1073274820964146.

ODGAARD, M., LOHSE, N., PETERSEN, A., & BÆKSGAARD, L. 2018. Oncological treatment and outcome of colorectal cancer in Greenland. *International Journal of Circumpolar Health,* 77**,** 1546069.

PANIGRAHI, G. & AMBS, S. 2021. How comorbidities shape cancer biology and survival. Trends in cancer, 7, 488-495.

PCSA 2017. Population Projection of Ethiopia for All Regions At Wereda Level from 2014 – 2017.

PULE, M. L., BUCKLEY, E., NIYONSENGA, T. & RODER, D. 2019. The effects of comorbidity on colorectal cancer mortality in an Australian cancer population. Scientific reports, 9, 8580.

RAWLA, P., SUNKARA, T. & BARSOUK, A. 2019. Epidemiology of colorectal cancer: incidence, mortality, survival, and risk factors. *Gastroenterology Review/Przegląd Gastroenterologiczny,* 14**,** 89-103.

RENEHAN, A. G., FLOOD, A., ADAMS, K. F., OLDEN, M., HOLLENBECK, A. R., CROSS, A. J. & LEITZMANN, M. F. 2012. Body mass index at different adult ages, weight change, and colorectal cancer risk in the National Institutes of Health-AARP Cohort. American journal of epidemiology, 176, 1130-1140.

SAIDI, H., ABDIHAKIN, M., NJIHIA, B., JUMBA, G., KIARIE, G., GITHAIGA, J. *et al.* 2011. Clinical outcomes of colorectal cancer in Kenya. *Annals of African Surgery,* 7.

SAWAID, I., SAMSON, A., & AL-RAMAHI, R. 2024. Evaluation of Stages, Treatment Protocols, and Outcomes of Colorectal Cancer among West Bank Patients. *Journal of Clinical Medicine,* 13**,** 2284.

SIEGEL, R., MILLER, K., FEDEWA, S., AHNEN, D., MEESTER, R., BARZI, A. *et al.* 2017. Colorectal cancer statistics, 2017. *CA: a cancer journal for clinicians,* 67**,** 177-193.

SØGAARD, M., THOMSEN, R. W., BOSSEN, K. S., SØRENSEN, H. T. & NØRGAARD, M. 2013. The impact of comorbidity on cancer survival: a review. Clinical epidemiology, 5, 3-29.

SUNG, H., FERLAY, J., SIEGEL, R. L., LAVERSANNE, M., SOERJOMATARAM, I., JEMAL, A. *et al.* 2021. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for clinicians,* 71**,** 209-249.

TABUNG, F., LIU, L., WANG, W., FUNG, T., WU, K., SMITH-WARNER, S. *et al*. 2018. Association of dietary inflammatory potential with colorectal cancer risk in men and women. *JAMA oncology,* 4**,** 366-373.

TEKA, M., YESUF, A., HUSSIEN, F., & HASSEN, H. 2021. Histological characteristics, survival pattern and prognostic determinants among colorectal cancer patients in Ethiopia: A retrospective cohort study. *Heliyon,* 7.

TRAN, B. & COLLABORATORS. 2019. The global, regional, and national burden of colorectal cancer and its attributable risk factors in 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017.

TSANG, N. M., PAI, P. C., CHUANG, C. C., CHUANG, W. C., TSENG, C. K., CHANG, K. P., *et al.* 2016. Overweight and obesity predict better overall survival rates in cancer patients with distant metastases. Cancer medicine, 5, 665-675.

VALDERAS, J. M., STARFIELD, B., SIBBALD, B., SALISBURY, C. & ROLAND, M. 2009. Defining comorbidity: implications for understanding health and health services. The Annals of Family Medicine, 7, 357-363.

VÄYRYNEN, J. P., TUOMISTO, A., VÄYRYNEN, S. A., KLINTRUP, K., KARHU, T., MÄKELÄ, J., *et al.* 2018. Preoperative anemia in colorectal cancer: relationships with tumor characteristics, systemic inflammation, and survival. Scientific reports, 8, 1126.

WALLACE, K., LI, H., BRAZEAL, J. G., LEWIN, D. N., SUN, S., BA, A., PAULOS, C. M., RACHIDI, S., LI, Z. *et al.* 2020. Platelet and hemoglobin count at diagnosis are associated with survival in African American and Caucasian patients with colorectal cancer. Cancer epidemiology, 67, 101746.

WHO 2022. cancer. (https://www.who.int/health-topics/cancer). Accessed on October 29, 2024.

WHO 2023. Colorectal cancer. (https://www.who.int/news-room/fact-sheets/detail/colorectal-cancer). Accessed on October 29, 2024.

WONG, M., DING, H., WANG, J., CHAN, P., & HUANG, J. 2019. Prevalence and risk factors of colorectal cancer in Asia. *Intestinal research,* 17**,** 317-329.

XI, Y. & XU, P. 2021. Global colorectal cancer burden in 2020 and projections to 2040. *Translational oncology*, 14**,** 101174.

ZINGETA, G., WORKU, Y., GETACHEW, A., FEYISA, J., FURGASSA, H., BELAY, W. *et al.* 2023. Clinical presentation, treatment patterns, and outcomes of colorectal cancer patients at Tikur Anbessa Specialized Hospital in Addis Ababa, Ethiopia: A prospective cohort study. *Cancer Reports*, 6**,** e1869.

8. ANNEXES

7.2. Data collection checklists

Reaserch title: Mortality And Its Associated Factors Among Colorectal Cancer Patients on Chemotherapy Follow Up at Hiwot Fana Comprehensive Specialized Hospital and Dilchora General Hospital, Eastern Ethiopia

Part 1: Socio-Demographic			
Serial No	**Variables**	**Category**	**Skip**
099	Site of admission	A. HFCSUH B. DRH	
100	Medical record number	----------	
101	Age in years	----------	
102	Sex	A. Male B. Female	
103	Residence	A. Rural B. Urban	
104	Marital status	A. Single B. Married C. Widowed D. Divorced	
105	Education status	A. No formal education B. Primary (1-8) C. Secondary (9-12) D. Diploma E. Degree F. Other ----	
106	Religion	A. Muslim B. Orthodox C. Protestant D. Catholic E. Other --------	
107	Mode healthcare care	F. Out-of-pocket G. Free Insurance H. Paid Insurance	

Part 2: Life Style Related Characteristics			
S.no	**Variables**	**Category**	**Skip**
201	Tobacco use	A. Yes B. No C. Unknown	
202	Alcohol use	A. Yes B. No C. Unknown	
203	Khat use	A. Yes B. No C. Unknown	

Part 3: Clinical factors Part 3.1: Medical History of CRC Patients			
S.no	**Variables**	**Categories**	**Skip**
301	Previous Cancer history	A. Yes B. No C. Unknown	
302	Family history of cancer	A. Yes B. No C. Unknown	
303	Comorbidities	A. Yes B. No C. Unknown	
304	If yes on Q 303 identify comorbid disease	A. DM B. HTN C. Asthma D. CHF E. Others (_____)	

Part 3.2: Clinical and pathological characteristics of CRC Patients					
S.no	**Variables**	**Category**	**Baseline**	**At follow up**	**Skip**
401	Primary tumor Location	A. Colon B. Rectal C. Both			
402	Histological cell Type	A. Adenocarcinoma B. Mucinous or Signet-ring cell carcinoma C. Other…			
403	Level of histological Differentiation	A. Well differentiated B. Moderately differentiated C. Poorly differentiated D. Undifferentiated E. Unknown/ Unspecified			
404	Weight of the patient	Body mass index ?			
405	Height of the patient				
406	Hemoglobin	From CBC			
407	TNM Stage	A. Stage I B. Stage II C. Stage III D. Stage IV			
408	Clinical stage	A. Localized B. Locally advanced C. Metastasis D. Unknown			
409	Date of the disease diagnosed and confirmed				
410	Treatment start date after diagnosis				
411	Depth of Tumor Invasion	A. T 1 B. T2 C. T3 D. T4			
412	Regional lymph node involvement	A. N0 B. N1 C. N2			

413	Distant metastasis	A. M0 B. M1			
414	Carcinoembryonic antigen (CEA)	A. Not elevated (<5 ng/ml) B. Elevated (>5 ng/ml)			

PART 4: Treatment profile of colorectal cancer patients			
S.no	**Variables**	**Category**	**Skip**
501	Surgery	A. Planned and done B. Planned but not done C. Not planned and not done D. Palliative diversion stoma	
502	Timing of surgery	A. Elective B. Emergency	
503	Chemotherapy	A. Planned and given B. Planned but not given C. Not planned and not given	
504	Chemotherapy used for	A. Adjuvant B. Neoadjuvant C. Palliative treatment	
505	Chemotherapy given	A. Fluorouracil (5-FU)) B. Oxaliplatin (OX) C. Irinotecan (IRI) D. Capecitabine (CAP or XELODA or XEL). E. FOLFOX (5-FU + OX), F. FOXFIRI (5-FU + IRI), G. XELOX or CAPOX (CAP + OX) H. Others (_____)	
506	Completed the prescribed cycles of CT	A. Yes B. No	
507	Radiotherapy/ Surgery	A. Planned and given B. Planned but not given C. Not planned and not given	
508	Radiotherapy/ chemotherapy	A. Planned and given B. Planned but not given	

		C. Not planned and not given	
509	Surgery/Radiotherapy/chemotherapy	A. Planned and given B. Planned but not given C. Not planned and not given	
510	Over all patient status after treatment	A. Recovered B. Remission C. Died D. Disappeared	
511	Time of event occurred	A. Recovered B. Remission C. Died D. Disappeared	
512	Common ADEs occurred along with values and time of experiencing the event		

7.2. Curriculum vitae

1. Background information

Full name: Ibrahim Ismael Mohammed	Nationality: Ethiopian
Age: 27 years	Date of birth: 05/01/1997
Sex: Male	Tell: +251931942827
Address: Dire Dawa	
Email: **ibrahimismael4436@gmail.com**	
Working institution: Haramaya University, CHMS	

2. Educational background

S. No	Name of school	Place	Grade	Year in E.C
1	Elementary school	Dire Dawa	1-8	1996-2003
2	Secondary High School	Dire Dawa	9-10	2004-2005
3	Preparatory school	Dire Dawa	11-12	2006-2007
4	Haramaya University, CHMS	Harar	Degree (B. pharm)	2008-2013
5	Haramaya University	Harar	MSc student of clinical pharmacy	2015- 2018

CHMS:- College of Health and Medical Science

3. **Qualification:** B. pharm Degree in pharmacy with CGPA of **3.6,** MSc of clinical pharmacy student (CGPA of **3.74**)

4. Language Skills

S. No	Language	Listening	Reading	Speaking	Writing
1	**English**	Excellent	Excellent	Excellent	Excellent
2	**Amharic**	Excellent	Excellent	Excellent	Excellent
3	**Afan Oromo**	Excellent	Excellent	Excellent	Excellent

5. Computer skills

- Very good in Microsoft Word, Microsoft PowerPoint, and Microsoft Excel
- Very good in Statistical Package for Social Science software (SPSS)
- Diploma in a Basic Computer Skills

6. Working experiences

I have had the opportunity to build strong experience in both technical and pharmaceutical roles. As a Senior Technical Assistant at CHMS, I supported key operations and worked closely with teams to ensure everything ran smoothly. At HFCSH, I was actively involved in delivering pharmaceutical care, helping to make sure patients received safe and effective treatments. I also took on the role of focal person for the pharmacovigilance centers at HFCSH and the Harari Regional Health Bureau, where I was responsible for monitoring and reporting medication safety work that really deepened my understanding of the importance of quality and safety in healthcare.