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Millennium Medical College**
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ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE

GRADUATE STUDY PROGRAM

**TREATMENT PATTERN, OUTCOME AND ASSOCIATED FACTORS
OF ACUTE CORONARY SYNDROME AMONG PATIENTS
ADMITTED TO THREE TERTIARY HOSPITALS IN ADDIS ABABA,
ETHIOPIA. A TWO AND HALF YEARS REVIEW**

Investigator: Dr. Bethelihem Ligaba (MD, Internal Medicine Resident)

**A research paper submitted to the department of Internal Medicine, St.
Paul's Hospital Millennium Medical College in partial fulfillment of the
requirement for specialty certificate in Internal Medicine.**

January, 2024

ADDIS ABABA, ETHIOPIA



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Treatment pattern, outcome and associated factors of acute coronary syndrome among patients admitted to three tertiary hospitals in Addis Ababa, Ethiopia. A two year and half review

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Advisors: Dr. Henok Benti (MD, Consultant Internist and Cardiologist)

Dr. Samrawit Solomon (MD, MPH, Associate professor)

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Addis Ababa, Ethiopia

St. Paul's Hospital Millennium Medical College

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List of acronyms

ACS: Acute Coronary Syndrome

ACEI/ARBs: Angiotensin converting enzyme inhibitors/ Angiotensin receptor blockers

ASA: Aspirin

BB: Beta Blockers

CCB: Calcium Channel Blockers

CABG: Coronary Artery Bypass Grafting

CAD: Coronary Artery Disease

CCS: Chronic Coronary Syndrome

CKD: Chronic kidney disease

CK-MB: Creatine kinase-myocardial band

CVD: Cardiovascular diseases

cTn: Cardiac troponin

DALYs: Disability Adjusted Life Years

DBP: Diastolic Blood Pressure

ECG: Electrocardiogram

EF: Ejection fraction

GRACE: Global Registry of Acute Coronary Events

GDMT: Guideline Directed Medical Therapy

HDL: High Density Lipoprotein

hs-cTn: High-sensitivity cardiac troponin

IHD: Ischemic Heart Disease

LDL: Low Density Lipoprotein

MI: Myocardial Infarction

NSTE-ACS: Non-ST-segment elevation acute coronary syndrome

NSTEMI: Non-ST segment elevation myocardial infarction

OPD: Outpatient department

PCI: Percutaneous Coronary Intervention

PR: Pulse Rate

SBP: Systolic Blood Pressure

SPSS: Statistical Package for Social Science

STEMI: ST segment elevation myocardial infarction

TASH: Tikur Anbessa Specialized Hospital

TG: Triglyceride

UA: Unstable angina

SPHMMC: Saint Paul Hospital Millennium Medical College

ZMH: Zewditu Memorial Hospital

Abstract

Background: Acute coronary syndrome (ACS) remains the leading cause of death in most developing nations including Ethiopia. In-hospital mortality remains alarmingly high, partly due to delayed or inadequate use of evidence-based medical and reperfusion therapies like percutaneous coronary intervention (PCI) or thrombolysis. This study aimed to investigate the treatment outcomes of ACS patients following specific therapies and identify factors associated with treatment outcome in three tertiary hospitals in Addis Ababa, Ethiopia.

Methods: A multicenter, retrospective, clinical chart review was conducted on a total of 384 patients from January 2021 to June 30, 2023. Convenience sampling was used to collect the data while structured checklist was used to collect data from patient card. Chi-square tests were used to assess associations between categorical variables, while binary logistic regression identified independent predictors of in-hospital mortality. Statistical significance was set at $p < 0.05$.

Results: Out of 384 patient card reviews, the mean age of patients was found to be 56.74 ± 12.46 years, urban residence accounted for 91.1% of cases and male predominance was seen in 69.8% cases. ST segment elevation myocardial infarction (STEMI) was diagnosed in 81.5%. Medical therapy was given for all patients but only 10.9% underwent percutaneous coronary intervention and 1.6% received streptokinase. Heart failure (49.5%) was the most common complication. In hospital mortality was 8.3%; with cardiogenic shock (5.2%) being the leading cause of death. Older age (>65 years), Killip class 4, and severely reduced ejection fraction ($EF < 30\%$) were independent predictors for death with AOR of 10.466, 74.848 & 20.044 respectively.

Conclusion: Despite the availability of reperfusion therapies, the rate of in-hospital mortality was high attributed to lack of timely intervention. Therefore, emergency services with advanced setup should be accessible for improved survival of patients with ACS.

Keywords: Acute coronary syndrome, Treatment outcomes of ACS, In-hospital mortality, Revascularization, Addis Ababa, Ethiopia

1 Introduction

1.1 Background

Acute coronary syndrome (ACS) is a term used to describe a range of conditions associated with sudden, reduced blood flow to the heart. The clinical definition of myocardial infarction denotes the presence of acute myocardial injury detected by abnormal cardiac biomarkers in the setting of evidence of acute myocardial ischemia with an elevated cardiac troponin (cTn) concentration above the 99th percentile of the upper reference limit. The injury is considered acute if there is a rise and/or fall of cTn values (1).

Studies have shown that several modifiable and non-modifiable risk factors significantly contribute to the development of ACS and negatively impact treatment outcomes. These include a history of hypertension, diabetes mellitus, dyslipidemia, family history of ACS, male sex, physical inactivity and smoking (2,3).

Globally, myocardial infarction (MI) is more common in individuals over 60, affecting 9.5% compared to 3.8% in younger populations (4). Studies show varying in-hospital mortality rates for ACS in Africa, with a systematic review reporting a 22% rate, 10% lower in cardiac centers (5). According to a meta-analysis done in sub Saharan African country, the hospital mortality varied from 1.2% to 24.5% depending on the study populations and the revascularization procedures performed(6).

Similarly, a review in Ethiopia reported a pooled mortality rate of 14.82%, higher in STEMI patients (16.1%) (7). Individual researches showed that the in-hospital mortality of ACS patients was very high (27.4%) and identified the factors that had significant association with in- hospital mortality including the presence of history of hypertension, old age, delayed time of presentation, Killip class II and III, and STEMI diagnosis(8,9).

Effective ACS management focuses on stabilizing the patient, relieving pain, and preventing further damage. This typically involves antithrombotic therapy and an early invasive strategy like diagnostic angiography with intent to perform revascularization. A nationwide study of patients with STEMI showed delay from first medical contact to

Primary PCI of more than 60 minutes led to a statistically significant increase in mortality from HRs of 1.26 (for 61 to 90 minutes) to 1.51 (121 to 360 minutes)(10). Even though, PCI is preferred to immediate fibrinolysis when both reperfusion strategies are available; the STREAM trial has showed that pre-hospital fibrinolysis with timely coronary angiography resulted effective reperfusion in those STEMI patients who could not undergone primary PCI within 1 hour(11). In conclusion, patients who received PCI intervention were more likely to recover early and had shortened hospital stay (3,9).

1.2 Statement of the problem

According to World health organization, cardiovascular diseases (CVDs) are the leading cause of death globally, taking an estimated 17.9 million lives each year, an estimated 32% of all deaths worldwide. More than 75% of CVD deaths occur in low- and middle-income countries and 85% of all CVD deaths are due to heart attacks and strokes(12).

Globally, it was estimated that in 2020, 244.1 million people were living with ischemic heart disease (IHD), and it was more prevalent in males than in females (141.0 and 103.1 million people, respectively)(13).

ACS incidence and mortality in Africa is increasing due to a sharp rise in cardiovascular risk factors such as diabetes, dyslipidemia, uncontrolled hypertension, expansion of the aging population, and change in lifestyle. Additionally, the lack of emergency cardiac services, healthcare infrastructure, availability of cardiovascular medicines, and inadequate staffing contributed for the increase in in-hospital mortality from ACS. This is even higher for patients coming from rural areas where there is limited access to medical expertise and diagnostic testing centers, coupled with challenges of transportation, holding back patients from seeking early medical care and timely treatment(14). Apart from these, independent risk factors were identified for increased mortality which includes older age, systolic blood pressure, serum creatinine, Killip class > II, ejection fraction <40%, and STEMI(15).

Coronary artery disease (CAD) is now one of the three leading causes of death in most SSA countries increasing the burden of health expenditures in regions that are also struggling with uncontrolled infectious diseases and malnutrition(6). Ethiopia as a second-most populous country in Africa is now also facing an increase in cardiovascular disease (CVD) burden. According to the 2015 global burden of disease study, IHD is one of the top five leading causes of premature mortality in the country(16).

In previous studies done in Ethiopia, the use of guideline-directed in-hospital medications and interventions were suboptimal, partly due to limited access and delayed interventions. It was also shown that less than a third of the patients, or 13 (7.2%), got late reperfusion treatment (all performed after 12 h of symptom onset). None of the patients got early PCI

or fibrinolytic treatment for reperfusion in which the mortality still remains high. These delays significantly impacted reperfusion success and likely contributed to the observed high mortality rates. Scarcity of interventional cardiologists, excessive pre-hospital and in-hospital delays, and the high cost of cardiac catheterization and reperfusion therapies in low-income settings like Ethiopia further exacerbate these challenges (15).

With the advent of revascularization procedures in several government and private hospitals, and growing expertise among cardiologists, patients with ACS might see improved survival and lower in-hospital mortality rates. While various studies have assessed ACS outcomes in Ethiopia, there is a lack of research analyzing the specific impact of reperfusion therapies on patient outcomes. This study aims to fill this gap by investigating the factors influencing treatment outcome of ACS patients, analyzing the trends and impact of current management practices, and identifying areas for improvement to reduce the burden of this disease.

1.3 Significance of the problem

Development of ACS in patients with established chronic coronary syndrome (previously called SIHD) and at risk patients is a major contributor for destabilization and worse outcome in hospital as well as in the long run. Poorly controlled risk factors, inadequate lifestyle changes, missed medication, and delayed revascularization further increase the risk of complications and death. Conversely, successful revascularization and adherence to secondary prevention (e.g., medication, healthy lifestyle) are associated with improved outcomes. As previous studies have shown, suboptimal treatment, particularly delayed or absence of reperfusion therapy (PCI or fibrinolysis), is a major contributor to high in-hospital mortality in ACS patients. This highlights the critical role of timely and appropriate interventions in improving survival rates (8,17).

This study will evaluate the impact of recent advances in cardiac catheterization labs and cardiac critical care units on the outcomes of ACS patients admitted to government hospitals in Ethiopia. It also assesses patient outcomes following various treatment strategies, including medical therapy and revascularization procedures, and identifies independent predictors of in-hospital mortality. While these findings might not directly apply to private healthcare settings, they will provide valuable insights and a crucial starting point for improving ACS care delivery. Considering the substantial economic burden of ACS in Ethiopia, optimizing management strategies has become increasingly important and mandatory in the current contemporary cardiology practice.

2 Literature review

2.1 Global burden of ACS

Globally, coronary artery disease is the leading cause of death and a reduction in Disability Adjusted Life Years (DALYs). Nearly 7 million fatalities and 129 million DALYs per year are accounted for by low- and middle-income nations, who bear a significant portion of this burden. The risk of recurrent infarction is considerable for myocardial infarction (MI) survivors, who also have a five- to six-fold greater annual death rate than people without CAD. Systolic blood pressure is the most major modifiable risk factor and explains some additional CAD hazards that arise with age. The chance of dying from CAD increases considerably with aging(18).

Acute coronary syndromes (ACS) and sudden death cause most IHD-related deaths, which represent 1.8 million deaths per year. Although it typically happens 7 to 10 years earlier in males than in women, the incidence of IHD and ACS both rise with age. Men are significantly more likely than women to have ACS before the age of 60, whereas women make up the majority of patients above the age of 75(19).

2.2 Epidemiology and prevalence of ACS

Acute myocardial infarctions (MIs) and deaths from coronary artery disease (CAD) affect over 720,000 Americans yearly, and more than 335 000 Americans experience recurring occurrences. Adults under the age of 75 make up 30% to 40% of all acute coronary syndrome (ACS) patients who are hospitalized, and the majority of ACS-related deaths are seen in this group of people(20). Similarly in United Kingdom, over 250,000 cases of ACS are diagnosed each year imposing significant costs on the National Health Service and the same is true for other western European countries(21). In the Asia-Pacific region as well, ACS is the leading cause of mortality and accounts for around half of the global burden(22).

A systematic analysis of observational studies on the acute coronary syndrome in sub-Saharan Africa conducted during a 10-year period, from January 1, 2010, to June 30, 2020,

was conducted in the MEDLINE (PubMed) database. For the final study, 27 articles out of 784 were taken into consideration. Ten studies report a prevalence of 0.21% to 22.3% acute coronary syndrome patients among admitted for cardiovascular disease. In South Africa and Djibouti, patients were younger, with a minimum age of 52 years. There was a significant male predominance(6).

In Ethiopia, a systematic review and meta-analysis of institutional and community-based studies were analyzed to assess the prevalence of cardiovascular disease and nine eligible cross-sectional studies were reviewed. Prevalence of CVD range from 1 to 20% with a 5% pooled prevalence. In comparison to the general population, which had a prevalence of 2%, the hospital visiting population had a prevalence of 8%. Between men and women, there was no discernible difference in the overall prevalence of CVD(23).

2.3 Risk factors and predictors of in hospital mortality of ACS

According to the INTERHEART study dyslipidemia, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, less consumption of fruits and vegetables, drinking alcohol and less regular physical activity were potentially modifiable risk factors for acute myocardial infarction worldwide(24).

From Global Registry of Acute Coronary Events (GRACE) registry eight independent risk factors accounted for 89.9% of the prognostic information in ACS patients as predictors of in hospital mortality. These include: age, Killip class, systolic blood pressure, ST-segment deviation, cardiac arrest during presentation, serum creatinine level, positive initial cardiac enzyme findings, and heart rate(25).

In a study conducted in Japan between January 2004 and December 2018, a 15-year data set from a single-center hospital-based registry was analyzed to determine the in-hospital mortality rate among consecutive patients with ST-Elevation myocardial infarction during the modern primary percutaneous intervention era. The 30-day mortality rate was 7.7%, and the in-hospital mortality rate was 9.2%. Ejection fraction (EF) 40%, culprit lesions in the left coronary artery as opposed to those in the right coronary artery, Killip class > II, chronic kidney disease, final thrombolysis in myocardial infarction (TIMI) grades, absence

of robust collaterals and hypertension were independent predictors of in-hospital mortality(26). Significant correlation of in-hospital mortality was also noted in studies done in Pakistan and Ethiopia(8,17,27).

2.4 Treatment outcome of ACS patients

An extensive analysis of elements from recent clinical trials that affected patients with ACS's prognosis was conducted from 2012 to 2017 in a systematic review. Clinical trials reporting on ACS prognosis that were published in the English literature were thoroughly searched for in the Cochrane and PubMed databases. According to this research, STEMI patients continue to have a greater chance of dying from any cause during close monitoring. Beyond the first 30 days, however, there was no distinction in patients with STEMI, NSTEMI, or stable IHD (SIHD) in terms of prognosis. No matter how they presented clinically, patients with NSTEMI had a greater likelihood of dying than those with SIHD. In addition, patients with NSTEMI had a worse prognosis over the long run than those with SIHD(28).

The Canadian Acute Coronary Syndromes Registry was used to evaluate the one-year prognosis of patients who had acute coronary syndromes. Overall, there was a 2.4% in-hospital death rate. Unadjusted 1-year death rates for hospital survivors were 6.5%, 10%, and 5.4%, respectively, for individuals who had unstable angina pectoris, Q-wave myocardial infarction, and non-Q-wave myocardial infarction(29). Similarly a retrospective cohort data analysis of patients from the Acute Coronary Syndrome Israeli Survey (ACSIS) carried out between the years 2000–2018 to examine temporal trends and outcomes of patients with prior MI admitted due to ACS showed high mortality rate for patients with prior MI compared with patients without prior MI with an overall higher mortality rate in the STEMI group(30).

According to a systematic review and meta-analysis of 29 studies published in Africa between 2005 and 2018 and involving a sample size of 11,788, the all-cause in-hospital death rate was estimated to be 22%. Compared to reference hospitals, the cardiac centers had a reduced risk of in-hospital death. Both Northern and Eastern Africa's mortality rates

were comparable. Heart failure, cardiogenic shock, arrhythmia, hemorrhage, acute stroke, and re-infarction all occurred at rates of 42, 17.0, 20.0, 16.0, 4.0, and 5.0%, respectively, in hospitals(14).

In order to evaluate the effectiveness of treatment, a retrospective cross-sectional study was carried out in patients who were discharged from Tikur Anbessa Specialized Hospital with the diagnosis of ACS between January 1, 2012 and December 31, 2014. Of 124 ACS patients, ST segment elevation myocardial infarction was identified in 72.6% of cases (STEMI). Hypertension was the main risk factor for developing ACS in roughly 61.3% of patients. Mortality in hospitals was 27.4%. Age, the amount of time since the onset of symptoms till presentation, a history of hypertension, being Killip classes III or IV, and a diagnosis of STEMI were all indicators of in-hospital mortality(8).

Another retrospective cross-sectional study was carried out on the treatment outcomes of acute coronary syndrome patients hospitalized to the Ayder Comprehensive Specialized Hospital (ACSH) in Mekelle between August 1, 2013, and July 31, 2018. Hypertension was the most common (46.4%) risk factor for ACS and the in-hospital mortality rate of the 151 patients was found to be 24.5%, which is comparable to the research conducted at Tikur Anbessa Specialized Hospital. Catheterization and primary percutaneous coronary intervention were performed in 27.1% and 3.9% of cases, respectively, in terms of management practice. Streptokinase was given for 6.3% of STEMI patients. In-hospital mortality was independently predicted by not taking beta-blockers, in-hospital cardiogenic shock, and a left ventricular ejection fraction of less than 30%(17). Another comparison was done at St. Paul Hospital from 2018 to 2020 similarly, 43.9% were diagnosed with STEMI. Hypertension served as the primary risk factor for 66.2% of the patients. Mortality rate was 3.8% which was low as compared to previous studies and 96.2% of patients were discharged alive(9).

In Africa percutaneous coronary intervention is not widely available but was performed in South Africa, Kenya, Côte d'Ivoire, Sudan, and Mauritania. Fibrinolysis was the most accessible means of revascularization, with streptokinase as the molecule of choice.

Hospital mortality was highly variable between 1.2% and 24.5% depending on the study populations and the revascularization procedures performed(6).

In the study done in Pakistan, patients receiving early revascularization were noted to have lower in-hospital mortality compared to those in whom revascularization was not done due to delayed presentation(27). Likewise, intervention with PCI for ACS patients is found to shorten the time of recovery of patients from ACS in a study done at St. Peter's Specialized Hospital where more than 65% of patients recovered after administration of PCI (3).

3 Conceptual framework

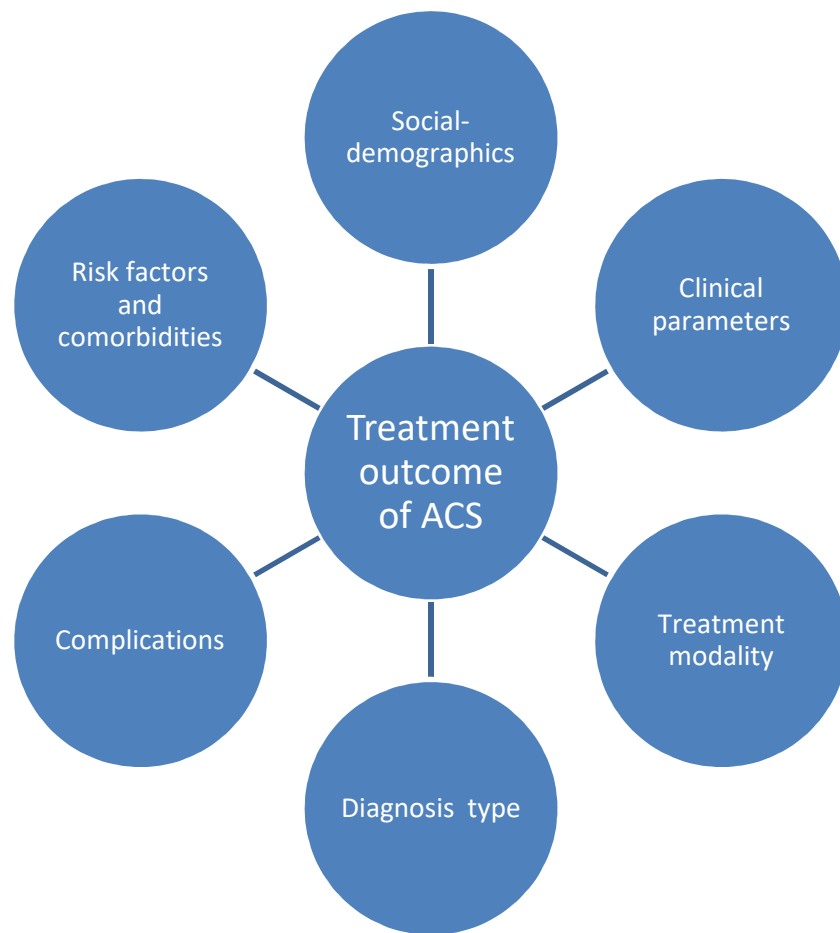


Figure 1. Conceptual frame work showing associated factors of treatment outcome in patients with ACS

4 Objectives

4.1 General objective

- To assess treatment pattern, outcome and associated factors of ACS among patients admitted with diagnosis of ACS at St. Paul Hospital Millennium Medical College, St. Peter Specialized Hospital and Zewditu Memorial Hospital from January 2021 to June 30, 2023 G.C.

4.2 Specific objectives

- ✓ To evaluate treatment pattern of patients admitted with diagnosis of ACS at St. Paul Hospital Millennium Medical College, St. Peter Specialized Hospital and Zewditu Memorial Hospital from January 2021 to June 30, 2023 G.C.
- ✓ To evaluate treatment outcome of patients admitted with diagnosis of ACS at St. Paul Hospital Millennium Medical College, St. Peter Specialized Hospital and Zewditu Memorial Hospital from January 2021 to June 30, 2023 G.C.
- ✓ To identify factors associated with treatment outcome of patients with a diagnosis of ACS at St. Paul Hospital Millennium Medical College, St. Peter Specialized Hospital and Zewditu Memorial Hospital from January 2021 to June 30, 2023 G.C.

5 Methodology

5.1 Study setting

The study was conducted at St. Paul's Hospital Millennium Medical College, the second largest governmental tertiary care hospital located in Gullele sub city, St. Peter's Specialized Hospital, which was established in 1963 as a tuberculosis (TB) treatment center in the nation and recently owns a cathlab center in collaboration with SPHMMC, and Zewditu Memorial Hospital which is the leading hospital in the treatment of ART patients in Addis Ababa, Ethiopia.

The study included patients admitted to those three tertiary hospitals starting from January 2021 to June 30, 2023 G.C. This is because the previous studies included ACS patients admitted until January 2019; therefore, it avoids duplication of results. Cards from patients admitted during the COVID 19 pandemic in between 2019 to 2020 were unavailable and the study period did not include this subjects.

5.2 Study design

A multicenter, retrospective clinical chart review

5.3 Population

5.3.1 Source population

All acute coronary syndrome patients admitted at SPHMMC, St. Peter cardiac catheterization lab and ZMH from January 2021 to June 30, 2023 G.C.

5.3.2 Study population

All patients with diagnosis of acute coronary syndrome fulfilling the inclusion criteria and are admitted at SPHMMC, St. Peter cardiac catheterization lab and ZMH from January 2021 to June 30, 2023 G.C. are included.

5.4 Eligibility criteria

5.4.1 Inclusion criteria

- All patients aged 18 years and above with discharge diagnosis of ACS during the study period.

5.4.2 Exclusion criteria

- Patients discharged against medical advice.
- Patients transferred or referred to other facility except St. Peter specialized hospital.
- Patients who had incomplete information on their chart.

5.5 Sample size determination and sampling technique

5.5.1 Sample size determination

Sample size is calculated by using the single population proportion formula.

$$no = (Z\alpha/2)^2 P \times (1-P)/d^2$$

no = required sample size

Z= confidence level at 95% (standard value of 1.96)

d= margin of error = 5%

P= prevalence of mortality and discharge (24.5% and 71.5%)(17).

$$no = (1.96)^2 \times 0.245 \times 0.755 / (0.05)^2 = 284$$

$$no = (1.96)^2 \times 0.715 \times 0.285 / (0.05)^2 = 313$$

The largest calculated sample size is 313, considering a 10% rate of incomplete medical records; the final sample size for the study will be 344.

The total number of ACS patients admitted to SPHMMC, St Peter cardiac catheterization lab and ZMH is <500, so all patients who fulfill the inclusion criteria will be included.

5.5.2 Sampling technique and procedures

This is the first study which is a multicenter chart review and all patient records during the study period included to give an estimate of government owned hospitals.

Patient records initially identified from the health management information system (HMIS) registers. Then, patient cards retrieved from card rooms using the medical registration numbers (MRNs) of each of the patients. A total of 432 patient cards were retrieved, out of these 48 cards were discarded using exclusion criteria and a final of 384 patient cards were used for data collection and entry.

5.6 Study variables

5.6.1 Independent variables

- ❖ Age,
- ❖ Sex,
- ❖ Residence,
- ❖ Time from symptom onset until presentation to ED,
- ❖ Presenting symptoms,
- ❖ Comorbidities,
- ❖ Behavioral risk factors,
- ❖ Blood pressure and pulse rate on initial presentation,
- ❖ Killip classification,
- ❖ Serum troponin, creatinine, CK-MB, lipid levels,
- ❖ Ejection fraction,
- ❖ Type of diagnosis,
- ❖ Treatment modalities (Medical &/or Revascularization procedure),
- ❖ Timing of revascularization therapies and
- ❖ Complications

5.6.2 Dependent variable

- ❖ Treatment outcome of ACS

6 Operational/standard definition

ACS: refers to patients with documented ST-segment elevation myocardial infarction (STEMI) or non–ST-segment elevation myocardial infarction (NSTEMI) or unstable angina according to the 4th universal definition of MI.

In hospital mortality: any death, regardless of cause, that occurs during the same hospitalization.

Killip class: Killip class of the patient at the time of hospital admission(31).

Class I	No evidence of heart failure
Class II	Findings consistent with mild to moderate heart failure (eg, S3 gallop, lung rales less than one-half way up the posterior lung fields, or jugular venous distension)
Class III	Overt pulmonary edema
Class IV	Cardiogenic shock

Table 1.Killip classification

Major bleeding: any intracranial bleeding (excluding micro hemorrhages of less than 10 mm evident only on gradient-echo magnetic resonance imaging); clinically overt signs of hemorrhage associated with a drop in hemoglobin of 5 g/dL or greater; fatal bleeding (bleeding that directly results in death within seven days)(32).

Medical therapy: drug therapy with Anti-ischemic, Antithrombotic, Beta blockers, Calcium channel blockers, ACEI/ARBs, Analgesics and Nitrates.

PCI: is a non-surgical procedure that uses a catheter (a thin flexible tube) to place a small stent to open up blood vessels in the heart that have been narrowed by plaque buildup(33).

CABG: a form of bypass surgery that can create new routes around narrowed and blocked coronary arteries(34).

Reperfusion with fibrinolysis: administration of drugs that dissolve clots occluding the blood vessels.

Re-infarction: used for acute MI that occurs within 28 d of acute MI with a 20% or greater increase in the cTn measurement(35).

6.1 Data Collection tools and methods and procedures

Data was collected from June 1- August 31, 2023 by developing a data abstraction format which was prepared using global registry of acute coronary events (GRACE) and questionnaire drafted from previous literatures reviews. The questionnaire had three components including:

- Socio-demographic characteristics (Q1-Q5)
- Risk factors with clinical parameters (Q6-Q13), and
- Treatment modalities with outcome of patients (Q14-Q21).

Data collected by retrieving patient chart by trained data collectors (general practitioner) after a day-long training before data collection. Records of the study population were assessed for completeness before data entry and the entered data checked by the data supervisor on a daily basis for any incompleteness and/or inconsistency.

6.2 Data processing and analysis

SPSS version 26 was used for data entry and analysis. Categorical variables were recorded as percentages and frequency then compared by chi square test. Continuous variables were recorded as mean and standard deviation. Bivariate analysis between dependent and independent variables was performed using binary logistic regression. Multivariable logistic regression was used to detect associated factors for recovery and mortality. Both Crude Odds Ratio (COR) and the Adjusted Odds Ratio (AOR) with a corresponding 95% confidence interval (CI) were computed to show the strength of association. Hosmer and Lemeshow goodness-of-fit test was done to confirm model fitness with p-value of 0.216. Variables with a p-value of < 0.05 in the multivariable logistic regression analysis were taken as statistically significant. Finally results were presented by tables, charts and graphs.

6.3 Data quality management/control

To ensure the quality of data, four data collectors and one supervisor were recruited for each hospital and trained a week before the actual data collection period by the principal investigator. The training was given for one day about ethical issues and processes to minimize missing information. The purpose of the study and data collection techniques was given for both supervisors and data collectors. During data collection, close supervision and reviewing data for its completeness and missing information at each point was done by the supervisor and principal investigator on daily basis. Any error, ambiguity, incompleteness and other problems were addressed before the next day's activities. Data clean up and crosschecking was done before analysis.

6.4 Ethical consideration

Ethical clearance was obtained from the Institutional Ethical Review Board of all institutions involved in the study and permission was sought from the school administration through the academic provost of the school with letter of support to carry out the study. Each patient's information collected using a structured checklist. The names of patients were coded to avoid individual identifiers. The collected information was used for this particular study and it is kept confidential and anonymous. The informed consent was waived due to the anonymized data, and this study is conducted in accordance with the Declaration of Helsinki which states that "In medical research using identifiable human material or data, physicians must normally seek consent for the collection, analysis, storage and/or reuse".

6.5 Dissemination of result

The results of this study will be submitted to the department of internal medicine, SPHMMC in partial fulfillment of the requirement for a specialty certificate in internal medicine. It will also be presented to the SPHMMC cardiology unit. In addition, the findings will be distributed to the Ethiopian society of cardiac professionals. The results will be published in locally accessible or international journals and will be used as baseline for subsequent studies.

7 Results

7.1 Socio-demographic characteristics

The mean age of patients was 56.74 ± 12.46 years with a range of 26–92 years. Females were older at diagnosis than males, with a mean age of 59.09 years (SD ± 13.059) compared to 55.72 years (SD ± 12.087) for males. Of the total study subjects, 69.8% were males and 30.2% were females. Study subjects under the age of 55 years account for 41.4% while those between ages of 55 to 65 years and above 65 years each account for 28.1% and 30.5% of total cases respectively. Urban residence accounted for 91.1% of total subjects.

Variable	Category	Treatment outcome		Total percentage
		Recovered (%)	Death (%)	
Sex	Male	250 (71%)	18 (56.3%)	268 (69.8%)
	Female	102 (29%)	14 (43.8%)	116 (30.2%)
Age	<55	155 (44%)	4 (12.5%)	159 (41.4%)
	55-65	102 (29%)	6 (18.8%)	108 (28.1%)
	>65	95 (27%)	22 (68.8%)	117 (30.5%)
Residence	Urban	320 (90.9%)	30 (93.8%)	350 (91.1%)
	Rural	32 (9.1%)	2 (6.3%)	34 (8.9%)

Table 2. Socio-demographic characteristics of ACS patients admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

7.2 Presenting symptoms and risk factors

The mean duration of presentation to emergency department (ED) from symptom onset was 3 days ($76.35\text{hours} \pm 94.09\text{hours}$), with a minimum of 1 hour and a maximum of 504 hours (21 days). Twelve subjects (3.1%) presented to ED within 1 hour of symptom onset, and 25.3% presented after 72 hours. The presenting symptoms to ED were chest pain (84.4%),

shortness of breath (SOB) (62.8%), nausea and vomiting (51%), diaphoresis (37.5%), epigastric pain (19.3%), palpitation (9.4%) and other symptoms (35.7%). Other symptoms include easy fatigability, orthopnea, paroxysmal nocturnal dyspnea (PND), cough, syncope and body swelling with easy fatigability being the most common among these (48.9%). Males were more likely to present with chest pain (75.9%) compared to females (24.1%).

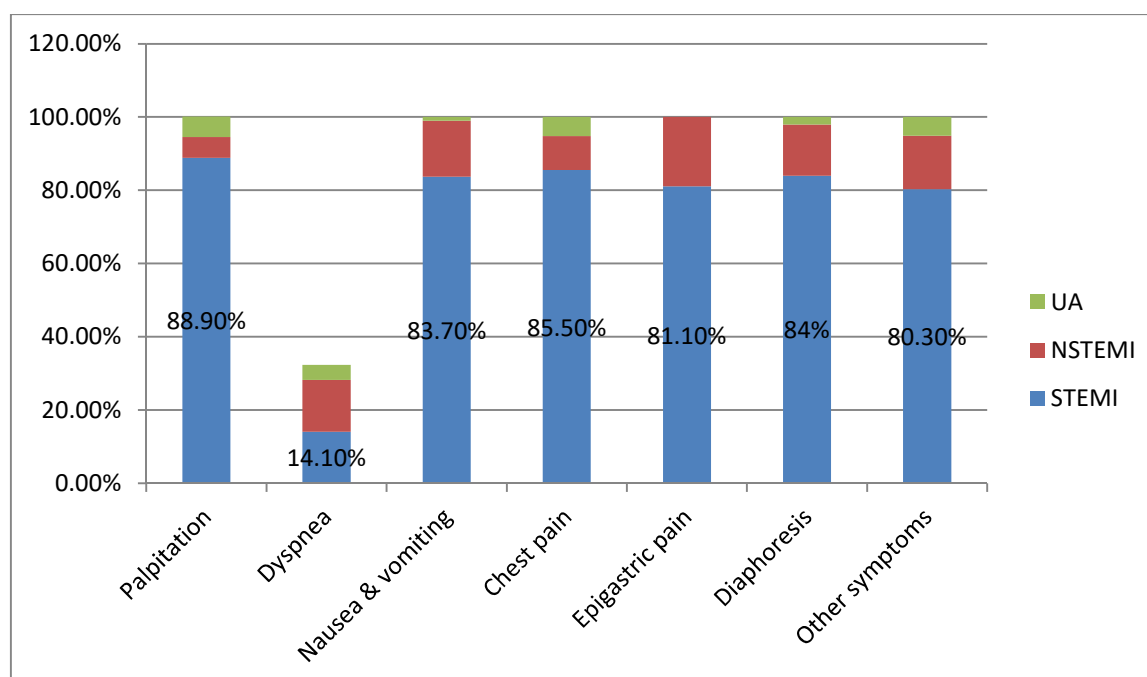


Figure 2. Presenting symptoms of patients with ACS admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

The study identified several prevalent risk factors, including hypertension (HTN) in 61.2% of patients, diabetes mellitus (DM) in 32.6%, prior myocardial infarction (MI) in 5.2%, chronic kidney disease (CKD) in 4.2%, angina in 3.1%, dyslipidemia in 2.9%, and stroke in 1% of patients. Hypertension (HTN) and diabetes mellitus (DM) were both more prevalent in males (70.6% & 69.6% respectively). Additionally, 12.5% of patients were diagnosed with heart failure on initial presentation, while other comorbidities like RVI, HBV infection, asthma, chronic obstructive pulmonary disease (COPD), dilated cardiomyopathy (DCMP), and benign prostatic hyperplasia (BPH) accounted for 24.5% of cases. Notably, 14.6% of patients had no identified comorbidities. Furthermore, based on laboratory cutoffs,

more than half of the patients met the criteria for dyslipidemia using either HDL or LDL cut-off values (58.1% & 52.3% respectively). The mean values for cholesterol, TG, LDL & HDL were 179.29 mg/dl (range 66-403), 147.33 mg/dl (range 57-861), 109.46 mg/dl (range 23-246) and 40.63 mg/dl (range 18-133), respectively. The study found that 22.4% of patients reported a history of smoking cigarettes, 14.1% reported alcohol consumption, and 10.9% reported khat chewing. Over 90% of both smokers and alcohol drinkers were male (95.3% and 88.9%, respectively). Importantly, 75% of patients reported no history of any of these behavioral risk factors.

7.3 Clinical parameters on initial presentation

The mean systolic blood pressure (SBP) was 124.22 mmHg $\pm$ 32.12 mmHg, and the mean diastolic blood pressure (DBP) was 77.85 mmHg $\pm$ 19.59 mmHg, with ranges of 0-210 mmHg for SBP and 0-133 mmHg for DBP. Upon initial presentation, 13.5% of patients had low SBP (<90 mmHg), while 29.9% had high SBP (>140 mmHg). Similarly, 25.5% of patients had low DBP ($\leq$ 60 mmHg), and 32% had high DBP (>90 mmHg).

The mean heart rate (HR) was 91.35 $\pm$ 18.94 beats per minute (bpm), with a minimum of 41bpm and a maximum of 153bpm. Of these patients, 4.2% had bradycardia (HR <60bpm) and 26.6% had tachycardia (HR >100bpm). Ten (2.6%) patients experienced cardiac arrest upon presentation.

Troponin was done for all patients and 97.9% had elevated level. Creatine kinase levels were assessed in 27.6% of patients (n=106), with elevated levels found in 25.5% (n=98).

Variable	Category	Treatment outcome		Total frequency (%)
		Discharge	Death	
SBP	$\leq$ 90mmHg	34 (9.7%)	18 (56.3%)	52 (13.5%)
	91-120mmHg	137 (38.9%)	14 (43.8%)	152 (39.5%)
	121-139mmHg	66 (18.8%)	0 (0%)	66 (17.1%)

	>=140	115 (32.7%)	0 (0%)	115 (29.9%)
DBP	<=60mmHg	76 (21.6%)	22 (68.8%)	98 (25.5%)
	61-89mmHg	153 (43.5%)	10 (31.3%)	164 (42.6%)
	>=90	123 (34.9%)	0 (0%)	123 (31.9%)
PR	<=60bpm	14 (4%)	2 (6.3%)	16 (4.2%)
	61-100	250 (71%)	16 (50%)	267 (69.4%)
	>100	88 (25%)	14 (43.8%)	102 (26.5%)
TG	<=150	242 (68.8%)	18 (56.3%)	260 (67.7%)
	>150	110 (31.3%)	14 (43.8%)	124 (32.3%)
Cholesterol	<=200	257 (73%)	22 (68.8%)	279 (72.7 %)
	>200	95 (27%)	10 (31.3%)	105 (27.3%)
LDL	<=100	169 (48%)	14 (43.8%)	183 (47.7%)
	>100	183 (52%)	18 (56.3%)	201 (52.3%)
HDL	<=40	207 (58.8%)	16 (50%)	223 (58.9%)
	>40	145 (41.2%)	16 (50%)	161 (41.9%)
Troponin	Elevated	344 (97.7%)	32 (100%)	376 (97.9%)
	Normal	8 (2.3%)	0 (0%)	8 (2.1%)
Creatinine	Elevated	67 (19%)	18 (56.3%)	85 (22.1%)
	Normal	285 (81%)	14 (43.8%)	299 (77.9%)
Killip class	1	164 (46.6%)	0 (0%)	164 (42.7%)

	2	113 (32.1%)	1 (3.1%)	114 (29.7%)
	3	66 (18.8%)	4 (12.5%)	70 (18.2%)
	4	6 (2.6%)	27 (84.4%)	36 (9.4%)
EF	<=40	157 (44.6%)	28 (87.5%)	185 (48.2%)
	41-49	40 (11.4%)	0 (0%)	40 (10.4%)
	>=50	155 (44%)	4 (12.5%)	159 (41.4%)

Table 3. Clinical parameters of patients with ACS admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

The study found that the majority of participants (81.5%) were diagnosed with ST-segment elevation myocardial infarction (STEMI) upon admission. Non-ST-segment elevation myocardial infarction (NSTEMI) and unstable angina (UA) were less common, comprising 14.1% and 4.4% of cases, respectively. Interestingly, more females presented with NSTEMI (59.3%) compared to males who were more likely to have STEMI (75.1%).

On initial presentation, 42.7% of patients were classified as Killip class I, indicating minimal cardiac dysfunction. However, a concerning 10.4% belonged to Killip class IV, reflecting severe heart failure. Additionally, almost half (48.2%) had a reduced ejection fraction (EF) of less than 40%, another marker of impaired heart function.

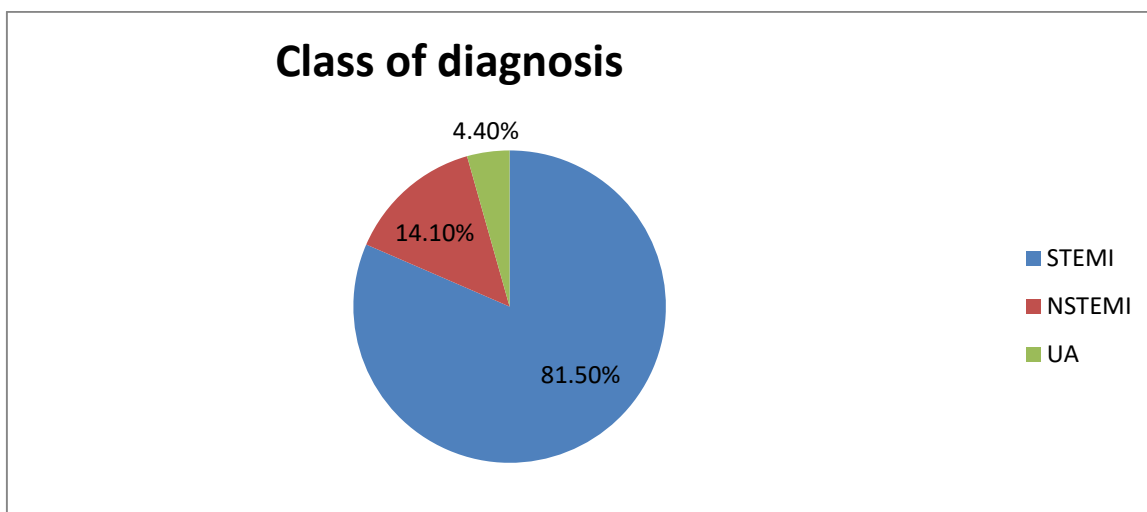


Figure 3. Class of diagnosis of patients with ACS admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

7.4 Treatment modalities, complications and outcome

Medical therapy was given for all patients with varying frequency depending on the specific drug. Coronary angiography (CAG) was performed in 48.9% (n=146) of patients. Among these, 10.9% (n=42) underwent percutaneous coronary intervention (PCI), with an average time from emergency department (ED) presentation to the procedure of 5.38 days (SD $\pm$ 4.173), ranging from 1 to 14 days. However, no patients underwent coronary artery bypass graft surgery (CABG) despite the presence of compelling indication.

Drugs used	Frequency	Percentage
ASA	384	100
Clopidogrel	378	98.4
BB	344	89.6
CCB	12	3.1
Statins	368	95.8
ACEI/ARBs	296	77.1

Nitrates	22	5.7
Morphine	209	54.4
Anticoagulation	350	91.1

Table 4. Medical therapies instituted for patients with ACS admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

Nearly half (49.5%) of the patients in this study developed heart failure, followed by cardiogenic shock in 9.9%. Other common complications included stroke (5.5%), re-infarction (3.6%), arrhythmia (3.1%), and major bleeding (1%). Fortunately, 34.6% of patients experienced no complications. Other less frequent complications included acute kidney injury (AKI), pneumonia (including COVID-19), and electrolyte imbalance.

Variable	Treatment outcome		Total frequency
	Discharge (%)	Death (%)	
Heart failure	172 (90.5%)	18 (9.5%)	190 (49.5%)
Cardiogenic shock	6 (15.8%)	32 (84.2%)	38 (9.9%)
Stroke	17 (81%)	4 (19%)	21 (5.5%)
Arrhythmia	4 (33.3%)	8 (66.7%)	12 (3.1%)
Re-infarction	6 (42.9%)	8 (57.1%)	14 (3.6%)
Major bleeding	0 (0%)	4 (100%)	4 (1%)

Table 5. In-hospital complications and treatment outcome of patients with ACS admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

Of the 384 study subjects, 91.7% (n=352) patients discharged improved while the in hospital mortality rate was 8.3% (n=32). Both discharge and mortality rates were higher in males (71% & 56.3% respectively). Within the different ACS groups, 8.9% of patients with STEMI died, compared to 7.4% in the NSTEMI group but none died in UA group. The

identified causes of death were cardiogenic shock (5.2%), arrhythmia (ventricular tachycardia and ventricular fibrillation) comprising 2.3% and other causes (0.8%) such as multi-organ failure secondary to refractory septic shock, pneumothorax and massive pulmonary embolism (PE).

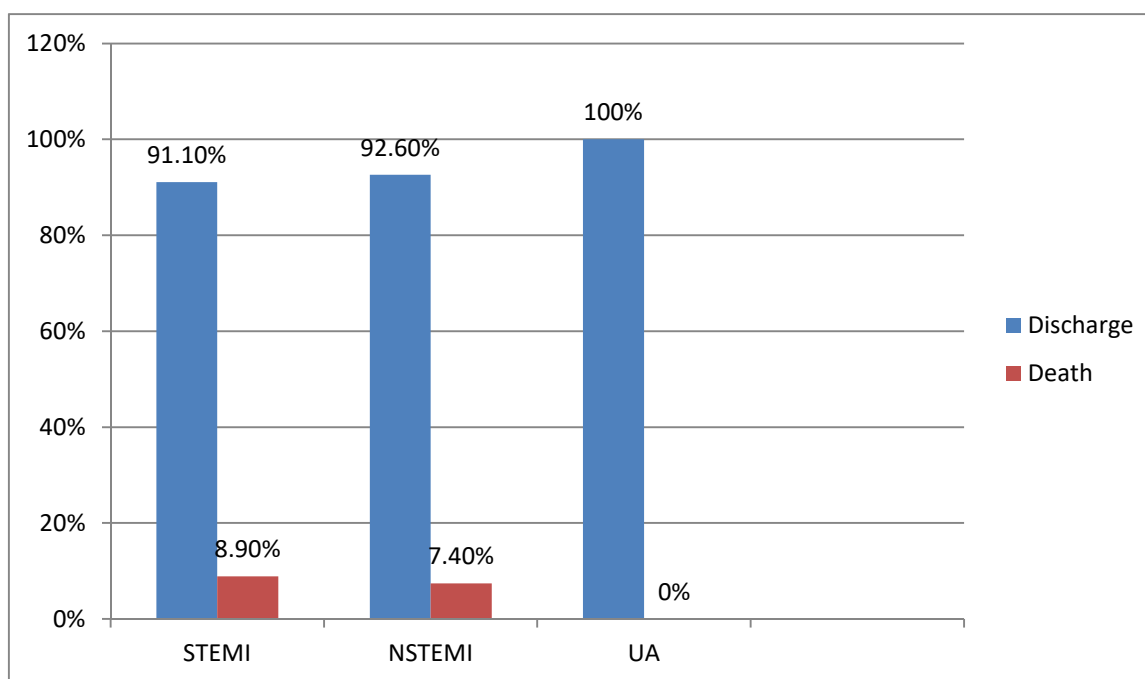


Figure 4. Class of diagnosis and treatment outcome of patients with ACS admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

7.5 Predictors of treatment outcome of ACS patients

Binary logistic regression model was used to identify factors associated with in hospital mortality and recovery including age, sex, residence, presenting symptoms, comorbidities, duration of symptom onset to ED presentation, behavioral risk factors, vital signs, Killip class, EF, laboratory investigations, presence of cardiac arrest initially, class of ACS diagnosis, treatment modalities, in hospital complications and length of hospital stay. Among these, age, Killip class, EF and creatinine level were found to have association with p value < 0.25 . Multivariable regression analysis was done and showed that age > 65 years, low EF ($< 30\%$) & being in Killip class 4 category on initial presentation were found to have statistical significance with p value of < 0.05 on treatment outcome of ACS patients.

Patients who were over 65 years, classified as Killip class 4 and those with an ejection fraction below 30% were more likely to die than their counterparts (P=0.004, 95% CI: 2.125-51.549, AOR: 10.466; P<0.0001, CI: 17.73-315.972, AOR: 74.848; P=0.001; CI: 3.662-109.724, AOR: 20.044 respectively).

Variable	COR	P Value (<0.25)	CI	AOR	P Value (0.05)	CI
Age >65 years	24.19	<0.0001	8.238- 71.029	10.466	0.004*	2.125- 51.549
Killip class 4	205.80	<0.0001	64.432- 657.336	74.848	<0.0001*	17.73- 315.972
EF <30 %	40.238	<0.0001	16.47- 98.307	20.044	0.001*	3.662- 109.724
Creatinine elevation	0.183	<0.0001	0.087-0.386	0.417	0.259	0.091-1.904

*Significant association

Table 6. Multivariable logistic regression analysis of factors associated with in-hospital mortality of acute coronary syndrome patients admitted in three tertiary hospitals from January 1, 2021 to June 30, 2023 G.C.

8 Discussion

This study revealed that the age distribution of ACS patients were 56.74 ± 12.46 years which is in line with the study done in TASH (56.3 ± 13.7 years) and St. Peter's Specialized Hospital (56.30 ± 10.04 years) with a decade difference from GRACE registry (64.9 ± 12.6 years) but lower than Ayder Comprehensive Specialized Hospital (59.12 ± 12.98 years) and SPHMMC (63.69 ± 8.23 years)(25)(3,8,9,17). The average age is 52 years in Djibouti, 55.5 ± 11.3 years in South Africa, 57.5 years in Kenya and 59.2 ± 12.4 years in Nigeria(36–39). Male dominance (69.8%) was also seen similar to studies from TASH, Ayder Comprehensive Specialized Hospital, St Peter Specialized Hospital & SPHMMC (75.8%, 72.2%, 68.1% & 68.2) respectively as well as in most of global reports(3,8,9,17). Urban residence accounted for 91.1% of cases. Overall, this study supports the existing knowledge on the socio-demographic characteristics of ACS patients in Ethiopia and Africa, with some interesting variations seen compared to a global registry.

This study found that patients waited an average of 3 days before seeking emergency care after symptom onset as seen in TASH (3.8 days) & SPHMMC (3.3 days). Twelve (3.1%) patients presented within 1 hour of symptom onset similar to Ayder Comprehensive Specialized Hospital (3.3%) and Nigeria (3.1%) but none in the study done at TASH & SPHMMC(3,8,9,17,39). Therefore, this study also confirmed the fact that there is patient delay as a factor for lack of timely management. The mean length of hospital stay was found to be 9.97 ± 6.81 days which is comparable to what was found from the study done in TASH (9.77 ± 6.42 days) but longer than that of St. Peter's Specialized Hospital (2.98 ± 1.30 days), South Africa (3 days), Kenya (5.3 ± 1 day), Nigeria (7.0 ± 6.4 days) and shorter than the study done in SPHMMC (14.5 days)(3,8,9,17,37–39). The discrepancy might be due to unavailability of revascularization services in SPHMMC & ZMH which contributes to faster recovery and early discharge even though it was not performed as per guideline.

Patients with atypical symptoms at presentation had a higher risk of death compared to those with chest pain (COR= 5.17) similar to the study from TASH and GRACE(8,25). Hypertension (61.2%) and diabetes (32.6%) were the most common comorbidities among

patients with ACS, consistent with the finding from TASH (61.3%, 21%), SPHMMC (66.2%, 29.9%) and Kenya (63%, 41%) but lower than Nigeria (78.7%, 37%) (8,9,38,39). This shows that HTN is still the leading cardiovascular risk factor for the development CCS and ACS. Dyslipidemia was found in 58.1% & 52.3% of cases using HDL and LDL cut off value respectively; however, it was underrepresented (2.9%) as it was often missing from their medical records, suggesting poor documentation. Previous MI accounted for 5.2% of cases comparable to South African (3.1%) study on the contrary to the studies from Ayder Comprehensive Specialized Hospital (23.2%), TASH (16.1%), SPHMMC (14%) (8,9,17,37). Smoking rates were higher (22.4%) which goes with the findings from SPHMMC (23.6%) & Nigeria (24.4%) as opposed to studies from South Africa (8.1%), Kenya (9%), Ayder Comprehensive Specialized Hospital (11.9%) and TASH (14.5%) however; undocumented smoking status might lead to underestimation of the overall smoking status in these studies(8,9,17,37–39).

Given the advances in investigational biomarkers of cardiac injury and with the advent of high sensitivity troponin, patients were classified as having STEMI & NSTEMI in 81.5% and 14.1% of cases with lower proportion of UA (4.4%) in line with the global trend but the same might not be true for Nigeria (STEMI/NSTEMI/UA=48.7%, 24.5%, 26.8%) and Iran (UA/STEMI/NSTEMI=69.5%, 11.5%, 1.75%) (39,40). However, creatinine kinase was done for 27.6% of patients unlike that of St Peter Specialized Hospital (66.6%)(3). This study highlights the increasing use of advanced biomarkers for diagnosing ACS, resulting in a higher proportion of STEMI and NSTEMI cases compared to previous researches. STEMI patients are more likely to present with chest pain as 72.15 % out of 84.4% patients with chest pain were STEMI patients. Fourteen out of 17 UA (82.35%) patients presented to the ED later than 72hours after symptom onset. This reveals that delayed arrival in UA patients is attributed to milder symptoms. All patients with UA presented with killip class 1 category whereas 8.1% of STEMI and 1.3% of NSTEMI patients were in killip class 4 upon presentation which is attributable to the degree of infarction associated with STEMI. Among patients with reduced EF ($\leq 40\%$), 44.5% out of 48.2% were those with STEMI. Furthermore, the mortality rate for patients with STEMI

was 7.26% (1.03% for NSTEMI and 0% for UA). This study highlights key differences in presentation, severity, and outcomes among patients with acute coronary syndrome (ACS). Patients with ST-segment elevation myocardial infarction (STEMI) were more likely to present with chest pain and experience higher mortality. Additionally, a higher proportion of patients with reduced ejection fraction (EF) belonged to the STEMI group. Notably, UA patients arrived later and demonstrated lower Killip class scores (indicating less heart failure), supporting the link between infarct size and severity. These findings emphasize the importance of early intervention for STEMI patients due to their higher risk of complications and death.

Guideline-directed medical therapy (GDMT) was used in all patients at varying frequencies including Aspirin (100%) and clopidogrel (98.4%). Beta blockers and ACEI/ARBs were given for 89.6% & 77.1% patients respectively. This is because of coexisting complications and comorbidities like cardiogenic shock, AVB and AKI/CKD which preclude the utilization. Overall the use of GDMT was higher in this study as compared to previous studies done in Ethiopia. As medications like nitrates, morphine and CCB had no mortality benefit; these medications were prescribed less and for those with symptom relief only. CAG was done for 48.9% of cases of which 10.9% undergone PCI (9.34% STEMI Vs 1.56% NSTEMI) and streptokinase for thrombolysis was given for 1.6% (100% STEMI) patients unlike other studies done in TASH (0%), Ayder Comprehensive Specialized Hospital (3.9%), Kenya (9% CAG, 12% PCI, 5% thrombolytics) and South Africa (19% PCI, 26% thrombolytics) (8,17,37,38). No deaths occurred in the revascularization groups despite delayed reperfusion therapy because of their favorable initial clinical presentation. All patients in streptokinase group and half of patients from PCI group were discharged within 1 week. Recent publication from Nigeria showed 42.8% reperfusion therapy rate (17.1% had thrombolysis, PCI was done 28.6% and CABG for 11.2% patients) (39). The same is true for Iran where thrombolytic therapy was given for 48.1% & 3.8% of patients with STEMI & NSTEMI; approximately, more than half of STEMI patients received reperfusion therapy (thrombolysis and PCI) as well(40). The mean time of PCI procedure was 5.38 days with a range of 1-14 days. Despite having a cath-lab center at St. Peter's Specialized

Hospital, timely interventions are still posing a major obstacle. This delay likely stems from several factors, including a lack of awareness among patients with risk factors leading to delayed presentation, limited availability of equipment and medications for reperfusion therapy, and the absence of readily available emergency PCI services. These challenges not only contribute to delayed PCI interventions at St. Peter's but also highlight the broader obstacles faced in providing timely and effective PCI treatment in many low-to-middle income countries.

The composite major adverse cardiovascular events (MACE) in this study were heart failure (49.5%), cardiogenic shock (9.9%), stroke (5.5%), re-infarction (3.6%), arrhythmia (3.1%) and major bleeding (1%). Resuscitated cardiac arrest accounted for 1.3% of cases out of 2.6% cardiac arrests. The in-hospital mortality rate was 8.3%, comparable to Nigeria (8.1%) but lower than previous studies in Ethiopia (TASH: 27.4%, Ayder: 24.5%) and Kenya (17%) (8,17,38). While the SPHMMC study found a lower mortality rate (3.8%), its generalizability might be limited (9). Cardiogenic shock (5.2%) was the leading cause of death, followed by arrhythmia (2.3%). Risk factors associated with patient outcomes included hypertension, previous heart attack, heart failure, chronic kidney disease, alcohol consumption, and medication use (β -blockers, ACE inhibitors/ARBs). Additionally, development of specific MACE components (cardiogenic shock, arrhythmia, re-infarction, and stroke) further impacted outcomes. The predictors for in-hospital mortality were older age, Killip class, low EF and elevated creatinine. Among these, older age (>65 years), Killip class 4 (most severe), and severely reduced ejection fraction (<30%) were independent risk factors for death with AOR 10.466, 74.848 and 20.044 respectively. Similar findings were reported in studies from TASH, Ayder Comprehensive Specialized Hospital, Kenya, Nigeria and South Africa(8,17,37–39).

Overall, this study reveals improvement in management of patients with ACS both medically and with reperfusion therapies like percutaneous coronary intervention (PCI) and thrombolysis, compared to previous researches. However, the utilization of these therapies, particularly Primary PCI, remains inadequate to meet the growing demand caused by the rising prevalence of Coronary Heart Disease (CHD). This gap, due to previously mentioned

constraints, contributes to ongoing suffering and premature deaths, unlike the situation in developed countries.

9 Strength and limitation of the study

9.1 Strength

The major strength of this study is that it was a multicenter study conducted in three tertiary hospital found in Addis Ababa, Ethiopia with a representative result for most of hospitals in public sector.

The study achieved its objectives including risk factor & comorbidity assessment, outcomes of ACS patients in terms of predictive factors and the pattern of management.

9.2 Limitation

Even if it is a multicenter study, generalizability might be difficult due to exclusion of privately owned hospitals with access to revascularization therapy.

Secondary data was collected from patient charts which made some patient cards to be excluded from inclusion due to incomplete data and lost charts especially during the COVID pandemic.

Shorter duration (2years) of review which might underestimate the current advances in treatment modalities applied till the end of 2023 G.C.

Prospective cohort studies would better assess outcomes of patients beyond hospitalization and apart from in-hospital survival with assessment of long term impact of medical and revascularization therapy

10 Conclusion

This study demonstrated improved management with regard to GDMT as compared to previous studies done in Ethiopia but with still lower rate of revascularization interventions. Currently the access for PCI is increasing even though primary PCI per ESC 2023 guideline is not being done due to unavailability emergency services, fibrinolytic medications and delayed presentation of patients after symptom onset. In-hospital mortality still remains high as compared to middle and higher income countries attributed to lack of emergency revascularization services, pre-existing co-morbidities, and patient delays in seeking medical attention early. ACS is now increasing in its prevalence worldwide as well as in low to middle income countries due to urbanization and lifestyle changes with increased mortality from scarcity of specialized intervention services which reduce the impact, quality improvement in the care given is mandatory.

11 Recommendation

Despite several reports on ACS and its mortality with recommendation for evidence-based and timely management, our facilities did not come in to action to eradicate these limitations. Therefore, nationwide implementation of appropriate management and disposition of patients is crucial for improved survival together with government-initiated increase in accessibility for the advanced therapies for tertiary hospital at least for now.

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Annexes

Annex 1: Information sheet

Research title: Treatment outcome and associated factors of acute coronary syndrome among patients admitted to three tertiary hospitals in Addis Ababa.

Principal investigator: Dr Bethelihem Ligaba (Internal Medicine Resident)

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Advisors: Dr. Henok Benti (Consultant Internist and Cardiologist)

Dr. Samrawit Solomon (MD, MPH, Associate professor)

Sponsor: St. Paul's Hospital Millennium Medical Collage

Annex 2: English Version Questionnaire

Part 1: Socio-demographic characteristic

1. Place of hospitalization.....
2. Medical record number.....
3. Age (in years).....
4. Sex
 - 1) Male 2) Female
5. Residence
 - 1) Urban 2) Rural

Part 2: Risk factors and clinical parameters

6. Presenting symptom
 - 1) Palpitation
 - 2) Shortness of breath
 - 3) Nausea and vomiting
 - 4) Chest pain
 - 5) Epigastric pain
 - 6) Diaphoresis
 - 7) Others (specify).....
7. Duration of symptoms from onset to hospitalization (in hours).....
8. Comorbidities (more than one answer is possible)
 1. Hypertension
 2. Dyslipidemia
 3. Diabetes Mellitus
 4. Previous MI
 5. Heart failure
 6. Previous angina
 7. PAD
 8. CKD

9. Stroke
10. Others (specify)_____
11. None
9. Behavioral variable (more than one answer is possible)
 1. Smoking
 2. Alcohol use
 3. Khat
 4. Cocaine
 5. Others (specify).....
 6. None
10. Initial assessment
 1. Blood pressure
 2. Heart rate
 3. Killip class
 4. Ejection fraction
 5. Lipid profile- TG-----LDL-----HDL-----CHOL-----
 6. Troponin
 7. Creatinine kinase
 8. Creatinine
11. Cardiac arrest on initial presentation
 1. Yes
 2. No
12. If yes, ROSC achieved
 1. Yes
 2. No
13. Class of diagnosis
 - 1) STEMI 2) NSTEMI 3) UA

Part 3: Treatment modalities and the outcome patients

14. Treatment modality during hospitalization

1. Medical
2. Medical + Coronary angiography
3. Medical + PCI(done during time of hospitalization)
4. Medical + CABG (done during time of hospitalization)

15. Which medical therapy used? (more than one answer can be used)

1. Aspirin
2. Clopidogrel
3. Beta Blocker
4. Calcium Channel Blocker
5. Statin
6. ACEI/ARB
7. Nitrates
8. Morphine
9. Anticoagulant

16. If PCI done, time after hospitalization? (In days).....

17. If CABG done, time after hospitalization? (In days).....

18. Complication occurred during hospitalization

1. Arrhythmia (specify).....
2. Cardiogenic shock
3. Major bleeding
4. Heart failure
5. Re-infarction
6. Stroke
7. Others (specify).....
8. None

19. Length of hospital stay (in days).....

20. Outcome of the patient

1. Discharged improved

2. Death

21. If the answer for number (17) is death, specify cause of death.....

- 1) Cardiogenic shock
- 2) Heart failure
- 3) Arrhythmia (specify).....
- 4) Septic shock
- 5) Major bleeding
- 6) Pulmonary embolism
- 7) Others (specify).....

Assurance of the investigator

I the undersigned resident agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I will communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the resident: Dr. Bethelihem Ligaba

Signature: _____

Date:

Approval of Advisors

Name of Public Health Advisor: Dr. Samrawit Solomon (MD, MPH, Associate professor)

Signature: _____

Date:

Name of Clinical Advisor: Dr. Henok Benti (Consultant Internist and Cardiologist)

Signature: _____

Date: