JIMMA UNIVERSITY

INSTITUTE OF HEALTH

FACULTY OF PUBLIC HEALTH

DEPARTMENT OF EPIDEMIOLOGY

SURVIVAL STATUS AND PREDICTORS OF MORTALITY AMONG ADULT STROKE PATIENTS ADMITTED TO JIMMA UNIVERSITY MEDICAL CENTER: RETROSPECTIVE COHORT STUDY

BY: WAKGARI MOSISA (BSC)

A THESIS SUBMITTED TO THE DEPARTMENT OF EPIDEMIOLOGY, FACULTY OF PUBLIC HEALTH, INSTITUTE OF HEALTH, JIMMA UNIVERSITY, FOR PARTIAL FULFILLMENT OF MASTERS OF PUBLIC HEALTH IN EPIDEMIOLOGY.

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JIMMA, ETHIOPIA

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Abstract

Background: *Stroke is the second leading cause of mortality in the world and the first leading cardiovascular disease cause of death in sub-Saharan African countries, and stroke-related deaths accounted for 6.23% of total deaths in Ethiopia. However, there is limited scientific evidence on survival experience and its predictors among stroke patients in Ethiopia.*

Objective: *To assess the Survival time of adult stroke patients and its predictors among adult stroke patients admitted at Jimma University Medical Center from April 1/2017 to March 31/2022.*

Method: *A retrospective cohort study was conducted on 480 adult stroke patients selected by simple random sampling among patients admitted to the stroke unit of Jimma University Medical Center from April 1/2017 to March 31/2022. Data were extracted from May to June 2022, entered into Epidata version 3.1, and analyzed by the R 4.2 version. Kaplan Meier curve with Log-rank test was used to estimate survival time and compare survival experience among categories of explanatory variables. The Cox proportional hazard model's assumptions were checked by Schoenfeld residual plot and global test. The Cox regression model was computed to identify predictors of the survival status of stroke patients. Then the 95% CI of hazard ratio with corresponding p-value < 0.05 was set to declare statistical significance.*

Result: *The study involved 480 eligible stroke patients in total, with a mean age of 55.43 ± 14.56 years. During 4350 person-days follow-up; 88(18.33%) patients died; yielding incidence mortality of 20.23per 1000 person-days, with a median survival time of 38 days. The cumulative survival rates for the first 7, 14, and 30 days were 0.852, 0.795, and 0.608 respectively. Glasgow coma scale <8 at admission (AHR= 7.71; 95% CI: 3.78, 15.69), dyslipidemia (AHR =3.96; 95% CI: 2.04, 7.69), aspiration pneumonia (AHR 2.30; 95%CI: 1.23-4.26) and increased intracranial pressure (AHR= 4.27; 95% CI: 2.33, 7.81), were the independent predictors of time to death.*

Conclusion and Recommendation: *The incidence of stroke mortality was higher in the seven and fourteen days, while the thirty-day mortality and median survival time were lower than in the previous studies. Glasgow Coma Scale, increased intracranial pressure, dyslipidemia, and aspiration pneumonia were independent predictors of mortality. Therefore, careful follow-up and early detection of stroke complications were recommended for unconscious patients.*

Keywords: *Stroke, Survival time, Predictors, Southwest Ethiopia*

Acknowledgment

I would like to express my gratitude to Jimma University, the Institute of Health, the Faculty of Public Health, and the Department of Epidemiology for granting me this opportunity by selecting my research topic and assigning advisors to develop my Thesis. Furthermore, I would like to express my profound gratitude to my advisors, Mr. Masrie Getnet and Mrs. Yenealem Gezehagn, for their helpful guidance and constructive feedback throughout the development of this paper.

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Abbreviations and Acronyms

AHA	American Heart Association
AOR	Adjusted Odds Ratio
BPR	Blood Pressure
BSc	Bachelor of Science
CT scan	Computerized Tomography scan
CVD	Cardiovascular Disease
DALYs	Disability Adjusted Life Years
ECG	Electrocardiography
ETB	Ethiopian Birr
GBD	Global Burden of Disease
GCS	Glasgow Coma Scale (Level of Consciousness)
HIV	Human Immunodeficiency Virus
HR	Hazard Ratio
HS	Hemorrhagic Stroke
ICH	Intra-Cerebral Hemorrhage
IQR	Inter Quintile Range
IS	Ischemic Stroke
JUMC	Jimma University Medical Center
LMICs	Low and Middle-Income Countries
MRI	Magnetic Resonance Imaging
NCD	Non-Communicable Diseases
SAH	Subarachnoid Hemorrhage
TIA	Transient Ischemic Attack
WHO	World Health Organization

1. Introduction

1.1 Background

World Health Organization(WHO) defines, Stroke as a clinical syndrome consisting of rapidly developing clinical signs of focal (or global in case of coma) disturbance of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than a vascular origin (1). Strokes can be broadly split into 2 types: ischemic and hemorrhagic strokes. Hemorrhagic strokes are associated with increased mortality from actual bleeding within the brain, compared to ischemic strokes which are caused by blockages of blood supply. A transient ischemic attack (TIA) is defined as stroke symptoms and signs that resolve within 24 hours (1,2).

Over 15 million of the 41 million people worldwide who die each year from non-communicable diseases do so between the ages of 30 and 70, with developing nations making up 85% of these deaths (3). Cardiovascular disease is the primary global cause of death, According to estimates; 17.9 million deaths worldwide in 2019 were attributable to CVDs, about 32% of all deaths; Heart attack and stroke deaths accounted for 85% of this mortality with more than three fourth of those deaths taking place in low- and middle-income countries (LMICs) (5).

The global epidemiology of stroke is changing rapidly (6). Stroke is the second leading cause of death worldwide after heart disease (7,8), for people above the age of 60 years, and the fifth leading cause for people aged 15 to 59 years old; accounting for 11.8% of total deaths (7). Each year nearly six million people worldwide die from stroke. One in six people will have a stroke in their lifetime (8). Patients with a stroke under the age of 50 years account for 5-10% of all strokes worldwide (9). Even it is the leading cause of acquired disability and a third leading cause of death in women worldwide (10). It has been estimated that around 17 million people worldwide have had a stroke for the first time; one every two seconds, and 62 million stroke survivors (11,12).

Global Burden of Disease (GBD) of 2019 data showed that in 2010 in sub-Saharan Africa and LMICs, the leading cardiovascular disease cause of death and disability was stroke (8,13–15). According to WHO, report 2018 including all ages and sexes, in Ethiopia of the total number of deaths, 39% were due to non-communicable diseases, and of these non-communicable diseases, more than one-third of mortality has been caused by cardiovascular diseases (CVDs) (16).

There is growing evidence for an increasing trend in the incidence of stroke in young adults. Stroke in young adults has a special significance in developing countries, as it affects the most economically productive group of the society (17), and even it is associated with higher mortality in this age group (18). In Ethiopia, Cerebrovascular disease was the 1st among the top 10 NCDs causes of death for both males and females, and 5th rank of the total deaths in 2007and increased by 8.35%, becoming the first rank in 2017 (19). Overall stroke is one of the top devastating NCDs globally and the majority of the burden is targeted in developing countries.

1.2 Statement of the problem

Stroke is among the most common medical emergencies (22). It is a devastating and disabling cerebrovascular disease that results in a significant amount of residual deficit leading to economic loss (23). This high burden of stroke is not only attributable to its high in-hospital mortality but also its high physical disability and huge economic loss. It is an important health issue (23,24).

According to the Global Burden of Disease (GBD) report of 2019, the ten most important drivers of increasing burden (i.e., the causes that had the largest absolute increases in the number of Disability Adjusted Life Years (DALYs) between 1990 and 2019) include six causes that largely affect older adults (ischemic heart disease, diabetes, stroke, chronic kidney disease, lung cancer, and age-related hearing loss). Overall between 1990 and 2019; DALYs for non-communicable diseases increased by 13·1% (9·5–16·3). In 2019, ischemic heart disease and stroke were the top-ranked causes of DALYs in both the 50–74-years and 75-years-and-older age groups (15).

The age-adjusted incidence rates of stroke in Africa range from 41 per 100, 000 population per year in Nigeria (1971–74) to 316/100 000/year in urban Dar-es-Salaam (25). Africa appears to be the global capital for strokes, with at least 6 Africans having a stroke every minute. The prevalence of up to 1460 per 100,000 in the Niger Delta region, and a 3-years case fatality rate greater than 80% (25,26).

Approximately 8-12% of ischemic strokes are fatal compared to 37-38% of hemorrhagic strokes and this depends on stroke severity, advanced age, comorbidities, and effectiveness of treatment of complications (27). The intrahospital mortality of stroke in developed countries is 3-11%, whereas in low and middle-income countries it is 7-15% (28). But, in Sub-Saharan African (SSA) countries it is much more significant, three to four times higher than that of developed countries which range from 11-43.4% (29).

In Ethiopia, the prevalence of stroke was 19.3%; with ischemic stroke accounting for 51.2% of all cases and having a ratio of 1.36 to hemorrhagic stroke (30)., the burden of stroke is increasing and has become the reason for 7.5% to 19.3% of hospital admission, and approximately (11% to 42.8%) death between (2014–2019) (31). The magnitude of stroke-related deaths in Ethiopia is

6.23% of total deaths, and the age-adjusted death rate of stroke in the country is 89.82 per 100 000 of the population (32).

In the absence of a significant global public health response stroke is projected to rise to 23 million new cases and 7.8 million deaths per year by the end of 2030 (33). Established risk factors such as arterial hypertension, diabetes mellitus, cigarette smoking, hyperlipidemia, Atrial fibrillation, micro-vascular rupture, male gender, age, obesity, excessive alcohol consumption, family history, drugs, Ethnicity, and observed co-morbidities such as sickle cell disease, hypercoagulability, human immune virus(HIV) infection and cerebral malaria are increasingly being encountered in the tropics (21,32). Trends of cerebrovascular stroke rise with age, and males are more affected than females. Hypertension is the most common risk factor and Ischemic stroke is the most common type of stroke (34).

Stroke leads to disability for a long time unless addressed promptly, and those patients usually require more excessive investigations to find an underlying cause of the disease. It is one of the most important life-threatening and serious medical emergencies, which requires timely medical assessment, diagnosis, and treatment (35). And it's an emerging public health problem that's poorly addressed, in the past stroke used to be a disease that only affected wealthy countries, but it is now emerging as a public health issue in developing countries as well. Even, evidence suggests that, compared to western Europe and the USA, the incidence and prevalence of stroke in Africa could be up to 2-3 times higher today (26). This has serious implications for lost productivity, premature deaths, and long-term disability (36).

In Ethiopia, stroke is becoming an increasingly serious public health issue and there are limited complete or reliable records of data specific to the Ethiopian setting that are limiting the formulation of an appropriate response. Even though a study was conducted five years back on Burden, clinical outcomes, and predictors of outcomes in this study area, there is no recent study done on long-term survival experience and its predictors among adult stroke patients admitted to Jimma University Medical Center. So the purpose of this study is to determine the survival status and its predictors among adult stroke patients admitted to Jimma University medical center.

1.3 Significance of the study

For effective, as well as efficient preventive, acute care, and rehabilitation program for stroke patients, it is vital to identify factors that predict the treatment outcome of admitted patients on follow-up generally in low and middle-income countries including Ethiopia where the magnitude is increasing.

Therefore, evaluation and better knowledge of the survival status and predictor of death will reduce intra-hospital mortality and complications which further helps to improve the quality of care given to stroke patients. Hence, this study will generate evidence to help clinicians and other service providers in designing interventions to reduce the mortality of stroke patients by identifying high-risk patients and predictive factors of mortality that they can target for priority intervention.

The study will also give evidence for governmental and Non-governmental organizations which work in the area of non-communicable diseases, and also help policymakers in designing context-specific appropriate strategies for addressing the modifiable risk factors of stroke by early screening, detection, treatment, and control of stroke complications

Finally, this study will help scientists and researchers update their understanding of the current incidence of adult stroke mortality in Jimma University medical center in addition to providing a baseline for future research.

2. Literature Review

2.1. The magnitude of stroke mortality

Globally Stroke is ranked as the second leading cause of death worldwide with an annual mortality rate of about 5.5 million; not only does the burden of stroke lie in the high mortality but the high morbidity also results in up to 50% of survivors being chronically disabled (37). According to a 3-year prospective cohort undertaken on 14 stroke units in the Netherlands among 747 patients during follow-up, more than half of the patients died 465 (62%) (28).

In Ethiopia the burden of stroke is also increasing resulting in Stroke mortality varies from 17 (12.0%) at Mekele Ayder Hospital (38), 56 (15.2%) at Felege Hiwot referral Hospital (31), 18(16.2%) at Ambo University Referral Hospital(39), 34 (20%) at Tikur Anbessa Specialized Hospital, Addis Ababa (30), and 30.1% at Saint Paul Teaching Hospital (40). Variances in sample size, study population characteristics, study population composition, study design, and study areas may be the reason for variations in mortality proportions.

According to a cross-sectional study done in Ali Ibn Abi Talib Hospital in Rafsanjan, 199 patients(9.04%) of patients died during hospitalization (41). Whereas, in a multicenter retrospective study in the Democratic Republic of the Congo 57 (31.7%) died from stroke (42).

2.2. Predictors of stroke patient's survival status

2.2.1. Socio-demographic characteristics

A systematic review on sex differences in stroke epidemiology found that males experience a 33% and a 41% higher incidence and prevalence of stroke than women do. Men also experienced their first stroke on average earlier than women, and men had higher rates of brain infarction and intra-cerebral hemorrhage. However, women had higher rates of subarachnoid hemorrhage (43). Additionally, a prospective cohort study in China found that men had a higher incidence of stroke than women did and the difference can be explained by traditional cardiovascular risk factors such as; age, systolic blood pressure, body mass index, low-density lipoprotein cholesterol levels, smoking, alcohol drinking, antihypertensive drugs, education, and physical activities (44). GBD 2019 also showed that 50–74-years and 75-years-and-older age groups are at the top rank for developing ischemic heart disease and stroke (15).

A cross-sectional study done in Tikur Anbessa Specialized Hospital found a ten-year increase in patients' age leads to a 25% higher risk for ischemic stroke and younger adults 8.587 higher chance to improve free of complications than older adults (30). Similarly, in retrospective cohort studies done in Felege_Hiwot referral Hospital older patients (Age greater than 65) had a 6.31 hazard of death compared to younger ages (<45years) (31). Moreover, at Abi Talib Hospital in the Rafsanjan study, 199 patients (9.04%) died out of 2,199 stroke patients (the mean age was 68.46±15.67, 46% male, and 54% female) during the hospitalization period (41). Consistent with this study in the Democratic Republic of Congo stroke mortality was significantly higher among females compared to males; it also investigated that being married had a protective effect on stroke mortality (42).

Retrospective studies on 4459 patients who had their first ischemic stroke in Pennsylvania found that the cumulative incidence of ischemic stroke recurrence was 8%, and the five-year survival probability was 87.2%. For the 18-55 age groups; the survival probability was determined to be 94.7%, 91.0%, and 87.2% at 1 year, 3 years, and 5 years, respectively. The survival probability was lower for those over 55years; at 1 year, 3 years, and 5 years, 83.3%, 71.2%, and 62.0%, respectively. When compared to patients over 55, those between the ages of 18 and 55 had a considerably lower risk of all-cause mortality. In the 18-55 age range, chronic kidney disease was found to be linked to higher mortality (45). Another retrospective study of the first-ever stroke patients in Malaysia indicated survival probabilities of 28 days, 1 year, and 5 years were, respectively, 78.0%, 74.2%, and 70.9% (46).

From a population-based cohort study in Lund, Sweden, Age (adjusted HR 1.09), stroke severity (AHR 1.11), and comorbidities (AHR 1.36) were independently closely associated with 3-year mortality (47).

2.2.2. Antecedent Risk factors

At Saint Paul Hospital, a hospital-based cross-sectional survey found that hypertension (60.7%), structural heart disease (18.4%), atrial fibrillation (14.7%), and diabetes mellitus (11%) were the most prevalent antecedent risk factors (40). Similarly, in Mekele Ayder Hospital, 66.2% of patients were hypertensive at hospital arrival, as well 38% of patients had pre-existing hypertension and 4.9% had pre-existing diabetes when they were admitted for stroke (38).

According to a hospital-based retrospective study conducted in Sri Lanka, the most prevalent risk factors were hypertension (79.4%), diabetes mellitus (41.2%), smoking (23.5%), alcohol (20.6%), stroke history (17.6%), and ischemic heart disease (IHD) (14.7%). As well, Stroke due to infarction is more common than hemorrhage (34). Retrospective hospital-based research at Ambo University Referral Hospital also, revealed that 94 patients (84.7%) had at least one antecedent risk factor, with hypertension making up 44.1% of those (39). correspondingly Hypertension was observed in 124 (39.8%) ischemic and 73 (23.4%) hemorrhagic stroke patients and it was the most common predictor of death in both ischemic and hemorrhagic stroke cases at Dessie Referral Hospital (48).

In a study done at Ali Ibn Abi Talib Hospital in Rafsanjan on 2,199 stroke patients, the main risk factors identified among dead patients were;18.6% hyperlipidemia, 35.7% diabetes mellitus, and 68.3% hypertension (41). Whereas, In peninsular Malaysia uncontrolled blood pressure [(AOR = 23.32), presence of atrial fibrillation [(AOR = 16.46), heart failure [(AOR = 30.28) and a repeat stroke [(AOR = 32.62)were predictors of stroke mortality (49).

2.2.3. Neurological risk factors

In a retrospective study at Mekele Ayder referral Hospital, ischemic stroke occurred in 55.6% of patients, intracerebral hemorrhage affected 32.4%, and subarachnoid hemorrhage affected 5.6%(38). Furthermore in Tikur Anbessa Specialized Hospital, ischemic stroke accounted for 51.2% of cases, with ischemic stroke deaths being 18 (52.9%) and hemorrhagic stroke deaths being 13(38.2%), respectively (30). It is comparable with studies conducted in Ethiopia and other African nations ischemic strokes were more common; 65.4% in Dessie Referral Hospital (48), 89 (80.2%) in Ambo University Referral Hospital (39), 71% in Nigeria (50), 64% in Uganda (51), and 70.7% in Gorgan, Iran (52), of all admitted stroke patients.

However, in a hospital-based retrospective study conducted at Saint Paul teaching hospital, Hemorrhagic stroke was the most common type of stroke accounting for 61.3% of cases. seventy-four (45.4%) patients were discharged with a neurologic deficit and the median duration of hospital stay was 11.14 days (40).

In a retrospective study in Kazakhstan, the mean Glasgow Coma Score (±SD) at baseline was 10.3 (±3.4). The in-hospital mortality rate was similar in patients with ischemic (36%) and hemorrhagic (39%) stroke (crude HR 0.88) (53). However, in Dessie Referral Hospital, The

mortality rate of ischemic stroke, 47 (15.3%), was two times higher than 20 (6.5%). hemorrhagic stroke. Infarctions in more than one lobe of the cerebrum (16.4%) and intracerebral hemorrhage in multiple areas of the cerebrum (7.4%) were observed in ischemic as well as hemorrhagic stroke cases (48). Similarly, Twelve (13.5%) died from ischemic stroke, and 6 (30.0%) died from a hemorrhagic stroke in Ambo university referral Hospital (39).

Further in Ali Ibn Abi Talib Hospital in Rafsanjan, the in-hospital mortality rate was 142 (7.54%) and 57 (17.98%) for ischemic stroke and cerebral hemorrhage, respectively. The most common fatal complications in dead patients were neurological complications 97 (48.7%), infections 46 (23.1%), cardiac complications 36 (18.1%), and thromboembolism (5.5%) (41).

In the Democratic Republic of Congo, the factors found to be positively associated with stroke mortality are hemorrhagic stroke (AOR 21.21), reaching hospital (late than 24h AOR 33.8), poor compliance to anti-diabetic medication (AOR 8.46), recurrent stroke (AOR 5.81) poor compliance to antihypertensive (AOR 4.46), and the advanced age >75 years (AOR 6.50) (42).

A population-based cohort study in Lund, Sweden, also found that among index patients with ischemic stroke, survival time was lowest in patients with cardio-aortic embolism (51/91; 56%). Cerebrovascular disease (54/135; 40%) and ischemic heart disease (25/135; 19%) were the most common causes of death. Within 3 years, 30 (8%) had a recurrent stroke (47).

2.2.4. Acute stroke information

In a retrospective study at Dessie referral Hospital, the median duration of hospital stay was 11.14 days (40). Most of the ischemic, 124 (39.8%), and hemorrhagic, 39 (12.5%), stroke patients presented loss of sensation and weakness of body parts (48).

In an institution-based retrospective, cross-sectional study in Tikur Anbessa specialized hospital Aspiration pneumonia was the leading cause of death accounting for 39% of all causes (30). Whereas in a retrospective hospital-based study at Ambo University Referral Hospital, the major predictors identified for poor stroke outcomes were substance abuse (AOR=2.839) and have had not received any medication for stroke treatment during admission (AOR=12.503) (39).

From a retrospective study conducted in Mekelle University Ayder Referral Hospital among 142 stroke patients, 9.9% of patients were admitted within the first 3 h of stroke symptom onset. 19.7% were admitted within 6 h, and 31.7% were admitted within 12 h. Nearly half (47.9%) of

the patients were delayed more than 1 day for hospital admission, 9.8% were delayed more than 7days, and 76.1% of patients received a CT scan (38). Further, from the hospital-based retrospective study conducted in Sri Lanka, on 34 patients, the male to female ratio was 1.6:1, 17 (50%) were affected on the left side and 17 (50%) were affected on the right side. Stroke due to infarction is more common than hemorrhage (34).

According to a retrospective analysis of patients with stroke in Kazakhstan, 148 critically ill patients (84 ischemic strokes, 64 hemorrhagic strokes); the mean age was 63 years, 45% were male and the mean Glasgow Coma Score (±SD) at baseline was 10.3 (±3.4). Median survival was 38 days (range: 1–89 days) in patients with ischemic stroke and 39 days (range: 1–63 days) in patients with hemorrhagic stroke (53).

2.2.5. Patients Baseline data

From a retrospective cohort study conducted at Felege_Hiwot referral Hospital; the overall survival rate was 72.2% at 51 months of follow-up with a median survival time of 0.26 months. Age greater than 65 (AHR 6.31), body temperature >7.1 degree centigrade (AHR = 7.14), potassium level below <2 mmol/l (AHR = 2) and creatinine level >1.2 mg/dl (AHR = 7.85) were predictive predictors of mortality (31).

A retrospective record review done in peninsular Malaysia showed, there were significant differences in the survival time based on the types of stroke, Glasgow Coma Scale, hyperlipidemia, atrial fibrillation, fasting blood glucose, and diastolic blood pressure. Glasgow coma scale score <8 (AOR = 50.348), convulsion [(AOR = 25.889) (49). Similarly in Uganda, a GCS score below < 9 (AHR =3.49) was a significant predictor of 30-day mortality. GCS score < 9 (AHR =4.34), stroke severity (NIHSS ≥21) (AHR = 2.63), and hemorrhagic stroke type (AHR = 2.30) were significant predictors of 90-day mortality. A shorter hospital stay of 7–13 days (AHR = 0.31) and being married (AHR = 0.22) had protective effects for 30 and 90-day mortality respectively (51).

2.3. Conceptual framework

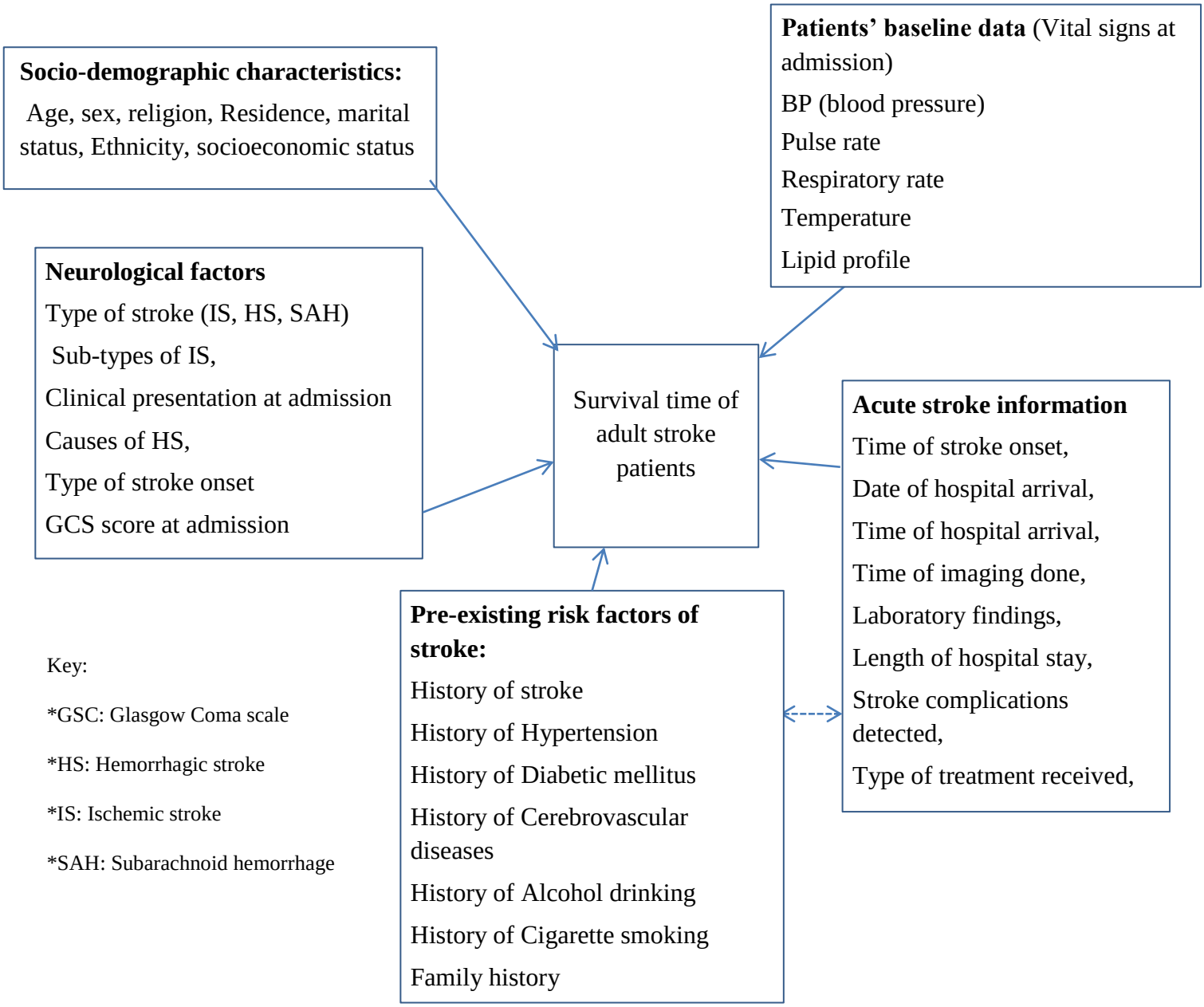

Figure 1: The conceptual framework for survival status of adult stroke patients and predictors of mortality, Adapted and modified from the WHO STEP wise approach to stroke surveillance manual, and different kinds of literature 2022 (38,54).

3. Objective

3.1. General objective

- To assess the Survival status and predictors of mortality among adult stroke patients admitted at Jimma University medical center from April 1, 2017, to March 31, 2022, G.C.

3.2. Specific objectives

- To determine the survival time of adult stroke patients admitted at Jimma University medical center from April 1, 2017, to March 31, 2022
- To identify predictors of mortality of adult stroke patients at Jimma University medical center from April 1, 2017, to March 31, 2022

4. Methods and materials

4.1. Study area and period

The study was conducted at the stroke unit of Jimma University Medical Center (JUMC), a tertiary hospital found in Jimma town, southwest Ethiopia. Jimma is located 352 km southwest of the capital city of Ethiopia, Addis Ababa. JUMC is providing services for approximately 160,000 outpatient attendants, 11,000 emergency cases, and 4500 deliveries per year coming to the hospital from the catchment population of about 15 million people with a bed capacity of 800. It is the main referral center for neurology patients in southwest Ethiopia. Recently there is one CT scan available in the Hospital. Other investigation modalities including electrocardiography (ECG), echocardiography, basic hematologic, and chemistry are available(45(56). The stroke unit of JUMC was established with the assistance of a project from the United Kingdom aid direct (UKAID) and tropical health and education trust (THET) with the help of Southampton hospital 7 years back. The unit has 12 beds (6 for females and 6 for males). It has a staff of 6 nurses and four senior internists. Data were retrieved from medical records of stroke patients that were under follow-up during April 1, 2017, to March 31, 2022; and data were collected from May to June 2022.

4.2. Study design

An institution-based retrospective cohort study design was employed.

4.3. Population:

4.3.1. Source population

All adult stroke patients ≥ 18 years admitted to the stroke Hospitals

4.3.2. Study population

All sampled adult stroke patients admitted to a stroke unit of Jimma University Medical Center from April 1, 2017 to March 31, 2022.

4.4. Eligibility criteria:

4.4.1. Inclusion criteria: cases identified either by clinical diagnosis or confirmed by brain imaging as per WHO criteria for diagnosis of stroke admitted to a stroke unit of Jimma University Medical Center from April 1, 2017, to March 31, 2022.

4.4.2. Exclusion criteria: age < 18 years, lost medical record numbers.

4.5. Sample size determination and sampling techniques

4.5.1. Sample size determination

The sample size for the survival analysis was determined using significant variables from the different studies using STATA software based on the following assumptions:

Significance level (α) (two-sided) =0.05, $Z_{\alpha/2} = 1.96$.

Power of 80%, $\beta = 0.2$, $Z_{\beta=}$0.842.

Adjusted hazard ratio (AHR) = 2

Variability of covariates of interest =0.5

The overall probability of death (d): 15 percent (31).

We assumed that no subjects will be anticipated to withdraw from the follow-up.

Finally, 10% of contingency was added for incomplete records.

Thus, the total sample size for this study was **480**.

Table 1: Predictor variables with parameters used for sample size determination at JUMC 2022

S.No	Predictor variables	Parameters		Sample size	Contingency (10%)	Final sample	Reference
		AHR	D				
1	Potassium level	2	0.15	436	44	**480**	(31)
2	Age	6.31	0.15	62	6	68	(31)
3	Hypertension	2.13	0.1491	369	37	406	(57)
4	Body temp	7.14	0.15	55	6	61	(31)
5	Glasgow Coma scale	7.23	0.1491	54	6	60	(57)
6	Cholesterol level	3.57	0.1491	131	13	144	(57)

4.5.2. Sampling techniques/methods

Simple random sampling by using computer-generated random numbers was used to select 480 patients among adult stroke patients admitted to the stroke unit of Jimma university medical center from April 1, 2017, to March 31, 2022, G.C. One thousand and eight hundred twenty-six stroke patients' medical record numbers were identified from the logbook and cross-checked with data taken from computer databases; and checked their availability on the order at record room office during the pretest. A sampling frame was prepared from the available medical record number (MRN) of patients. The randomly generated numbers were printed and used to take a patient medical record from the record center of the hospital for data abstraction.

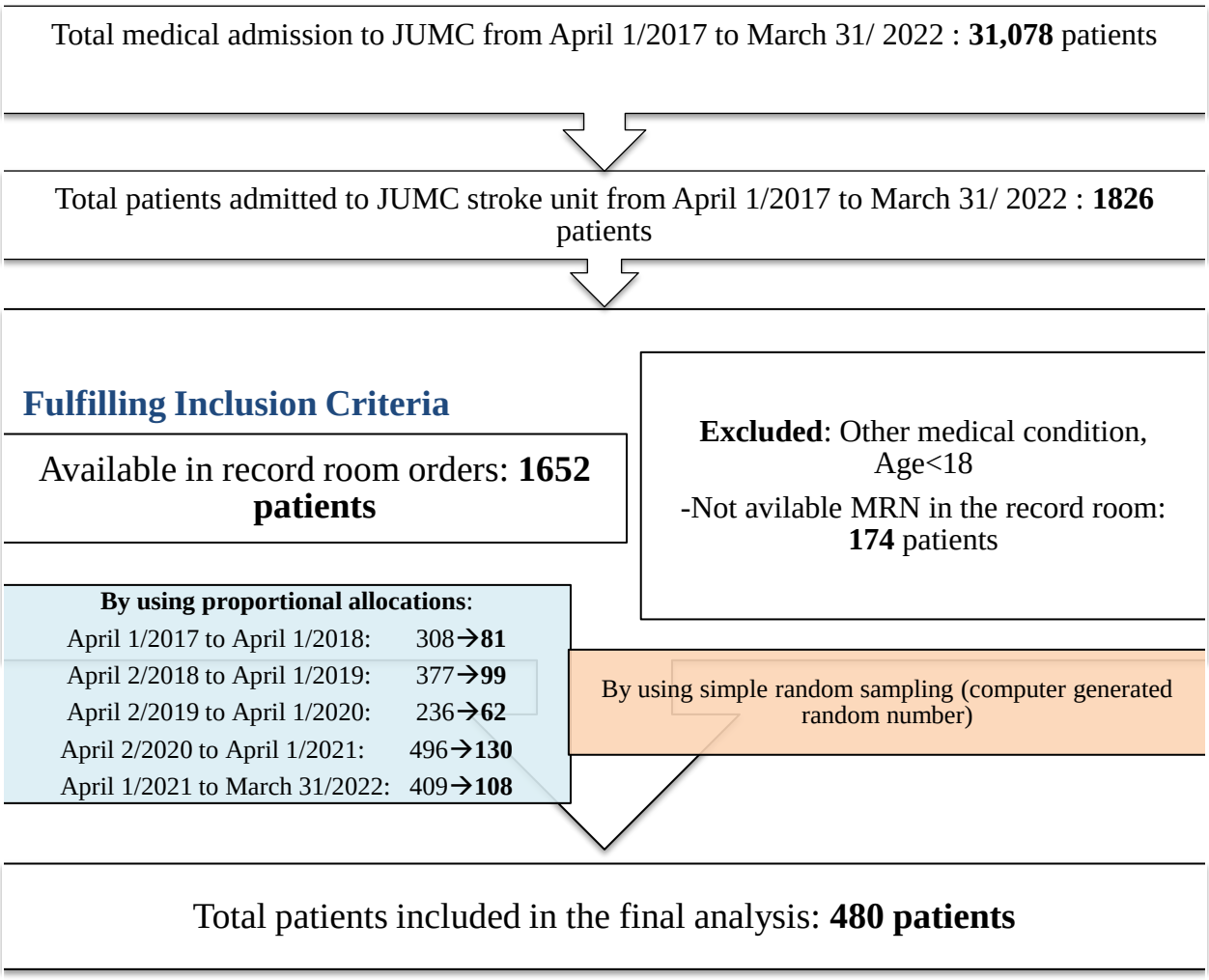

Figure 2: Flow diagram of sampling procedures

4.6. Study Variables

4.6.1. Dependent variable

Time to death of the stroke patient from first-day admission to the event (death)

4.6.2. Independent variables

Socio-demographic variables (age, sex, residency, religion, ethnicity, insurance status),

Pre-existing risk factors of stroke: (previous stroke, Hypertension, Diabetes Mellitus, Cerebrovascular diseases, Alcohol drinking, Cigarette smoking, Family history)

Acute stroke information: Time of stroke onset, hospital arrival, and imaging done, Date of hospital arrival, Laboratory findings, Length of hospital stay, Stroke complications detected, Type of treatment received, Treatment outcome at discharge)

Patients' baseline data (Vital signs at admission): Blood pressure (mmHg) Pulse rate (beat/min), Respiratory rate (breath/min), body temperature (^{0}C)

Neurological factors: Type of stroke (IS, HS, SAH)**,** Sub-types of IS, Clinical presentation at admission**,** Causes of HS, episode of stroke**,** GCS score at admission,

Co-morbidities (hypertension, diabetes mellitus, heart disease, chronic kidney disease)

4.7. Data collection procedure and technique

4.7.1. Data collection instrument: data abstraction tools were adapted from the WHO Stepwise guideline and related studies(38,54)**,** which contain information about socio-demographic characteristics, patient baseline data, pre-existing risk factors for stroke, Neurological factors, comorbidities, and discharge status were used to extract data from medical records of patients.

4.7.2. Data collection procedure: Four BSc. Nurse Professionals who have experience in data registry and one second-year MPH student with a background in nursing were assigned to collect data and the principal investigator as a supervisor check the data collection process and missed data daily and guided them. Before data collection, training was given to data collectors on the contents of the data abstraction checklist, and how to abstract data from patient medical records for two days.

4.8. Data process and analysis

After collection, data were checked for completeness and consistency, and then entered into Epidata version3.1 software and exported to STATA version 14.2 for data cleaning, and exported to R software version 4.2.0, for analysis, the event of interest (death) was coded as one and censored as Zero, for categorical variables descriptive analysis were carried out and results were expressed as the frequency with percentage, mean with standard deviation for normally distributed continuous variables, and median and IQR if skewed continuous variables. Kaplan-Meier (KM) curves were used to estimate survival time and compare survival (or hazard) rates between categories of variables. Moreover, the Log-Rank tests were used to assess for a statistically significant difference in survival (or hazard) rate between categories of variables, and a p-value <0.05 in the log-rank test indicates there is a statistically significant difference in survival (or hazard) rate.

To identify risk factors associated with the Stroke survival time Cox proportional hazard analysis model was computed. Then Bi-variable and multivariable cox proportional hazard analysis models were fitted to identify factors associated with the outcome. Variables with P-value < 0.25 in Bi-variable Cox proportional analysis were selected for the multivariable cox-proportional hazard analysis model. Missing data were handled by simple deletion from the bivariate and multivariable analysis. Interaction for the main effect model was also checked by adding interaction terms into the model with the corresponding p-value. The proportional hazard assumption was checked by the goodness of fit test, where the p-value is greater than 0.05, which indicates that proportional hazard assumptions are satisfied. Additionally, the graphical assessments were also done by Schoenfeld residual plot & by log minus log plot **(**i.e. if *ln(-ln(S(t))* Vs. *ln(time)* cross each other, the assumption fails violated) to fit the data. The overall goodness of fit of the model was assessed with Cox-Snell residual plot.

Variables with P-value < 0.05 in the multivariable Cox proportional hazard analysis model were considered statistically significantly associated with the outcome. Then the 95% CI of hazard ratio (HR) with a corresponding p-value < 0.05 were set to declare statistical significance.

4.9. Data quality control

One week before the study, a pretest was conducted on 12 patients (5%) of the sample size at JUMC in a similar study area to ensure the availability of important variables and to make partial or complete modifications to questions that affect the consistency of data(the modified checklist was **Annex-II: Data extraction tools**). Their results were then excluded from the final analysis. Data collectors and supervisors took an orientation on the overall technique of data collection to adhere to the protocol. To assure the quality of the data, the primary investigator actively monitored data collectors every day during the data collection period. Using the Epidata manager version 3.1 software, double data entry and data entry validation was performed.

After entry data were cleaned by data exploration, simple frequency, and tabulation for consistency and sorting techniques, coded, and edited before analysis, data exploration was employed to see if some odd codes and items are not logical. Length of hospital stay/ admission was recorded for 374 patients, for the rest calculated as the time gap from the patient admission to the stroke unit until discharged or died in the hospital.

4.10. Operational definitions

Survival status: discharge status of adults stroke patients on discharge summary which can be either of 'death' (1) or' censored' (0)

Event: Adult stroke patient who died during treatment.

Censored: An adult stroke patient whose discharge status is either alive at the end of the follow-up, lost to follow-up, withdrawn, or transferred to other health institutions without knowing the outcome status.

Survival time: calculated in completed days using the time between dates of admission and the date of the event (death) or date of censoring.

Time to death: time in days from the first date of admission to a stroke unit to the time of death of an adult stroke patient**.**

Atrial fibrillation: Had atrial fibrillation in ECG before stroke (records seen) or during hospitalization (54).

Diabetes Mellitus: Defined as when the patient was taking any anti-diabetic medication or when a random blood sugar level of ≥ 200 mg/dL or two consecutive fasting venous plasma glucose levels of ≥ 126 mg/dL persists beyond the acute phase of stroke (58).

Dyslipidemia: Defined as when the patient was taking lipid-lowering medications or a total cholesterol level ≥ 240 mg/dL (57,59).

First-ever stroke: A stroke that occurred in persons who never had a stroke before (54).

Recurrent stroke: is defined as a history of a previous stroke event at some time in the past that meets the WHO definition or a history of a new stroke event occurring more than 28 days after the onset of a stroke event already registered (54).

4.11. Ethical considerations

This study was approved by the institutional review board of Jimma University. An official letter that allows conducting the investigation and data collection was received from Jimma University. A permission letter was gotten from the chief executive officer and medical director of the Jimma University Medical Center. Finally, the objective of the study was explained to the coordinator and stroke unit staff of JUMC. Identifiers such as name and cell phone were eliminated from the data collection tool to ascertain confidentiality.

4.12. Plan for dissemination of findings

The manuscript report of this study will be submitted to Jimma University's department of epidemiology and presented to Jimma University Public Health staff as scheduled by the department. Additionally, the report will be submitted to the Jimma University Medical Center. Furthermore, Attempts will be made to publish the finding in peer-reviewed journals

5. RESULTS

5.1. Socio-demographic and patient-related Characteristics

There were 480 patients involved in the study. The mean age of the patients was 55.43±14.56 years. The mean age of patients who died (88/480, 18.33%) was 55.11 ±15.36 years, and 55.51±14.40years among those censored. The incidence of stroke was maximum in the age group of 45-65/middle age, which comprised 224 (46.67%) of patients. Young stroke cases (age <45 years) comprised 102(21.25%). Male comprised 299 (62.29%) with a male-to-female ratio of 1.65:1. Two hundred eighty-five (59.38%) of patients were from rural and less than one-fourth (22.7%) have health insurance (**Table 2).**

Table 2: Socio-demographic and other patient-related characteristics of adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

Variables	Category	Died Frequency (%)	Censored Frequency (%)	Total Frequency (%)
Sex	Male	51(10.63)	248(51.67)	299 (62.29)
	Female	37(7.71)	144(30.00)	181 (37.71)
Age of individuals	Mean ± SD	55.11(15.36)	55.51(14.39)	55.43(14.56)
	<45	25(5.21)	77(16.04)	102(21.25)
	45-65	34(7.08)	190(39.58)	224 (46.67)
	>65	29(6.04)	125(26.04)	154 (32.08)
Region	Amhara	1(0.21)	1(0.21)	2(0.42)
	Gambela	2(0.42)	13(2.71)	15 (3.13)
	Oromia	71(14.79)	331(68.96)	402(83.75)
	SNNPR[1]	14(2.92)	47(9.79)	61(12.71)
Residence	Urban	42(8.75)	153(31.87)	195 (40.63)
	Rural	46(9.58)	239(49.79)	285(59.38)
Health insurance status	Insured	21(4.38)	88(18.33)	109(22.71)
	Not insured	67(13.96)	304(63.33)	371(77.29)

[1] Southern Nations, Nationalities and Peoples Region

5.2. Antecedent Risk factors

In the present study, 349(72.71%) of the study participants have a history of hypertension whereas 94(26.93%) were diagnosed with hypertension after being admitted for a stroke. The median duration of hypertension before stroke was 3(IQR 1-5) years. Of the 255 (73.07%) hypertensive patients with pre-existing hypertension, 98(38.58%) were taking antihypertensive medication when they arrived at the hospital. Of these patients, 64 (65.98%) did not have their blood pressure under control (BP≥140/90). In addition, it was identified that 146(30.42%) and 65(13.54%) of the study participants had atrial fibrillation, and coronary heart disease, respectively.

Moreover, 42 (8.75%) had diabetes and twenty-four patients who had a history of diabetes were taking medication, and 14 (56%) of them had their blood sugar controlled (RBS≤200) when they arrived at the hospital **(**in the Annex-IV-**Table 12).**

5.3. Neurological factors

In this study, 262(54.58%) of the study participants had an ischemic stroke. In addition, concerning patients' level of consciousness during hospital arrival 244(50.83) patients had a mild level of unconsciousness, GCS score of 13-15.

Furthermore, the median time elapsed between stroke onset and hospital arrival was 24 (IQR 11-48) hours. Four hundred sixty-three (96.46%) of the manner of occurrence of stroke was sudden onset. On the other hand, 423(88.13%) suffered from the first event stroke episode and the remaining 57(11.88%) exhibited the underlying condition of previous/recurrent stroke (**Table 3**Error! Reference source not found.).

Table 3: Neurological factors of adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

Variable	Category	Died Frequency (%)	Censored Frequency (%)	Total Frequency (%)
Onset to arrival interval	<24 hours	43(8.96)	160(33.33)	203(42.29)
	1-7days	44(9.17)	219 (45.63)	263(54.79)

	>7days	1(0.21)	13(2.71)	14(2.92)
Manner of occurrence	Sudden	84(17.50)	379(78.96)	463(96.46)
	Insidious	4(0.83)	13(2.71)	17(3.54)
Brain imaging done	Yes	83(17.29)	372(77.50)	455(94.79)
	No	5(1.04)	20(4.17)	25(5.21)
Episode of stroke	First ever	80(16.67)	343(71.46)	423(88.13)
	Recurrent	8(1.67)	49(10.21)	57 (11.88)
Type of stroke	Ischemic	43(8.96)	219(45.63)	262(54.58)
	SAH	1(0.21)	34(7.08)	35 (7.29)
	ICH	44(9.17)	139(28.96)	183 (38.13)
Etiologic subtypes of Ischemic Stroke(N=262)	cardio embolic	20 (7.63)	65(24.81)	85 (32.44)
	LAA	9 (3.44)	21 (8.02)	30(11.45)
	SAO	8(3.05)	37 (14.12)	45 (17.18)
	undetermined causes	6(2.29)	96(36.6)	102 (38.9)
Causes of Hemorrhagic stroke(N=218)	HTN	32(14.67)	107(49.08)	139(63.76)
	Vascular aneurysm	6 (2.75)	44(20.18)	50(22.94)
	CAA	3 (1.40)	10 (4.58)	13 (5.96)
	Anticoagulants	5(2.29)	11 (5.04)	16 (7.34)
Glasgow Coma scale at admission	<8	47(9.79)	34(7.08)	81(16.88)
	9-12	28(5.83)	127(26.46)	155(32.29)
	13-15	13(2.71)	231(48.13)	244(50.83)

*SAH=subarachnoid hemorrhage,*ICH=intra-cerebral hemorrhage, *HTN =Hypertension.*LAA=large artery atherosclerosis, *SAO= small artery occlusion *CAA: cerebral amyloid angiopathy

5.4. Acute stroke information and Clinical presentation during admission

Clinical presentation during admission

In the present study, speech disturbance and hemiplegia were identified on 322(67.08%) and 322(67.08%) respectively. Most deaths of patients were presented with altered mental status (Stupor/lethargy/coma) **(Table 4).**

Table 4: Clinical presentation of stroke patients among adult patients admitted to the stroke unit of JUMC from April 2017 to March 31/2022

Variable	Category	Died Frequency (%)	Censored Frequency (%)	Total Frequency (%)
Altered mental status	Yes	31(6.46)	50(10.42)	81(16.88)
	No	57(11.88)	342(71.25)	399(83.13)
Speech disturbance	Yes	68(14.17)	254(52.92)	322(67.08)
	No	20(4.17)	138(28.75)	158 (32.92)
Hemiplegia	Yes	51(10.63)	271(56.46)	322(67.08)
	No	37(7.71)	121(25.21)	158(32.92)
Hemiparesis	Yes	31(6.46)	165(34.38)	196(40.83)
	No	57(11.88)	227(47.29)	284(59.17)
Headache	Yes	50(10.46)	243(50.84)	293(61.30)
	No	38(7.95)	147(30.75)	185(38.70)
Vomiting	Yes	48(10.00)	145(30.21)	193(40.21)
	No	40(8.33)	247(51.46)	287(59.79)
Vertigo/Dizziness	Yes	7(1.46)	46(9.62)	53(11.09)
	No	81(16.95)	344(71.97)	425(88.91)
Blurred vision	Yes	14(2.92)	38(7.92)	52 (10.83)
	No	74(15.42)	354(73.75)	428 (89.17)
Urine incontinence	Yes	28(5.83)	119(24.79)	147 (30.63)
	No	60(12.50)	273(56.88)	333(69.38)
decreased level of consciousness	Yes	54(11.25)	114(23.75)	168 (35.00)
	No	34(7.08)	278(57.92)	312(65.00)
Fall down injury	Yes	1(0.21)	20(4.17)	21(4.38)
	No	87(18.13)	372(77.50)	459(95.63)

Stroke event factors

At admission 319(66.46%) of the stroke patients had a systolic blood pressure of ≥140mmHg, on the other hand, 299(62.29%) of them had diastolic blood pressure ≥90 mmHg. In addition, 159(81.54%) had total cholesterol of <200 with a median cholesterol level of 163.2 (IQR=132.8-190.9). Furthermore, 289(66.90) had a serum creatinine of 0.6 to 1.2 with a median serum creatinine level of 86(IQR=0 .69-1.08) (**Table 6**).

Table 5: Stroke event factors of adult stroke patients admitted to JUMC from April 2017 to March 31/2022

Variable	Category	Died Frequency (%)	Censored Frequency (%)	Total Frequency(%
Systolic blood pressure at arrival(mmHg)	<120	12(2.50)	50(10.42)	62(12.92)
	120-129	12(2.50)	34(7.08)	46(9.58)
	130-139	4(0.83)	49(10.21)	53(11.04)
	≥140	60(12.50)	259(53.96)	319(66.46)
Diastolic blood pressure at arrival(mmHg)	≤59	0	5(1.04)	5 (1.04)
	60-80	29(6.04)	113(23.54)	142(29.58)
	81-89	5(1.04)	29(6.04)	34 (7.08)
	≥90	54(11.25)	245(51.04)	299(62.29)
Pulse rate (beats/min) at arrival	Median± IQR	92 (80-104)	88(78- 96)	88(79.5-98)
	<60	4(0.83)	9(1.88)	13 (2.71)
	60-100	53(11.04)	306(63.75)	359(74.79)
	>100	31(6.46)	77(16.04)	108(22.50)
Respiratory rate (breaths/min) at arrival	Median ± IQR	24(22- 25)	22(20- 24)	22(20- 24)
	(12-20)	1(0.21)	22(4.58)	23(4.79)
	>20	87(18.13)	370(77.08)	457(95.21)
Temperature at arrival	<36	6(1.25)	20(4.17)	26(5.42)
	36-37.1	62(12.92)	317(66.04)	379(78.96)
	>37.1	20(4.17)	55(11.46)	75(15.63)
Hemoglobin(g/dl)	Median ± IQR	14.75(13.15-16)	14.4(13.2 -15.7)	14.45(13.215.8)
	<11	8(1.81)	23(5.19)	31(7.00)
	(11-16)	61(12.71)	306(63.75)	367(72.23)
	>16	19(3.96)	63(13.13)	82(17.08)
Total cholesterol level	Median ± IQR	163.2(134.8 - 188.28)	188.6(126.58-210.35)	163.2(132.8-190.9)

(N=195)	<200	17(8.72)	142(72.82)	159(81.54)
	200-239.9	8(4.10)	17(8.72)	25 (12.82)
	≥240	3(1.54)	8(4.10)	11 (5.64)
Random blood sugar	Median ± IQR	136(120-152)	127(112-147)	128(113-148)
(N=399)	<170	0	3(0.75)	3(0.75)
	170-200	58(14.54)	308(77.19)	366(91.73)
	>200	9(2.26)	21(5.26)	30(7.52)
	Median ± IQR	0.89(0 .69-1.12)	0.85(0.69 -1.07)	.86(0 .69-1.08)
serum creatinine (mg/dl)	<0.6	12(2.78)	48(11.11)	60(13.89)
(N=432)	0.6-1.2	50(11.57)	239(55.32)	289(66.90)
	>1.2	16(3.70)	67(15.51)	83 (19.21)
Sodium (mmol/L)	Median± IQR	138(134-141.5)	137(134-139)	137(134-140)
(N=278)	<135	16(5.76)	72(25.90)	88 (31.65)
	135-145	37(13.31)	133(47.84)	170(61.15)
	>145	7(2.52)	13(4.68)	20(7.19)
Potassium(mmol/L)	Median ± IQR	3.9(3.54-4.225)	4(3.58- 4.31)	3.96 (3.58-4.27)
(N=278)				
	<3.5	12(4.32)	48(17.27)	60 (21.58)
	3.5-5.0	44(15.83)	152(54.68)	196 (70.50)
	>5.0	4(1.44)	18(6.47)	22 (7.91)
Chloride (mmol/L)	Median ± IQR	99.9(96.35-104.45)	101.3 (97.64-106)	101(97.1-105.7)
(N=273)				
	<98	23(8.42)	54(19.78)	77(28.21)
	98-106	27(9.89)	103(37.73)	130(47.62)
	>106	10(3.66)	56(20.51)	66(24.18)
Length of Hospital	Median ± IQR	3(2-8)	8(5-12)	7(4-11)
stay(days)	1-7	65(13.54%)	159(33.13)	224 (46.67)
	7-14	10(2.08)	161(33.54)	171(35.63)
	>=14	13(2.71)	72(15.00)	85(17.71)

Hospital complications of a stroke

Two hundred forty-two (50.40%) individuals had a hospital stroke complication. Among these complications, the most frequent were increased ICP, aspiration pneumonia, and urinary tract infection which were diagnosed in 135(28.13%), 127(26.46%), and 46(9.58%) respectively **(Table 6**).

Table 6: Hospital complications among adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

Variable	Category	Died Frequency (%)	Censored Frequency (%)	Total Frequency(%
Stroke complication detected	Yes	77(16)	165(34.4)	242(50.4)
	No	11(2.3)	227(47.3)	238(49.6)
Aspiration pneumonia	Yes	61(12.71)	66(13.75)	127 (26.46)
	No	27(5.63)	326(67.92)	353(73.54)
Increased intracranial pressure	Yes	63(13.15)	72(15.03)	135(28.13)
	No	25(5.21)	320(66.67)	345(71.88)
Urinary tract infection	Yes	6(1.25)	40(8.33)	46(9.58)
	No	82(17.08)	352(73.33)	434(90.42)
Deep vein thrombosis	Yes	3(0.63)	15(3.13)	18(3.75)
	No	85(17.71)	377(78.54)	462(96.25)
Gastrointestinal bleeding	Yes	2(0.42)	12(2.50)	14(2.92)
	No	86(17.92)	380(79.17)	466(97.08)
Seizure	Yes	9(1.88)	14(2.92)	23(4.79)
	No	79(16.46)	378(78.75)	457(95.21)
Myocardial infarction	Yes	3(0.63)	11(2.29)	14(2.92)
	No	85(17.71)	381(79.38)	466(97.08)
Acute kidney injury	Yes	8(1.67)	33(6.88)	41 (8.54)
	No	80(16.67)	359(74.79)	439(91.46)

Approaches/protocols to stroke management

In this study, 319(66.46%) of study participants had been taken anti-hypertensive, 202(42.08%) had treated with antiplatelet, and only 35(7.32%) were on Anti-Diabetic drugs (**Table 8**).

Table 7: Approaches/protocols of stroke management among adult patients admitted to UMC from April 2017 to March 31/ 2022

Type of treatment received	Category	Died Frequency (%)	Censored Frequency (%)	Total Frequency (%)
Antiplatelet	Yes	30(6.25)	172(35.83)	202(42.08)
	No	58(12.08)	220(45.83)	278(57.92)
Anticoagulants	Yes	33(6.88)	115(23.96)	148(30.83)
	No	55(11.46)	277(57.71)	332(69.17)
Anti-hypertensive	Yes	53(11.04)	266(55.42)	319(66.46)
	No	35(7.29)	125(26.04)	160(33.33)
Statin	Yes	33(6.88)	176(36.67)	209(43.54)
	No	55(11.46)	215(44.79)	270(56.25)
Anti-Diabetic drugs	Yes	7(1.46)	28(5.86)	35(7.32)
	No	80(16.74)	362(75.73)	442(92.47)
Antibiotics	Yes	58(12.11)	119(24.84)	177 (36.95)
	No	30(6.26)	272(56.78)	302(63.05)

5.5. Treatment outcome

In the present study, 88 patients died at discharge from the hospital making an in-hospital mortality rate of 18.3%. The remaining were alive at discharge, where 319 (66.46%) were discharged with improvement, and 9 (1.88%) left against medical advice (LAMA) at the request of the patient and/or the patient's family (**Figure 2**).

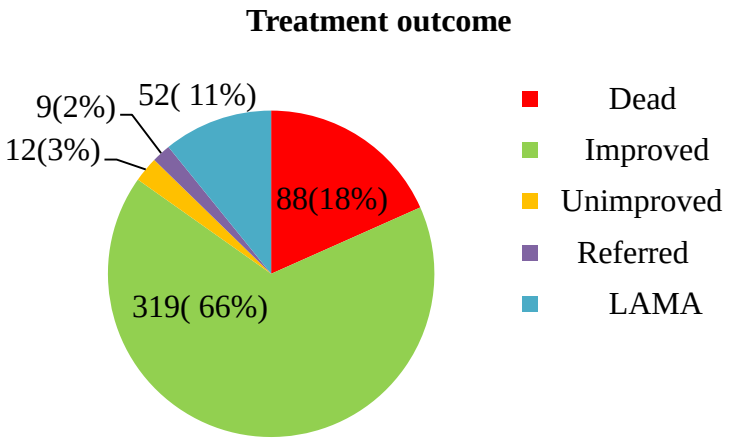

Figure 3: Treatment outcome of adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

5.6. Survival analysis

For survival analysis, patients who died at discharge status were classified as events and coded as one (1), while those who were discharged alive (i.e., improved, discharged unimproved, referred, and left against medical advice) were considered Censored and coded as zero (0). The complete cohort was observed for a total of 4350 person-days with a median follow-up time of 7 (IQR 4–11) days.

5.6.1. Kaplan Meier Survival and Hazard Function

The estimated overall Kaplan-Meier survival curve shows that most stroke patients died in the first few months, with the likelihood of surviving increasing as time went on. The minimum overall survival time was 1day and the maximum survival time was 55days during the follow-up time. In addition, the median survival time was 38 days (95% CI: 29 - not reachable). A cumulative survival probability was 85.2% (95% CI: 82-90), 79.5% (95% CI 74.9-84.4), 69.6% (95% CI: 61.2-79.2), 60.8% (95% CI: 49.6-74.5) and 32.7% (95% CI: 15.9- 67.0) by the end of the first week, second week, third week, first month, and sixth weeks respectively (**Table 9**).

Table 8: Kaplan-Meier estimate of survivor function of adult stroke patients admitted to JUMC, from April 2017 to March 31/ 2022

Time	No. at risk	No. of events	Survival	standard error	95% CI
1	480	13	0.97	0.01	0.96-0.99
2	465	18	0.94	0.01	0.91-0.96
3	422	16	0.90	0.01	0.87-0.93
4	387	8	0.88	0.02	0.85-0.91
5	350	1	0.88	0.02	0.85-0.91
6	311	7	0.86	0.02	0.83-0.89
7	258	2	0.85	0.02	0.82-0.89
8	224	2	0.85	0.02	0.81-0.88
9	186	2	0.84	0.02	0.80-0.87
10	160	2	0.83	0.02	0.79-0.87
11	134	1	0.82	0.02	0.78-0.86
12	115	2	0.81	0.02	0.76-0.85
14	87	1	0.80	0.02	0.75-0.84
15	78	1	0.79	0.03	0.74-0.84
16	71	2	0.76	0.03	0.71-0.82
19	41	1	0.75	0.03	0.68-0.82
20	31	1	0.72	0.04	0.65-0.81
21	30	1	0.70	0.05	0.61-0.79
22	28	1	0.67	0.05	0.58-0.78
24	24	1	0.64	0.06	0.54-0.76
29	18	1	0.61	0.06	0.50-0.75
31	14	1	0.56	0.07	0.44-0.73
35	10	1	0.51	0.08	0.37-0.70
38	7	1	0.44	0.10	0.28-0.68
42	4	1	0.33	0.12	0.96-0.99

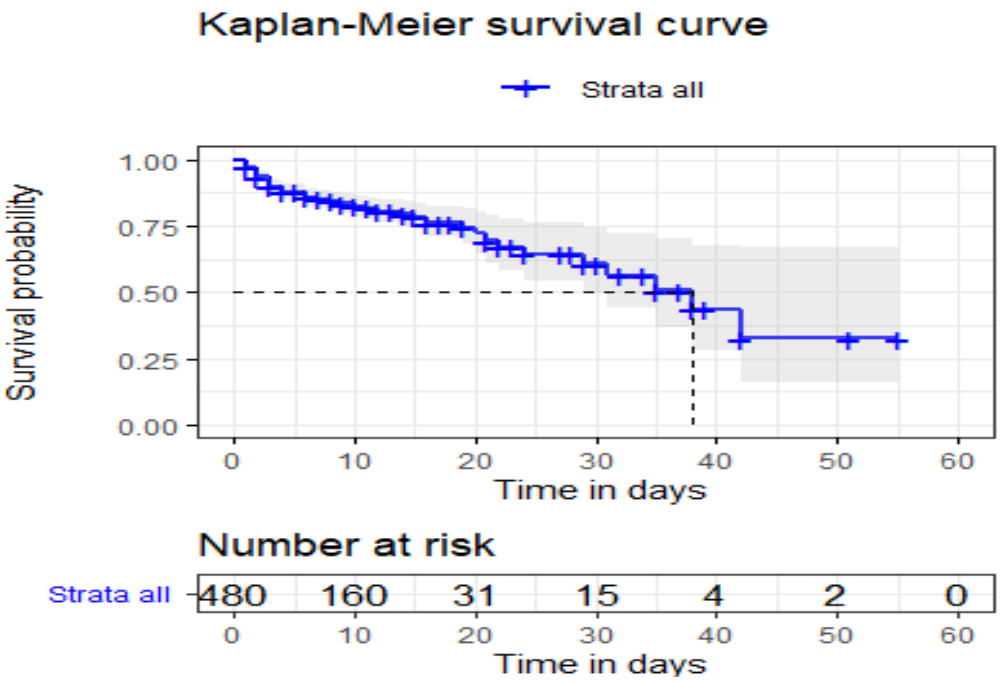

Figure 4: Overall survival probability of adult stroke patients admitted to JUMC from April 2017 to March 31/2022

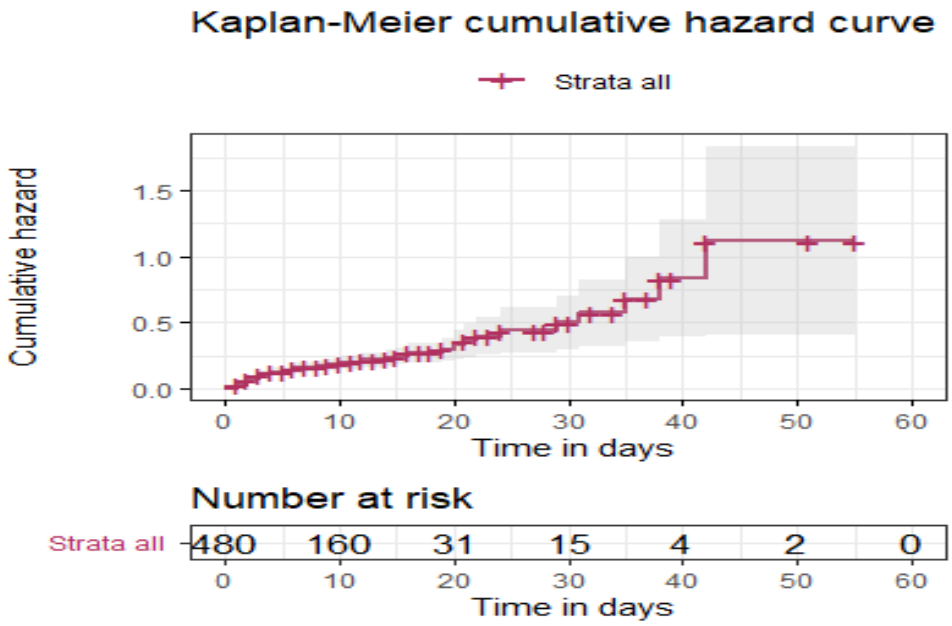

Figure 5: Cumulative Hazard of adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

In comparison to the survival curve of patients with GCS scores of 13–15, there was a faster decline in the cumulative survival probability of patients with GCS scores of 3–8 with a median survival time of 7 days and patients with GCS scores of 9–12 with a median survival time of 35 days. According to statistical analysis, patients with GCS scores of 13 to 15 had higher survival than those with scores of 3 to 8 and 9 to 12(**Figure 6**).

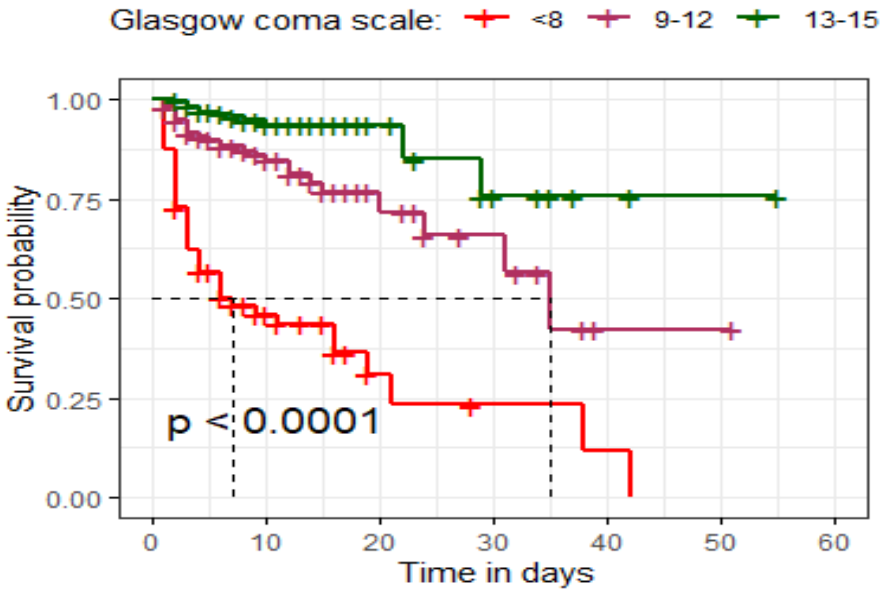

Figure 6: KM Survival curve for GCS score of adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

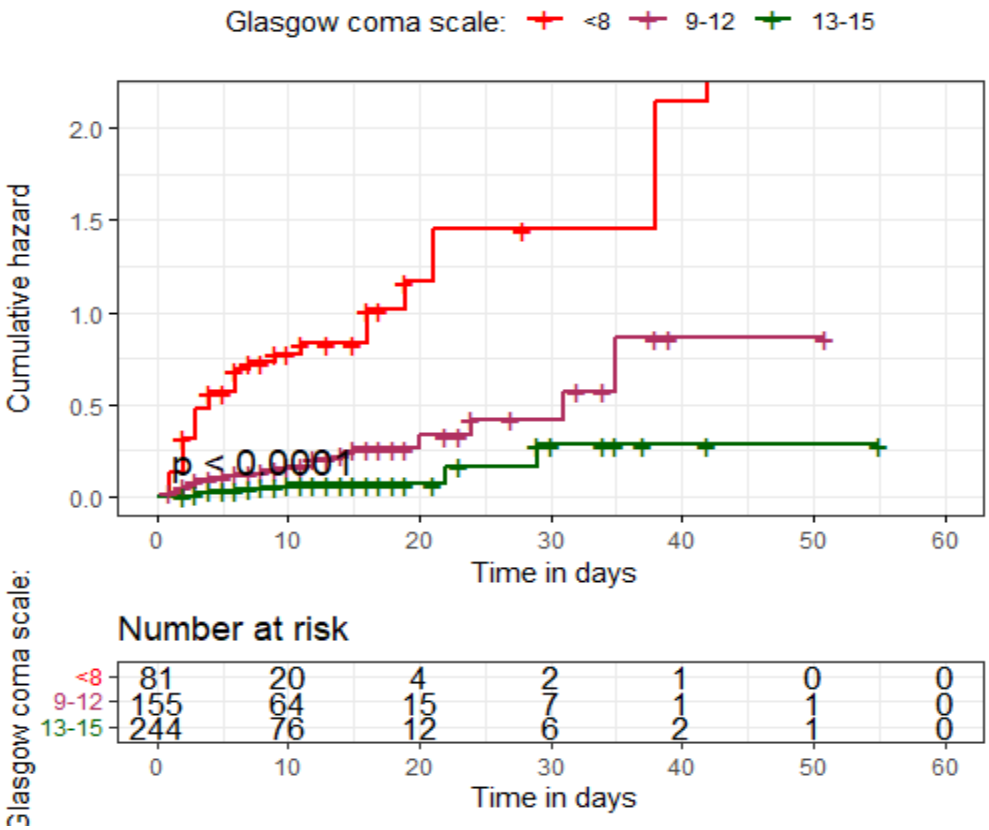

Figure 7: KM Cumulative Hazard curve for GCS score of adult stroke patients admitted to JUMC from April 2017 to March 31/2022

Patients who experienced stroke complications due to increased intracranial pressure experienced a faster decline in their cumulative survival probability with a median survival time of 15 days than those who did not experience these complications with median survival duration of 42 days. In addition, statistical significance was found to be <0.0001) (**Figure 8).**

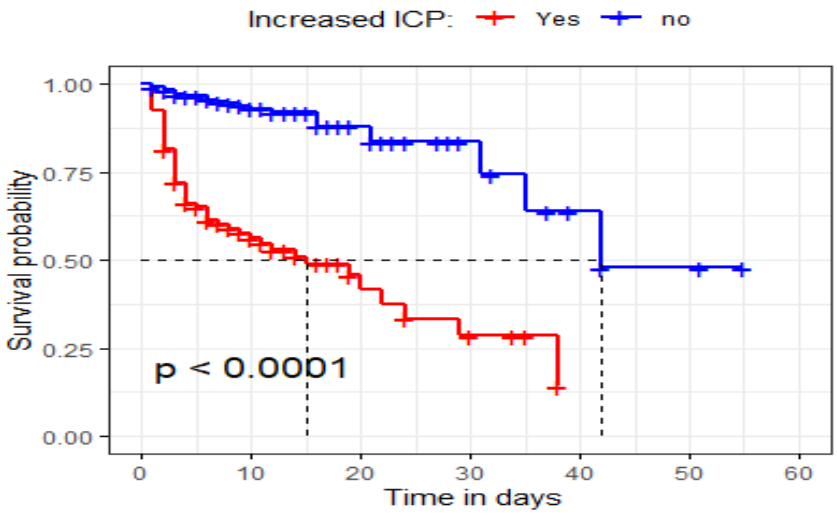

Figure 8: KM Survival curve for increased ICP among adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

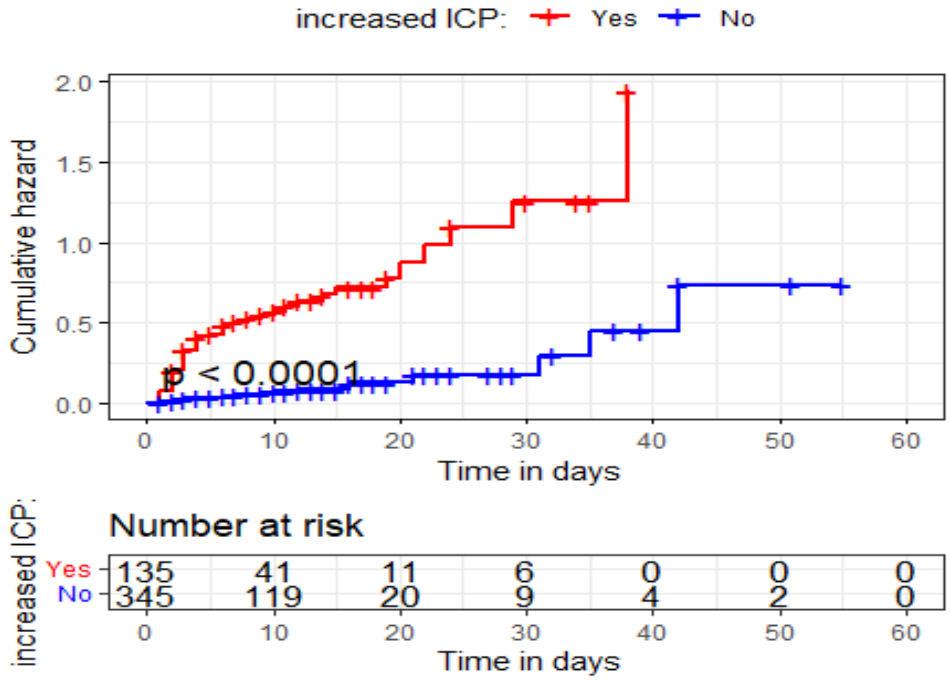

Figure 9: KM Cumulative Hazard curve for increased ICP of adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

The median survival time of patients who had an aspiration pneumonia complication was 20 days; we saw a faster decline in survival probability than patients who did not have aspiration pneumonia. In addition, the log-rank test was found to be significant (P <0.001).

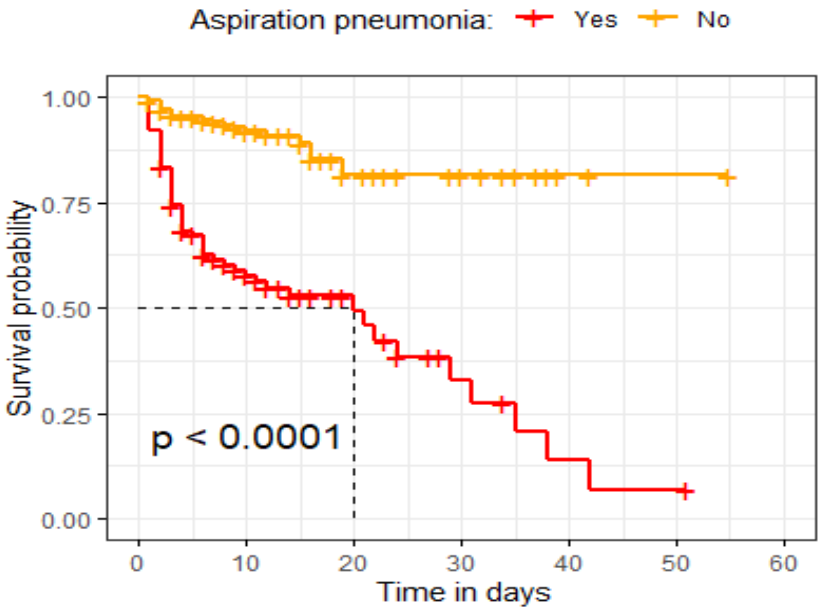

Figure 10: KM survival curve for Aspiration pneumonia complication among adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

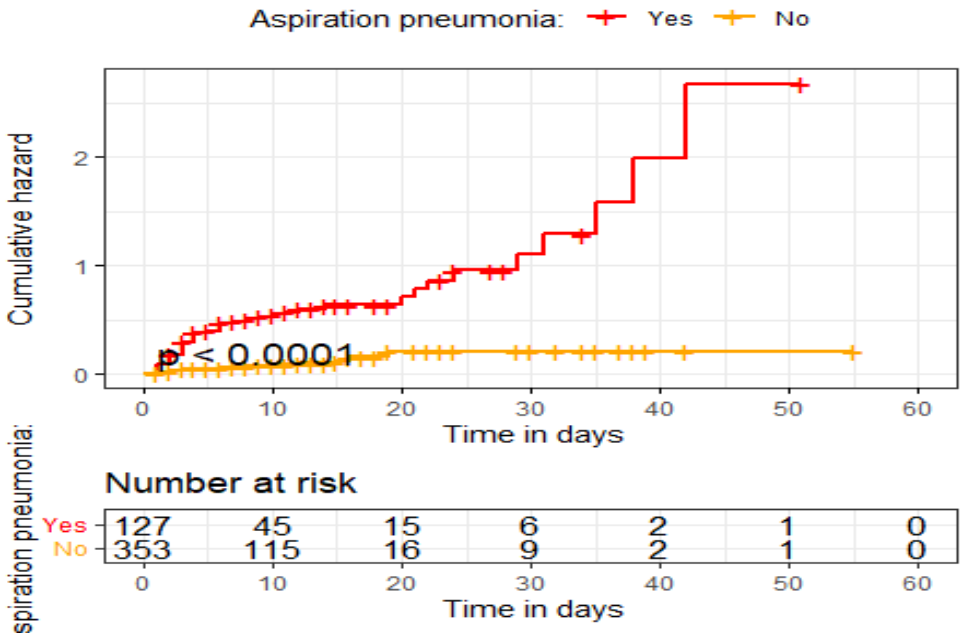

Figure 11: KM Cumulative Hazard curve for Aspiration pneumonia complication among adult stroke patients admitted to JUMC from April 2017 to March 31/2022

Patients who had a history of dyslipidemia were found to decline in survival probability more than patients who had no history of dyslipidemia and the log-rank test of this survival probability was found to be <0.001.

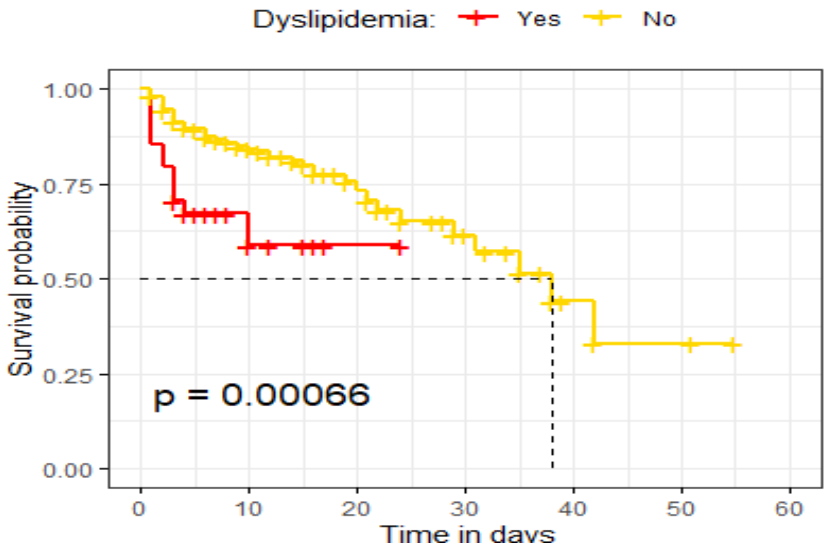

Figure 12: KM survival curve for the history of Dyslipidemia among adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

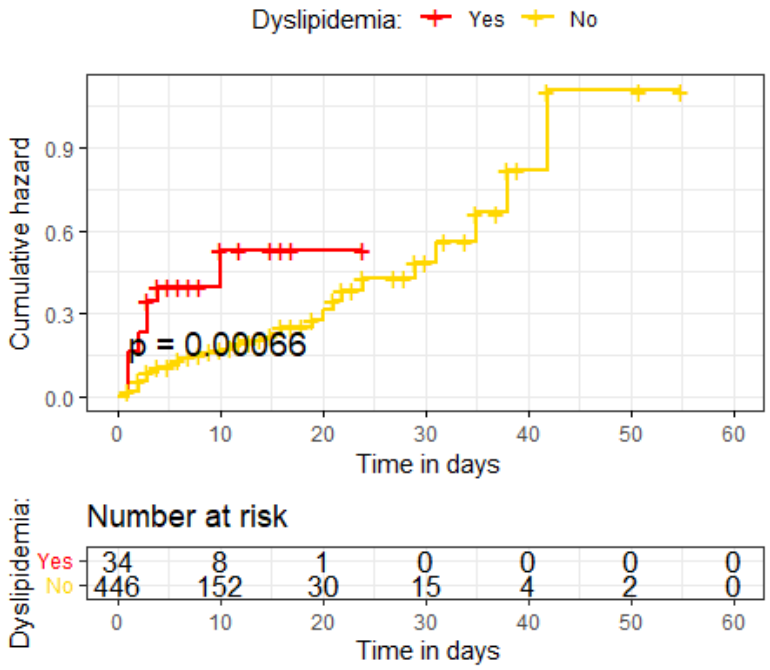

Figure 13: KM Cumulative Hazard curve for the history of dyslipidemia among adult patients admitted to JUMC from April 2017 to March 31/ 2022

5.6.2. Log-rank tests

The log-rank test was found to be statistically significant for the category of GCS score, history of stroke complication, atrial Fibrillation, aspiration Pneumonia, increased ICP, Vomiting, Dyslipidemia, and Seizure (**Table 10**).

Table 9: Log-rank test for equality of survivor functions among adult stroke patients admitted to JUMC from April 2017 to March 31/ 2022

Covariates		Observed deaths	Expected deaths	χ 2 (df)	P-value
Age (Years)	<45	34	40.4	2.4(2)	0.3
	45-65	25	20.1		
	>65	29	27.5		
Type of stroke identified	IS	43	48.8	1.6(1)	0.2
	HS	45	39.2		
GCS score	<8	47	12.5	122(2)	<0.001*
	9-12	28	31.3		
	13-15	13	44.3		
Stroke Complication	Yes	77	46.3	45.3(1)	<0.001*
	No	11	41.7		
Pulse Rate(Beats/Min)At	<60	4	2.14	13.2(2)	0.001*
Admission	60-100	53	67.23		
	>100	31	18.63		
Respiratory Rate(Breaths/Min) At	120-20	1	5.72	4.3(1)	0.04*
Admission	>20	87	82.28		
Atrial Fibrillation	Yes	38	27.6	5.9(1)	0.02*
	No	50	60.4		
Aspiration Pneumonia	Yes	61	24.1	81.5(1)	<0.001*
	No	27	63.9		
Increased ICP	Yes	63	23	97.6(1)	<0.001*
	No	25	65		

Diabetes	Yes	11	6.9	2.7(1)	0.1
	No	77	81.1		
Vomiting	Yes	48	35.7	7.3(1)	0.007*
	No	40	52.3		
Dyslipidemia	Yes	12	4.83	11.6(1)	<0.001*
	No	76	83.17		
Seizure	Yes	9	4.64	4.5(1)	0.03*
	No	79	83.36		
RVHD	Yes	9	6.26	1.3(1)	0.2
	No	79	81.74		

5.6.3. Predictors of time to death among adult stroke patients

The Glasgow coma scale at admission, aspiration pneumonia, type of stroke, atrial fibrillation, increased ICP, diabetes, vomiting, dyslipidemia, rheumatic valvular heart disease, seizure, the pulse rate at hospital arrival, the respiration rate at arrival, the presence of stroke complication, and the patient's age were variables with $p<0.25$ in the Bi-variable Cox proportional hazard and selected for multivariable Cox proportional hazard model.

By controlling the effect of other variables, the multivariable Cox Proportional Hazards Model reveals that the independent predictors of time to death of adult stroke patients were GCS score≤8 (AHR:7.71 (95%CI:3.78-15.69)), aspiration pneumonia(AHR:2.30 (95%CI:1.23-4.26) history of dyslipidemia(AHR: 3.96(95%CI: 2.04-7.69)) and increased ICP(AHR:4.27(95% CI(2.33-7.81)).

By controlling the impact of other covariates, the risk of death among adult stroke patients admitted with GCS scores of less than eight was 7.71 times higher than the risk among those with GCS scores of 13–15(AHR= 7.71; 95% CI 3.78-15.69). In addition, having aspiration pneumonia complications was a 2.3 times higher hazard of death compared to those who have not (AHR: 2.30(95%CI: 1.23-4.26).

By adjusting for other factors, the adult stroke patients who experienced complications related to increased intracranial pressure had a 4.27 higher death hazard at any given time than those who did not (AHR:4.27(95% CI: 2.33-7.81)). Moreover, patients with a history of

dyslipidemia had a 3.96-times higher risk of death at any given time than patients without a history of dyslipidemia (AHR: 3.96(95% CI: 2.04-7.69)) (**Table 11**)

Table 10: Bi-variable and Multivariable Cox proportional hazard Model of adult stroke patients admitted to JUMC, from April 2017 to March 31/ 2022

Covariates		**CHR**	**P-value**	**AHR**	**95%CI**	**P-value**
Age (Years)	<45		Ref			Ref
	45-65	1.50	0.125	1.43	0.80, 2.55	0.227
	>65	1.26	0.366	1.18	0.66,2.10	0.577
Type of stroke	IS		Ref			Ref
	HS	1.31	0.209	0.85	0.51, 1.42	0.547
GCS score	<8	13.8	<0.001	7.71	**3.78,15.69**	**<0.001**
	9-12	3.11	0.001	1.86	0.90, 3.86	0.093
	13-15		Ref			Ref
Stroke Complication	Yes	6.64	<0.001	1.04	0.43,2.56	0.925
	No		Ref			Ref
PR(beats/min) at arrival	<60	2.41	0.09	1.82	0.61,5.39	0.281
	60-100		Ref			Ref
	>100	2.14	0.001	1.34	0.83,2.17	0.233
RR(breaths/min) at arrival	120-20		Ref			Ref
	>20	6.18	0.071	4.44	0.57,34.39	0.154
Atrial Fibrillation	Yes		Ref			Ref
	No	0.59	0.016	0.65	0.40,1.06	0.073
Aspiration Pneumonia	Yes	6.41	<0.001	2.30	**1.23,4.26**	**0.008**
	No		Ref			Ref
Increased ICP	Yes	7.68	<0.001	4.27	**2.33,7.81**	**<0.001**
	No		Ref			Ref
Diabetes	Yes		Ref			Ref

	No	0.59	0.102	0.59	0.29,1.21	0.152
Vomiting	Yes		Ref			Ref
	No	0.56	0.007	0.84	0.52,1.38	0.500
Dyslipidemia	Yes	2.81	0.009	3.96	**2.04,7.69**	**<0.001**
	No		Ref			Ref
Seizure	Yes		Ref			Ref
	No	0.48	0.038	1.69	0.75,3.80	0.209
RVHD	Yes		Ref			Ref
	No	0.66	0.245	0.48	0.22,1.04	0.06

*RR=Respiratory rate, *GCS=Glasgow Coma scale, *ICP=increased intracranial pressure, *RVHD=rheumatic valvular heart disease

5.6.4. Test of proportional hazard assumption

In model construction, it is necessary to make diagnostics before concluding that the model with the final predictors. Testing the assumption of proportional hazards, and overall summary measures of goodness of fit are important. One of the main assumptions of the Cox proportional hazard model is that the hazard ratios are constant over time. That means the risk of failure must be the same no matter how long subjects have been followed. We used testing the proportionality assumption by using the Schoenfeld and scaled Schoenfeld residuals. Since the test results in (**Table 12**) are not statistically significant (p-values >0.05) we could not reject proportionality. In addition, the assumption of proportionality was also assessed graphically by plotting the scaled Schoenfeld residuals of each covariate against log time (**Figure 14**).

Table 11: Proportional hazard assumption checking using Schoenfeld residual

Variable	Chi-square	Degree of freedom	p-value
Type of Stroke	1.613	1	0.20
GCS score	1.411	2	0.49
Atrial Fibrillation	0.862	1	0.35
Increased intracranial pressure	0.336	1	0.56
Aspiration Pneumonia	0.443	1	0.51
Diabetes mellitus	0.059	1	0.81
Vomiting	2.290	1	0.16
Dyslipidemia	0.308	1	0.58
Rheumatic valvular heart disease	1.158	1	0.28
Seizure	0.040	1	0.84
PR at admission	0.289	2	0.87
RR at admission	0.204	1	0.65
Stroke Complication	0.006	1	0.94
Age category	4.100	2	0.13
Global	12.553	17	0.77

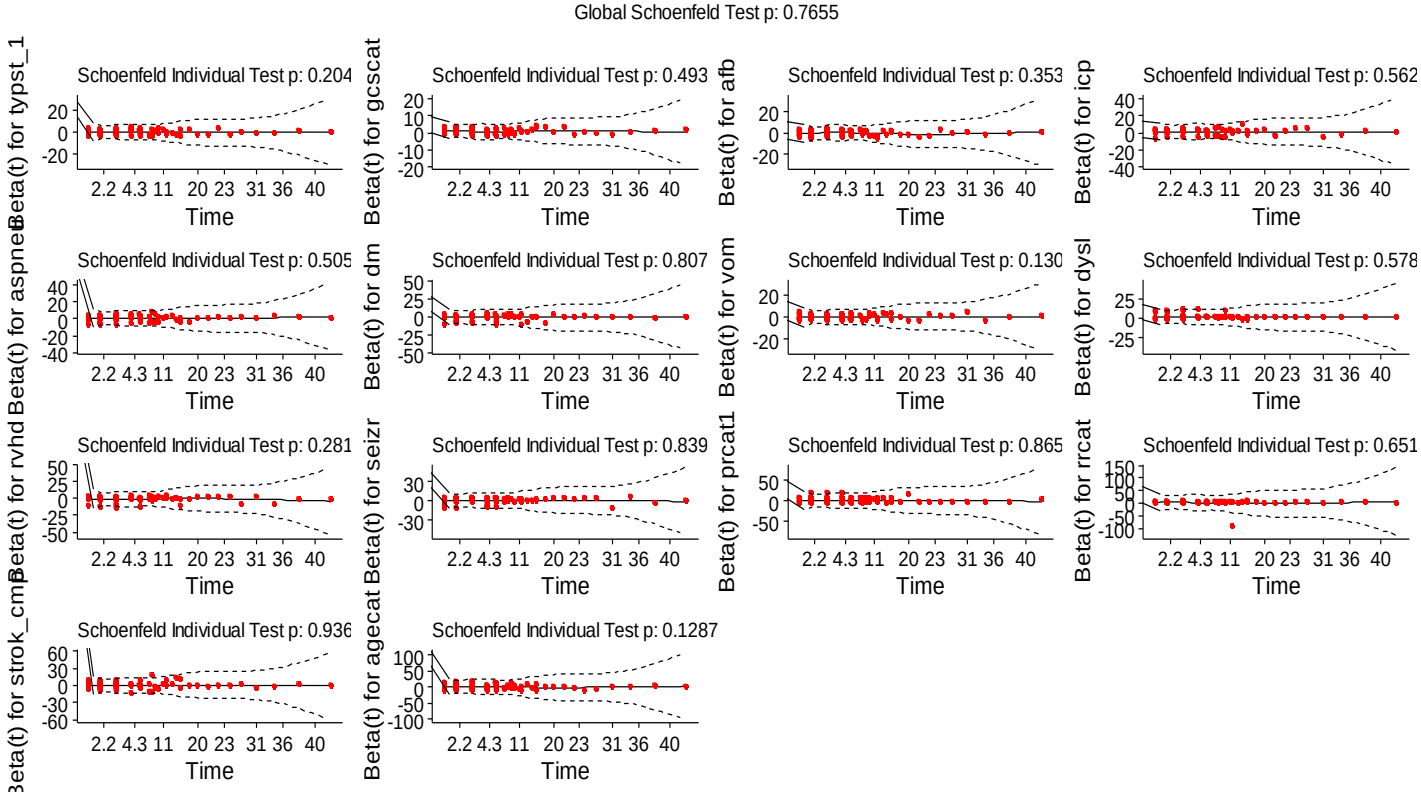

Figure 14: proportional hazard assumptions tests of each covariate against log time by scaled Schoenfeld residual

5.6.5. The overall goodness of the fit test

We evaluate the fit of the model by using the Cox-Snell residuals. If the model fits the data well then the true cumulative hazard function conditional on the covariate vector has an exponential distribution with a hazard rate of one. The straight line through the origin is drawn for reference. We see that the hazard function follows the 45-degree line very closely. Overall we would conclude that the final model fits the data very well (**Figure 15**).

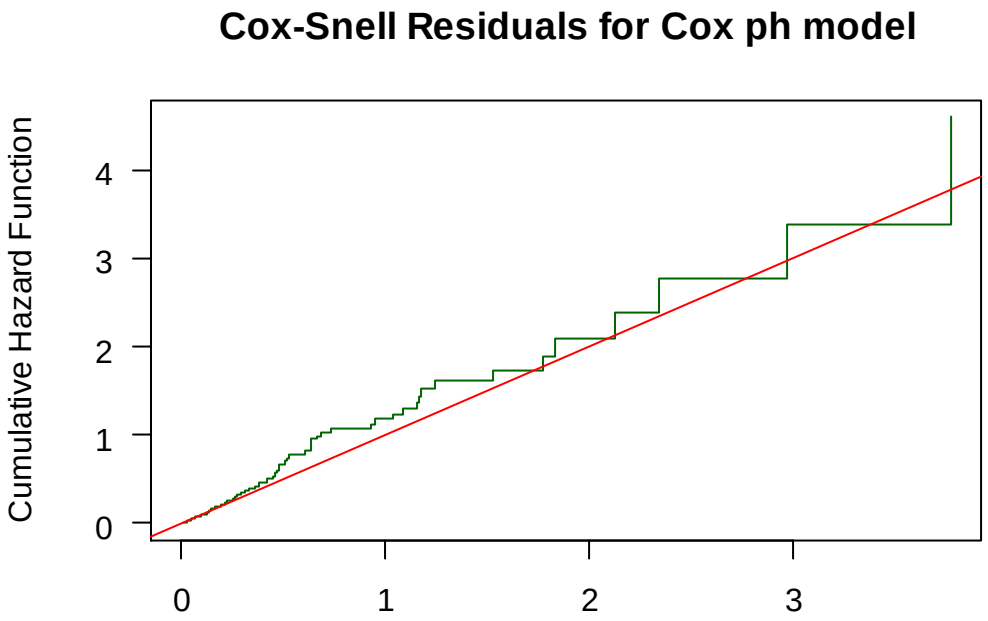

Figure 15: Cox Snell residual plot to check overall goodness of fit

The figure below also demonstrates that the GCS score at admission, elevated intracranial pressure, aspiration pneumonia, and history of dyslipidemia are the independent predictors of stroke mortality (95% confidence intervals for these variables' hazard ratios did not cross HR=1).

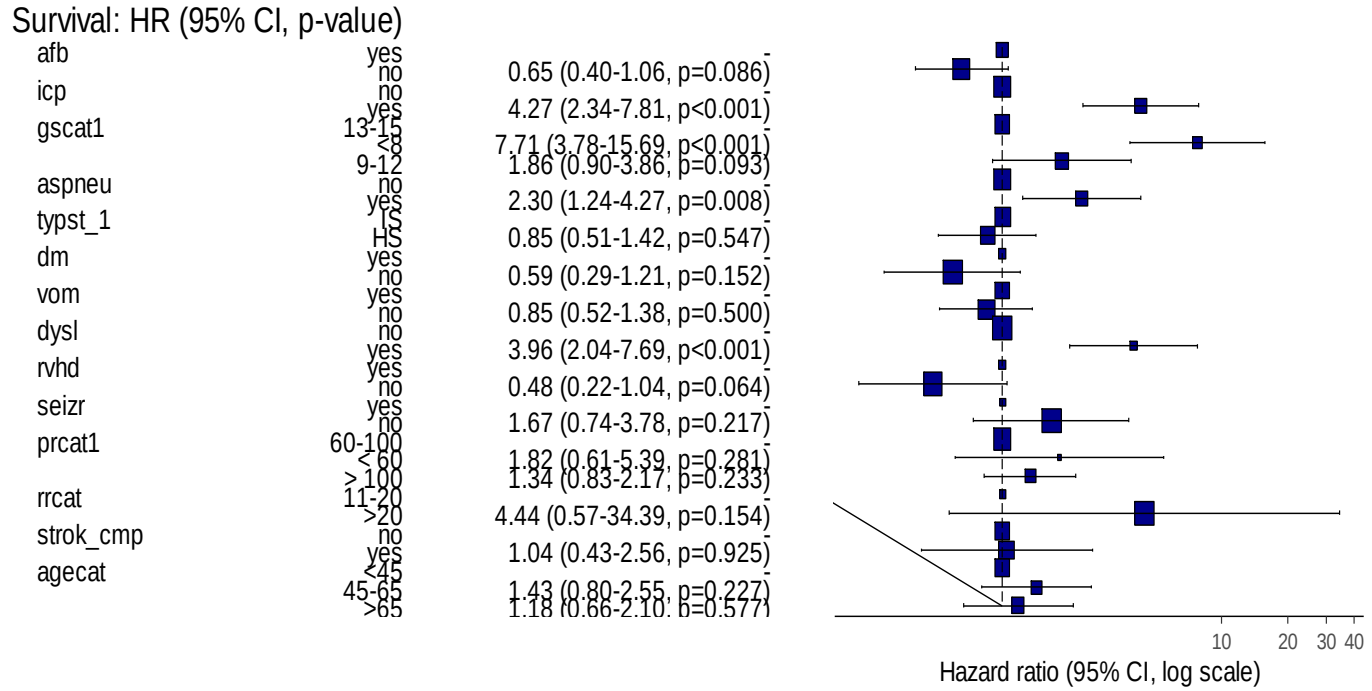

Figure 16: Hazard plot of predictor variables using forest plot for cox proportional hazard model

6. Discussion

This retrospective cohort study aimed to assess time to death, and its predictors among adult stroke patients admitted to Jimma University Medical Center from April 1/2017 to March 31/2022 G.C, with data extracted from May to June 2022. We identified an incidence of stroke mortality of 20.23per 1000 person-days. The median survival time was 38 days, and the four predictors of time to death of the adult stroke patients were poor (<8) admission GCS score, dyslipidemia, aspiration pneumonia, and increased intracranial pressure.

The Mean age at which a stroke occurs was 55.43±14.56 years, which was comparable to studies done in different areas in Ethiopia (24,38,40,60,61), this shows that stroke is frequently a disease that affects the elderly population. After adjusting for potential confounders, stroke patients aged >65 years old had an 18% higher hazard of death compared to those aged less than 45 years, even though there was no statistically significant difference in overall survival time between the age groups. However, a study carried out in Northwest Ethiopia found that age over 65years was an independent predictor of death from stroke (31,60).

In our study, hemorrhagic stroke accounted for 45.42 percent of stroke patients, which is in line with a study at Tikur Anbesa specialized Hospital (30), Dessie Referral Hospital (48), and Mekele Ayder Referral Hospital (38). However, it is less than the studies conducted in Addis Ababa and Nigeria (40,50). The sample size difference may be the reason for the discrepancy. However, the findings were higher than the study conducted in Iran (52). The possible explanation could be due to the high magnitude of hypertension in Africa, and the majority of patients in our study (72.4%) were not adherent to their prescribed anti-hypertensive drugs as directed, all of which contribute to the high incidence of hemorrhagic stroke. According to research done in Mekele, the cardio-embolic subtype for ischemic stroke was the most frequently detected (57), supporting our finding that the cardio-embolic subtypes of ischemic stroke predominated.

The present study showed 18.33% of stroke patient death, which is comparable to the proportion reported in other parts of Ethiopia (30,62); however, it is higher than studies done at Ambo University Referral Hospital, which were 8.6% and 16.2% (39,63), Felege Hiwot Referral Hospital(15.2%) (31), in Mekele Ayder Hospital(12%) (38); and lower than Tikur Anbessa

specialized Hospital (40). Variances in sample size, study population characteristics, study population composition, study design, and study areas may be the reason for variations in mortality proportions. On the other hand, it is lower than the proportion in the Democratic Republic of Congo and Uganda which was 31.7% and 31% respectively (42,51). The study in Congo was conducted at a multicenter, whereas the lower unit health institution may not have a standard laboratory investigation. This disparity in treatment facilities may be the possible cause of the discrepancy. On the other hand, the difference in study design, sample size, and inclusion criteria might be the possible reason for being lower than the study conducted in Uganda.

Furthermore, we found that the median survival time was 38 days, lower compared to the study conducted in Northern Ethiopia which was 48days (57).

According to this study, the probability of survival at 7 days, 14 days, 30 days, and 42 days was 85.2%, 79.5%, 60.8%, and 32.7%, respectively. 30days survival probability is slightly lower than the previous studies (57,61). A study in southern Nigeria reported a case fatalities rate at 7 days, 14 days, and 30 days were 22.2%, 25.5%, and 30.8%; which is higher for 7 days and 14 days and 30 days were lower (50).

In this study, we found no significant difference in survival time between males and females, which is in line with previous studies done in Ethiopia (31,57). Furthermore, we found that there was no significant difference in the survival time between hemorrhagic and ischemic types of stroke, this finding is in line with previous studies done in Ethiopia (57).

At a given instant of time during the follow-up period, stroke patients who had a GCS score of ≤ 8 were 7.71 times more likely to die as compared to those with a GCS score of 13-15, adjusting for other variables. This finding is consistent with a study conducted in other parts of Ethiopia (31,57), Nigeria (49), Sierra Leone (64), and Uganda (51). Patients with poor GCS scores are more likely to die, typically because of complications such as aspiration pneumonia, and intracranial pressure increment. This might imply that patients with poor GCS scores require more immediate care, such as securing the airway, positioning them correctly to prevent aspiration, and immediate managing of underlying complications.

At any particular point in time during the follow-up period, the hazard of death among adult stroke patients who had aspiration pneumonia complications was 2.3 times higher than those

who had no it, after adjusting for other variables; which is in line with a study on tertiary referral in the east of England and Sierra Leon (51,65). Stroke Patients with aspiration pneumonia are usually at increased risk of respiratory infection. This might imply that stroke patients with a history of dysphagia need close follow-up for the prevention of aspiration of the foreign body to prevent the occurrence of the above-stated complication.

Moreover, it was identified that an adult stroke patient with a history of dyslipidemia(on lipid-lowering medication or total cholesterol ≥240mg/dl) died at a hazard of 3.96 times at all follow-up periods as compared to those who did not have, which is consistent with the study conducted in Mekele (57), which shows there is a significant difference in survival time of patients who had borderline cholesterol had four times higher risk of death compared to with normal cholesterol level.

At any particular time during the follow-up period, the hazard of death among patients having the complication of raised intracranial pressure was 4.27 times higher than those who did not. Increased intracranial pressure increases the hazard of death of stroke patients mainly since it results in: lower cerebral perfusion pressure, cerebral ischemia, herniation of brain stem, and other important structures. Therefore, this implies that elevated ICP must be recognized as soon as possible to monitor it and begin therapies aimed at lowering it. Both clinically and scientifically, a higher ICP is measurable. Continuous ICP monitoring is crucial for determining the effectiveness of treatment.

In our study, there is no statistically significant difference in survival time among types of stroke; the hazard of death among hemorrhagic stroke patients was 15 % lower than patients who had an ischemic stroke, after adjusting for other variables; in line with other studies in Ethiopia (57), Kazakhstan (53), which shows no statistically significant difference in survival time among stroke types.

Strengths and limitations of the study

Strengths of the study

We tried to estimate the incidence rate of stroke death among adult stroke patients by following the minimum gold standard recommendations of the Epidemiologic stroke study and reporting quality survival analysis data. World Health Organization clinical case definition of stroke, stroke type, and sub-types along with the adjusted estimate of predictor variables was used.

Because, potential predictors were measured before the outcome occurs, and this chronology of events enhances the inferences that potential predictors might be a cause of the outcome (death of stroke patients).

Data were collected with experienced data collectors

Limitations of the study

The study was not done without limitation; the retrospective nature of the study and it is a referral hospital-based study rather than a population-based study, thus selection (referral bias) may occur because severe cases may have died before reaching the hospital or mild cases may have not reported to the hospital. There were also missing socio-demographic variables (such as marital status, educational status, and occupational status) and some covariates such as BMI which might affect the adjusted estimates of covariates. We hope that by acknowledging these potential limitations, this study will still be useful in shedding light on survival status and its predictors for future studies.

7. Conclusion and Recommendations

Conclusion

The incidence of mortality among adult stroke patients admitted to the study area was higher in the first & second weeks than in the previous studies. But thirty days mortality was lower than in previous studies. More than two third of stroke mortality occurred within the first seven days of admission with a median survival time of 38 days. The median survival time was higher than in previous studies in Ethiopia.

Poor admission GCS scores, a complication of raised intracranial pressure, a history of dyslipidemia, and aspiration pneumonia were independent predictors of time to death on the multivariable cox regression model.

Recommendations

Clinicians: We recommend clinicians strengthen the early detection and treatment of stroke complications and other co-morbidities as well as diligent follow-up of adult stroke patients who are unconscious to improve stroke patients' survival rates.

Researchers: We suggest researchers and scientific communities conduct prospective community-based studies to estimate the incidence of stroke deaths.

Policymakers: We recommend policymakers develop appropriate strategies, to address the modifiable risk factors for stroke via early screening, detection, treatment, and control of stroke complications.

NGOs and other nonprofit organizations that work in areas of non-communicable disease should focus on the current debilitating condition of stroke in SSA including Ethiopia through better funding of the healthcare system to improve the quality of care.

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ANNEXES

Annex-I: Information sheet and consent form

Participant information sheet and informed consent form for health facilities administrators

My name is _____. I am working as a data collector for the research being conducted to assess survival status and predictor of mortality among adult stroke patients admitted at Jimma University Medical Center by **Wakgari Mosisa** who is an MPH in Epidemiology student at the Faculty of Public Health, Jimma University. I kindly request you to lend me your attention to explain to you the study and study participants.

The study Topic: Survival Status and Predictors of Mortality among Adult Stroke patients admitted at Jimma University Medical Center, Southwest Ethiopia, 2022.

Purpose of the study: The main aim of this study is to write a thesis as a partial requirement for the fulfillment of a master's degree in Epidemiology for the principal investigator. Moreover, the result of the study will be used as evidence and input for the health facilities of Jimma University Medical Center and other governmental and non-governmental organizations working on NCDs.

Procedure and duration: The data collectors will collect the necessary information from patient files using structured data extraction tools to have pertinent data that is helpful for the study. The duration of data collection will be 30 days.

Risk and discomfort: By participating in this research project, no risk comes to the stroke Unit in general and the client whose record was reviewed. Whereas the review is of great importance to the research project which is in turn important for the overall planning of the program.

Benefit: The research has no direct benefit to those who have participated in this project. But the indirect benefit of the research for the participant and all other clients in the program is great. As identifying areas of improvement and taking appropriate decisions helps to improve the service, increase access and overall effectiveness of the program and reduce the incidence of mortality among adult stroke patients.

Confidentiality: The information acquired from the patient file will be confidential. There will be no information that will identify in particular. The findings of the study will be general for the study community and will not reflect anything, particularly on individual persons.

The data extraction tools will be coded to exclude showing names and other personal information. No reference will be made in oral or written reports that could link participants to the study.

Rights to refusal or Withdrawal: Permitting this study is fully voluntary. You have the right to permit or not this study. If you decide to permit the study, you have the right to terminate the study at any time if you consider something related to the study is wrong.

Contact address: This research project will be reviewed and approved by the IRB of the Institute of Health, Jimma University. If in any case, you want to know more information about the research and its undertakings, you can contact the committee through the address of the advisor and /or principal investigator.

Principal investigator: Wakgari Mosisa (BSc), Mobile phone: +251-917-843-505

E-mail: wakgarimosisa@gmail.com or wamosisa@gmail.com

Advisors:

1. Mr. Masre Getnet (MSc, Assistant professor) Jimma University, Faculty of Public Health, Department of Epidemiology and Biostatistics

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Declaration of Informed Voluntary Consent:

I have read/was read the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the right of participation, and the contact address for any queries. I have been allowed to ask any questions about things that may have been unclear. I was informed that I can terminate the study at any time. Therefore, I declare my voluntary consent to permit this study to be conducted in this institution with my signature as indicated below.

Signature of health facilities administrator: _____

Name: _____ Date: _____

Signature of Principal Investigator: _____

Name: Wakgari Mosisa **Date: _____**

Thank you for your cooperation!!

Annex-II: Data extraction tools

Abstraction done by: _____date_____
Name of supervisor: _____ Date: ___/____/____ sign: _____

I. Patient socio-demographic information

MRN/card number:_____	Date of admission_____	**Age**:_____ (yrs)	**Sex:** **1.** Male 2. Female	Kebele:_____ Woreda:_____	Residence 1. Urban 2. Rural

Marital status ☐ single ☐ Married ☐ Divorced ☐ Widow	**Ethnicity** ☐ Oromo ☐ Amhara ☐ Kefa ☐ Other_____	**Education status** ☐ Illiterate ☐ Able to read & write ☐ Primary completed ☐ Secondary completed ☐ College/university ☐ Postgraduate degree ☐ Unrecorded	**Health insurance status** ☐ Insured ☐ Uninsured ☐ Not known	☐ Weight(kg)_____ ☐ Height (cm):_____ ☐ BMI:_____ ☐

Occupational status
- ☐ Government employee
- ☐ Self-employee
- ☐ Student
- ☐ Farmer
- ☐ Daily laborer
- ☐ Retired
- ☐ Housewife
- ☐ Other(specify)_____

☐ **Patient's baseline data(Vital signs at admission)**

		BP (mmHg) _____	Total cholesterol (mg/dL) _____
	Sodium(*mmol/L*) : _____	Temp (^{o}c) _____	HGB level (g/dL) _____
	Potassium(*mmol/L*): _____	PR(beat/min)_____	RR (breaths/min)_____
	Chloride(*mmol/L*): _____	RBS(mg/dL)_____	Serum Creatinine (mg/dL) _____

clinical presentation at admission(multiple responses are possible)

☐ Altered mental status (Stupor/lethargy/coma)	☐ Speech disturbances	☐ Hemiplegia	☐ Hemiparesis	**GCS at admission**_____	☐ Was there any fall-down injury associated with the stroke? 1. Yes 2. No
	☐ Headache	☐ Vomiting	☐ Vertigo/ dizziness		
☐ Blurred vision	☐ Urine incontinence	☐ Decreased LOC	☐ Others _____	Unrecorded	☐ If yes, which type? ☐ Head injury ☐ Fracture

II. Antecedent Risk factors/ causes

Hypertension status **1**. Yes 2. No

- If hypertensive was he/she,
  - Newly diagnosed
  - have history of hypertension , *duration of HTN*_____
- **If hypertensive was he/she *on medication?***
  - *Yes*
  - *No*

If* he/she was *on antihypertensive:

- *BP not controlled (≥140/90 on ≥2 measurements)*
- *BP controlled(<140/90)*

NB: control diabetes can be RBS > 200 mg/dl and hyperlipidemia can be by total cholesterol > 200mg/dl, serum triglycerides ≥150 mg/dl

- Diabetes mellitus: 1. Yes 2. No
- If DM was he/she
  - Known DM patient
  - Newly diagnosed
  - Not recorded

If DM was he/she on insulin or oral hypoglycemic:

- *yes*
- No

- If on insulin or oral hypoglycemic agents was the DM controlled?
  - *yes*
  - No
- *BG controlled (FBS 70-130 mg/dl*
- *BG not controlled (FBS>130 mg/dl)*

- Alcohol consumption 1.Yes, 2. No
- Smoking / Tobacco use
  - *never smoked*
  - *current smoker*
  - Ex-smoker
  - Unrecorded
- Khat chewing
  - *yes*
  - No
  - Unrecorded
- Dyslipidemia 1. Yes 2. No
- duration)_____

If on the lipid-lowering agent: at admission

- *lipid controlled (LDL<100mg/dl)*
- *Lipid not controlled (LDL ≥100 mg/dl)*

Ischemic heart disease 1. Yes 2. No NR

Cardiomyopathy 1.Yes 2. No 3. NR

Rheumatic valvular heart disease 1. Yes 2. No 3. NR

Atrial fibrillation 1. Yes 2. No 3. NR

- HIV infection
  - Yes
  - No

- Contraceptive drug use
- Previous stroke/TIA
- Traumatic brain /head injury

Coronary disease (CHD, IHD)

Thyrotoxicosis

Other cardiovascular diseases such as DCM

- Sickle cell disease
- Infective meningitis (tuberculosis meningitis or bacterial meningitis)

- Family history of
  - *Sudden death*
  - *Stroke*
  - *Ischemic heart disease*
  - *DM*
  - *HTN*
  - *Other*_____

- VTE/hypercoagulable states
- Oral anticoagulants
- Other comorbidities

III. Neurological factors

- Manner of occurrence of the stroke?
  - Sudden
  - Insidious
  - Not known

Was brain imaging done for stroke confirmation (CT Scan/ MRI)

- No imaging was done (only clinical diagnosis)
- Yes:

Type of stroke identified

- Ischemic stroke
- Hemorrhagic stroke (subarachnoid)
- Hemorrhagic stroke (intracerebral)
- Other stroke_____
- Unrecorded

- If Ischemic stroke, Sub-type of Ischemic stroke (select only one)
  - Cardio-embolism
  - Large artery atherosclerosis
  - Small artery occlusion
  - Other determined cause
  - Undetermined cause
  - Unrecorded

☐ If hemorrhagic stroke, Causes of hemorrhagic stroke (select only one) ○ Hypertension ○ Vascular Aneurysm ○ Amyloid Angiopathy ○ Anticoagulant related ○ Unrecorded	☐ An episode of stroke events ○ First ever ○ Recurrent			
IV. Acute stroke events:				
☐ The chief complaint of the stroke patient? _____	☐ Date of stroke symptoms onset)____/___/_____	☐ Time of stroke onset_____	☐ Date of hospital arrival ____/___/_____	☐ Time of hospital arrival_____AM /PM
☐ Duration from the onset of the stroke to the arrival in the hospital? ☐ _____hour/s ☐ Was a Carotid Doppler ultrasound done? ○ Yes' ○ No	☐ Mode of hospital arrival? ☐ Ambulance ☐ Public transport ☐ Carried by people ☐ Other specify	☐ Was the brain imaging done ○ Yes ○ No	☐ If yes, the Date of brain imaging done? ☐ ____/___/_____	☐ Time of brain imaging done ☐ _____ (AM/PM)
☐ If done, the findings ☐ Normal ☐ Atherosclerosis without stenosis ☐ Atherosclerosis with stenosis A.0-30% stenosis B. 30-50% stenosis C. 50-70% stenosis D. >70% stenosis ☐ Unrecorded	**Type of treatment received (multiple responses are possible)** ☐ Antiplatelet(Aspirin, Clopidogrel) ☐ Anti-coagulants (Heparin, Warfarin) ☐ Anti-hypertensive ☐ Statins ☐ Anti-diabetic drugs ☐ Antibiotics ☐ Others (specify) _____ ☐ Unrecorded	**Stroke complications detected (multiple responses are possible)** ☐ Aspiration pneumonia ☐ Increased ICP ☐ UTI ☐ DVT ☐ Gastrointestinal bleeding ☐ Seizure ☐ Myocardial infarction ☐ AKI ☐ others (specify_____) ☐ Unrecorded	**Treatment outcome** ☐ Dead ☐ Discharged improved ☐ Discharged unimproved ☐ Referred for better care ☐ Left against medical advice (LAMA) ☐ Unrecorded	☐ Date of discharge (if alive) ____/___/_____ ☐ Date of death(if dead) ____/___/_____ ☐ Length of stay in hospital _____ day/s

Annex III: the clinical scale of patient status

Glasgow coma scale (GCS): helps to measure the level of consciousness(66).

Eye Opening (E)	
-Spontaneous eye opening	4
-Eye-opening in response to verbal command, speech, or shout	3
-Eye-opening in response to pain	2
-No eye opening	1
Best Verbal Response (V)	
Oriented — patient knows self, place, year, season, and month	5
Confused conversation — able to answer questions but with disorientation or confusion	4
Inappropriate speech — random or exclamatory speech, no conversational exchange	3
Incomprehensible speech — no words uttered, only moaning	2
No verbal response	1
Best Motor Response (M)	
Obeys command — does simple things you ask	6
Purposeful movement and localization to pain	5
Withdraws to pain — pulls limb away from a painful stimulus	4
Flexor response to pain — pain causes abnormal flexion of limbs or decorticate posture	3
Extensor response to pain — stimulus causes limb extension — decerebrate posture	2
No motor response to pain	1
Total (E + V + M) = _____ Note: Lowest score is 3. The maximum score is 15	

- Good GCS (13-15): mild brain injury (alert)
- Moderate GCS (9-12): moderate brain injury (drowsy)
- Poor GCS (≤8): severe brain injury (unconsciousness)

Annex-IV: supportive

Table 12: Antecedent risk factors of adult stroke patients admitted to JUMC from April 2017 to March 31/2022

Variable	Category	Died Frequency (%)	Censored Frequency (%)	Total Frequency (%)
Hypertension status	Yes	65(13.54)	284(59.17)	349(72.71)
	No	23(4.79)	108(22.50)	131(27.29)
Hypertension status	Newly diagnosed	18(5.16)	76(21.78)	94(26.93)
	Known Hypertensive	47(13.47)	208(59.60	255(73.07)
Diabetes Mellitus	Yes	11(2.29)	31(6.46)	42(8.75)
	No	77(16.04)	361(75.21)	438(91.25)
Alcohol consumption(N=409)	Yes	8(1.67)	43(8.96)	51(10.63)
	No	61(12.71)	297(61.88)	358(74.58)
Smoking (N=303)	Yes	8(1.67)	21(4.38)	29(6.04)
	No	37(7.71)	237(49.38)	274(57.08)
Khat chewing (N=336)	Yes	4(0.83)	24(5.00)	28(5.83)
	No	42(8.75)	266(55.42)	308(64.17)
Coronary Heart Disease (CHD, IHD)	Yes	16(3.33)	49(10.21)	65(13.54)
	No	72(15.00)	343(71.46)	415(86.46)
Cardiomyopathy	Yes	7(1.46)	25(5.21)	32(6.67)
	No	81(16.88)	367(76.46)	448(93.33)
Rheumatic valvular heart disease	Yes	9(1.88)	19(3.96)	28(5.83)
	No	79(16.46)	373(77.71)	452(94.17)
Atrial Fibrillation	Yes	38(7.92)	108(22.50)	146(30.42)
	No	50(10.42)	284(59.17)	334(69.58)
HIV infection	Yes	3(0.63)	5(1.04)	8 (1.67)
	No	85(17.71)	387(80.63)	472(98.33)

Contraceptive drug use (female)	Yes	1(0.21)	8(1.67)	9(1.88)
	No	87(18.13)	384(80.00)	471(98.13)
Previous stroke/TIA	Yes	11(2.29)	42(8.75)	53(11.04)
	No	77(16.04)	350(72.92)	427(88.96)
Sickle cell diseases	Yes	2(0.42)	4(0.83)	6(1.25)
	No	86(17.92)	388(80.83)	474 (98.75)
Other cardiovascular diseases.	Yes	1(0.21)	13(2.71)	14(2.92)
	No	87(18.13)	379(78.96)	466(97.08)
Infective meningitis	Yes	13(2.71)	20(4.17)	33(6.88)
	No	75(15.63)	372(77.50)	447(93.13)
Dyslipidemia	Yes	12(2.50)	21(4.38)	33(6.88)
	No	76(15.83)	371(77.29)	447(93.13)
Family History	Yes	4(0.83)	8(1.67)	12(2.50)
	No	84(17.50)	383(79.79)	467(97.29)
VTE	Yes	4(0.84)	6(1.26)	10 (2.09)
	No	84(17.57)	384(80.33)	468(97.91)
Oral anticoagulants	Yes	4(0.84)	7(1.46)	11(2.30)
	No	84(17.57)	383(80.13)	467(97.70)

*VTE: Venous thromboembolism, *TIA: Transient ischemic attack, *CHD: Coronary heart disease, *IHD: Ischemic heart disease. Other: such as Dilated cardiomyopathy

EPIDEMIOLOGY DEPARTMENT

DECLARATION

I, the undersigned, Master of Public health in Epidemiology student declare that this thesis is my original work in partial fulfillment of the requirements for the degree of master of Public Health in Epidemiology and has not been presented for a degree in this or any other University, and all sources of materials used for this thesis have been duly acknowledged, and the comments given during defense were fully accommodated.

Name of the student: Wakgari Mosisa Abdisa (BSc)

Signature: _____ Date_____

Name of institution: Jimma University

Date of submission: _____

Approval of Advisors

This thesis has been approved for submission with my approval as a University advisor(s)

1 Mr. Masrie Getnet (MSc, Assistant Professor)
Signature_____ Date_____

2 Mrs. Yenealem Gezehagn (BSc, MPHE)
Signature_____ Date_____

Approval of internal examiner

This thesis has been submitted with my approval as an internal examiner.

1. Mrs. Chaltu Fikru (BSc, MPHE, Assistant professor)

Signature: _____ Date: _____