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RESEARCH

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Magnitude, risk factors and outcomes of stroke at Debre Markos Referral Hospital, Northwest Ethiopia: a retrospective observational study

Henok Mulugeta^{1*}, Amare Yehuala², Dessalegn Haile¹, Nakachew Mekonnen³, Getenet Dessie⁴, Getachew Mullu Kassa^{5,6}, Zerihun Shimelis Kassa⁷ and Tesfa Dejenie Habtewold⁸

Abstract

Background: Stroke is one of the leading causes of death and disability in developing countries. The burden of stroke has varied widely in different areas, and there is a paucity of information about stroke in the selected study area.

Objectives: To assess the burden, risk factors, and outcomes of stroke at Debre Markos Referral Hospital, Northwest Ethiopia

Patients and methods: A hospital-based retrospective observational study was conducted in the medical ward of Debre Markos Referral Hospital from March 2017 to April 2019. A pretested checklist was used to extract relevant data from the chart of stroke patients. All statistical analyses were performed in the SPSS version 20 software.

Results: From a total of 2100 admissions in the medical ward, 162 of them were stroke patients, giving the in-hospital magnitude of 7.7%. The in-hospital case fatality rate was 8.6%. Additionally, 27.2% of patients were improved and 39.5% of them were referred. There was a significant association between types of stroke and risk factors such as sex, comorbid hypertension, hyperlipidemia, and atrial fibrillation ($P \leq 0.05$).

Conclusion: The in-hospital period prevalence of stroke was 7.7%. Ischemic stroke was the most common type of stroke. Hypertension and hyperlipidemia were the leading identified risk factors for stroke. The overall in-hospital mortality was lower than previous studies in sub-Saharan African countries. Therefore, effective strategies and guidelines for the prevention and control of stroke and its risk factors are needed.

Keywords: Stroke, Hemorrhagic stroke, Ischemic stroke, Risk factors, Outcomes, Ethiopia

Background

Stroke is defined as the abrupt onset of neurologic deficit which is caused by the interruption of the blood supply to the brain. The two main types of stroke are ischemic and hemorrhagic stroke. Ischemic stroke, the most common type, results from reduced blood supply

to the brain tissues, whereas hemorrhagic stroke occurs due to the rupture of blood vessels within the brain [1, 2]. Stroke is one of the leading healthcare problems in both developed and developing countries. Globally, stroke is the second leading cause of death and responsible for 5.8 million deaths each year [3–5]. Besides, it remains the leading cause of disability among adults [6].

The neglected burden of stroke is increasing with high morbidity and mortality rate in Africa, where 86% of all stroke deaths occur. History and physical examination

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remain the pillars of the clinical diagnosis of stroke. Focal weakness, speech disturbance, headache, and arm paresis are some of the findings for clinical diagnosis of stroke. Besides, imaging studies such as computed tomography scan and magnetic resonance imaging are widely used in the diagnosis of stroke. For example, a finding of acute hemorrhage and areas of infarction in the brain on CT scans or MRI may suggest a stroke [7]. Nevertheless, diagnosis and treatment of stroke are poor especially in sub-Saharan countries [8, 9]. The magnitude of stroke is high in Ethiopia, in which 39,409 deaths occurred in 2004 alone. One of the main reasons for the higher percentage of stroke-related deaths in the country is the limited diagnosis and treatment resources [10, 11].

Several factors are responsible for stroke. According to the Global Burden of Disease (GBD) 2019 report, 90% of stroke risk is due to high blood pressure, obesity, diabetes hyperlipidemia, and renal dysfunction [12]. The remaining 10% of stroke risk could be due to a family history of stroke, cigarette smoking, obesity, lack of exercise, alcohol consumption, and unhealthy diets. Hemorrhagic stroke is associated with uncontrolled hypertension, and ischemic stroke is mostly related to diabetes mellitus [13].

Stroke can be prevented with lifestyle changes and controlling major risk factors including hypertension, diabetes, and heart diseases [14]. Currently, community-based stroke prevention programs and the use of community health workers are recommended to increase access to medical information and stroke care. Blood pressure controlling campaigns, legislations to protect populations from tobacco and its products, regulation of salt intake, and promotion of physical exercise are some of the strategies for the prevention of stroke [4, 15].

Although stroke is becoming a major public health problem in Ethiopia, there are limited data on its burden, risk factors, and outcomes in Northwest Ethiopia. Hence, the objective of this study was to assess the magnitude, risk factors, and outcomes of stroke in Debre Markos Referral Hospital, Northwest Ethiopia. The findings of this study will be important to identify the possible strategies to reduce the burden of stroke in the country and to inform policymakers for areas of improvement in the care of stroke patients.

Patients and methods

The study was conducted at Debre Markos Referral Hospital which is found 300 km northwest of Addis Ababa, the capital city of Ethiopia. The hospital provides health services to more than 3.5 million populations. It has 140 beds with 152 staff for inpatient and outpatient services. The internal medicine department is one of the departments serving both regular and referral patients for chronic healthcare services. The department can give

services for 88 patients per month with 44 beds. This study was conducted among 162 adult stroke patient records (a 2-year record) from March 2017 to April 2019.

Institution-based retrospective cross-sectional study design was used to conduct this study. All adult stroke patients who had been admitted between March 2017 and April 2019 with the diagnosis of stroke (both clinically and with imaging) in the medical ward of Debre Markos Referral Hospital were included. However, patients' medical charts with incomplete information were excluded.

In this study, different measurement variables and terms were defined. According to the American Heart Association, stroke is defined as a neurological deficit due to the reduction of the blood supply to the brain tissue [16], which leads to several medical and psychiatric complications. In our study, the outcomes of stroke were categorized as dead, improved, referred, left against medical advice, and undetermined. Patients with reduced signs and symptoms as compared with the admission time were categorized as improved. Those who were directed or transferred from one health institution to another for better diagnosis and management were described as referred. Patients who left or were discharged from the hospital with advises and recommendations from the healthcare providers to promote their health were categorized as "left against medical advice," whereas, if the patient presents a dilemma for the physician to determine the outcome, he/she was categorized as undetermined. We defined physical activity as any bodily movement and activities such as walking, sitting, standing, and performing activities of daily living at least for 30 min per day for 3 to 5 days per week. Comorbidity is the co-occurrence of one or more additional diseases with the primary diagnosis. Hypertension, diabetes, and dyslipidemia were ascertained if blood pressure $\geq 140/90$ mmHg [17], fasting plasma glucose level ≥ 126 mg/dl [18], and total cholesterol level of > 2 g/l, LDL > 1.3 g/l, and triglycerides > 1.5 g/l [19], respectively. Moreover, atrial fibrillation was defined as an abnormal irregular heart rhythm characterized by a fast and irregular heart-beat, absence of P waves, and no pattern to R wave occurrence on ECG [20].

The data were extracted using a pretested checklist prepared after reviewing different literature on the related issues [10, 21–26]. Data were collected from the registration logbook of the internal medicine department and patient chart by trained data collectors. The checklist included patient's sociodemographic characteristics, clinical presentation, comorbidities, lifestyle behavior, different outcomes, and other variables. Training was given for data collectors, and a pretest was done on 5% of the sample before the actual data collection. The collected data were checked out for completeness, accuracy,

and clarity. The data collection was supervised to minimize bias that may be introduced during the data collection procedure.

Statistical analysis

The extracted data were entered into a pre-designed template in the Epi-Data version 3.1 software. The data were then exported to the SPSS version 20 software for analysis. Descriptive statistics were performed to describe the frequency and percentage of sociodemographic characteristics and other variables of the sample. A chi-square test was done to test the presence of an association between the independent variables with a type of stroke. A *P* value less than or equal to 0.05 was considered to declare statistically significant association.

Results

A total of 2100 patients were admitted to the medical ward of Debre Markos Referral Hospital from March 2017 to April 2019. Of these, 162 (7.7%) patients were admitted with the diagnosis of stroke. The median age of stroke patients was 60 years (IQR = 45–70). Majority (53.7%) of the study participants were female. Most (69.14%) of the patients were married and 53.7% were rural residents. Additionally, 41.4% of study participants had a history of alcohol intake and about 11.7% were cigarette smokers (Table 1).

Table 1 Sociodemographic and lifestyle characteristics of stroke patients in Debre Markos Referral Hospital, Northwest Ethiopia, 2017–2019

Variables	Categories	Frequency	Percentage
Age (years)	18–39	29	17.9
	40–64	71	43.8
	≥ 65	62	38.3
Sex	Male	75	46.3
	Female	87	53.7
Marital status	Single	11	6.79
	Married	112	69.14
	Divorced	5	3.09
	Widowed	23	14.2
Residence	Separated	11	6.79
	Urban	75	46.3
Life style	Rural	87	53.7
	Alcohol intake	Yes	67
Cigarette smoking	No	95	58.6
	Yes	19	11.7
Physical exercise	No	143	88.3
	Yes	135	83.3
	No	27	16.7

Regarding comorbidities, hypertension was the most common comorbid condition observed in 34.6% of the participants. Diabetes mellitus was observed in 13% of the cases. Additionally, 8% of the study participants had hypertension and diabetes conditions (Table 2).

From all admissions (2100 patients) in the medical ward of DMRH, 162 of them were admitted with the diagnosis of stroke. Accordingly, the magnitude of stroke was 7.7% (95% CI 6.56, 8.84). The most common subtype of stroke was ischemic stroke (50%, *n* = 81), followed by hemorrhagic stroke (30%, *n* = 49), whereas the remaining 20% (*n* = 32) of stroke cases were undetermined (Fig. 1).

There was a significant association between types of stroke and sex of the respondent, presence of comorbid hypertension, and atrial fibrillation as *P* value ≤ 0.05. Patient with comorbid hypertension was more likely to have a hemorrhagic stroke (*P* = 0.001). In addition, dyslipidemia had also significantly associated with the type of stroke (*P* = 0.04) (Table 3).

Regarding the clinical presentations, the majority (67%) of the patients presented with focal neurological deficit followed by coma or altered mental status which accounts for 26.6%. About 8.6% of the cases presented with functional neurological symptoms. However, no symptoms were recorded for 7.4% of cases. Further, infection (23.5%), seizure (14.2%), and intracranial hemorrhage (6.2%) were the most common stroke complications. Regarding the management of stroke, antibiotics and anti-hypertensive medications were the most frequently used drugs prescribed for 44.4% and 36.4% of patients, respectively (Table 4).

Regarding the outcomes, 8.6% (*n* = 14) of stroke patients died in the hospital, whereas 11.7% (*n* = 19) were

Table 2 Comorbidities on stroke patients in Debre Markos Referral Hospital, Northwest Ethiopia, 2017–2019

Types of comorbidity	Response	Frequency	Percentage
Hypertension	Yes	56	34.6
	No	106	65.4
Diabetes	Yes	21	13
	No	141	87
Hypertension and diabetes	Yes	13	8
	No	149	92
Dyslipidemia	Yes	34	21
	No	128	79
Atrial fibrillation	Yes	30	18.5
	No	132	81.5
Pneumonia	Yes	43	26.5
	No	119	73.5

Percentage (%) cannot be 100% because it is based on multiple response questions

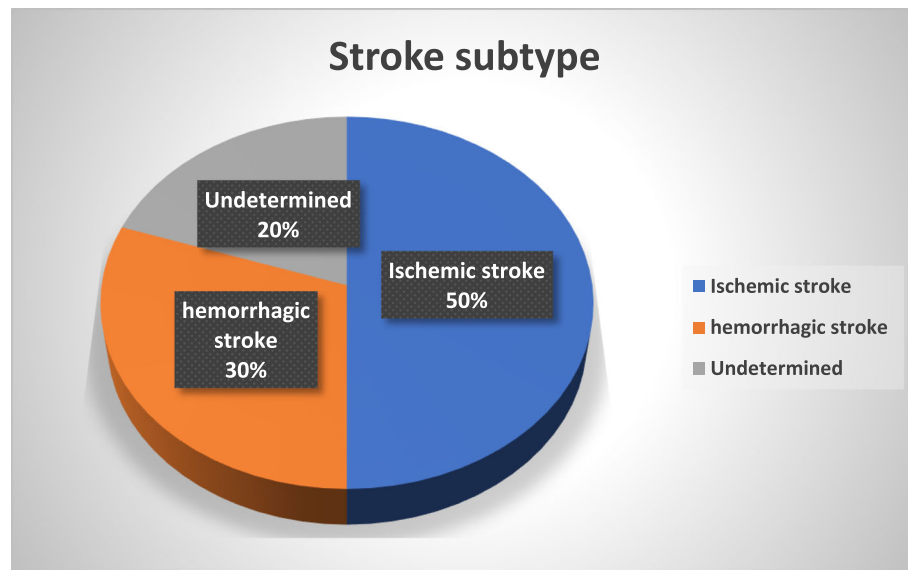


Fig. 1 Distribution on the types of stroke in the medical ward of Debre Markos Referral Hospital, Northwest Ethiopia, 2017–2019

discharged with medical advice. More than one-fourth (27.2%) of stroke patients were discharged with improvement and 39.5% were referred to the next health institution for better management. The official discharge summary was undetermined in the medical chart of 13% ($n = 21$) patients (Fig. 2).

Among all in-hospital deaths, the majority (14.3%) of deaths occurred among hemorrhagic stroke patients. However, the proportion of stroke patients with improvement was higher in ischemic stroke than in the hemorrhagic group (Table 5).

Discussion

Stroke is one of the most common reasons for hospital admission in Ethiopia. For example, about 24% of all neurological admissions are due to stroke [23, 26]. The objective of this study was to describe the magnitude, risk factors, and outcome of stroke patients in Debre Markos Referral Hospital, Northwest Ethiopia. Accordingly, the magnitude of stroke was 7.7% (95% CI 6.56, 8.84). This finding was consistent with a previous study conducted in Ethiopia [24]. However, this prevalence was higher than another hospital-based study conducted in Kenya [27] and lower than another population-based study in China [28]. The difference in the study setting and period could be the reasons for the variation between the studies [10].

In the present study, ischemic stroke (50%) was the commonest type followed by a hemorrhagic stroke. This is in agreement with previous studies [10, 21, 23, 27, 28]. On the contrary, hemorrhagic stroke was the most prevalent subtype in other studies [22, 26, 29]. This discrepancy could be due to an underlying difference in risk

factors [28]. In this study, about 20% of cases were undetermined (neither ischemic nor hemorrhagic) since there was no clearly identified evidence of stroke both clinically and using imaging (CT scan or MRI).

Hypertension was the most commonly observed risk factor in 34.6% of stroke patients, and it was significantly associated with the type of stroke, which is consistent with other hospital-based studies conducted in other African countries [27, 30]. This could be due to poor hypertensive control in sub-Saharan countries [22]. Likewise, other similar studies from Ethiopia have also reported a higher prevalence of comorbid hypertension among stroke patients [11, 21–23, 25, 26]. Further, other comorbid conditions such as hyperlipidemia and atrial fibrillation were significantly associated with the type of stroke. This finding was consistent with a study done in China [28]. Impaired fibrinolysis and increased thrombus formation in the arterial wall can cause atherosclerosis which could be the possible reason for its association with stroke [31]. However, a contradictory finding was reported from India and Egypt where both hyperlipidemia and atrial fibrillation were not significant risk factors for stroke [30, 32]. In this study, the risk of stroke increases among women. The association of female gender with stroke was also observed in a study done in China [33]. Physiological and hormonal mechanisms could be the possible reason for such gender differences [34].

The brain needs a continuous and adequate supply of blood to sustain cell functions. If the blood supply reduced, the functions of brain cells are greatly affected. In ischemic stroke, infarction of brain tissues occurs due to disruption of blood flows to the brain secondary to

Table 3 Association between type of stroke and patient's sociodemographic characteristics in Debre Markos referral hospitals, Northwest Ethiopia, 2017–2019

Variables	Categories	Total, n (%)	Ischemic, n (%)	Hemorrhagic, n (%)	Chi-square test
Age	18–39	29 (17.9)	14 (17.3)	6 (12.2)	$\chi^2 = 0.72$, DF = 2; $P = 0.70$
	40–64	71 (43.8)	32 (39.5)	22 (44.9)	
	≥ 65	62 (38.3)	35 (43.2)	21 (42.9)	
Sex	Male	75 (46.3)	32 (39.5)	29 (59.2)	$\chi^2 = 4.75$, DF = 1; $P = 0.03^*$
	Female	87 (53.7)	49 (60.5)	20 (40.8)	
Marital status	Single	11 (6.79)	5 (6.2)	2 (4.1)	$\chi^2 = 2.10$, DF = 4; $P = 0.72$
	Married	112 (69.14)	54 (66.7)	36 (73.5)	
	Divorced	5 (3.09)	3 (3.7)	2 (4.1)	
	Widowed	23 (14.2)	13 (16)	8 (16.3)	
	Separated	11 (6.79)	6 (7.4)	1 (2)	
Residence	Urban	75 (46.3)	40 (49.4)	24 (49)	$\chi^2 = 0.002$, DF = 1; $P = 0.96$
	Rural	87 (53.7)	41 (50.6)	25 (51)	
Hypertension	Yes	56 (34.6)	14 (17.3)	38 (77.6)	$\chi^2 = 46.2$, DF = 1; $P = 0.001^*$
	No	106 (65.4)	67 (82.7)	11 (22.4)	
Diabetes	Yes	21 (13)	9 (11.1)	6 (12.2)	$\chi^2 = 0.04$, DF = 1; $P = 0.85$
	No	141 (87)	72 (88.9)	43 (87.8)	
Hypertension and diabetes	Yes	13 (8)	9 (11.1)	4 (8.2)	$\chi^2 = 0.30$, DF = 1; $P = 0.56$
	No	149 (92)	72 (88.9)	45 (81.8)	
Dyslipidemia	Yes	34 (21)	26 (32.1)	8 (16.3)	$\chi^2 = 3.93$, DF = 1; $P = 0.04^*$
	No	128 (79)	55 (67.9)	41 (83.7)	
Atrial fibrillation	Yes	30 (18.5)	26 (32.1)	7 (14.3)	$\chi^2 = 5.11$, DF = 1; $P = 0.02^*$
	No	132 (81.5)	59 (72.8)	42 (85.7)	
Pneumonia	Yes	43 (26.5)	22 (27.2)	13 (26.5)	$\chi^2 = 0.01$, DF = 1; $P = 0.94$
	No	119 (73.5)	59 (72.8)	36 (73.5)	
Alcohol intake	Yes	67 (41.4)	31 (38.3)	25 (51)	$\chi^2 = 2.02$, DF = 1; $P = 0.16$
	No	95 (58.6)	50 (61.7)	24 (49)	
Cigarette smoking	Yes	19 (11.7)	13 (16)	6 (12.2)	$\chi^2 = 0.35$, DF = 1; $P = 0.55$
	No	143 (88.3)	68 (84)	43 (87.8)	
Physical exercise	Yes	135 (83.3)	72 (88.9)	39 (79.6)	$\chi^2 = 2.12$, DF = 1; $P = 0.15$
	No	27 (16.7)	9 (11.1)	10 (20.4)	
Patient category	New	119 (73.5)	56 (69.1)	33 (67.3)	$\chi^2 = 0.05$, DF = 1; $P = 0.83$
	Repeat	43 (26.5)	25 (30.9)	16 (32.7)	

*Significant at P value ≤ 0.05

either thrombus or embolus. However, unlike in ischemic stroke, in patients who develop hemorrhagic stroke, the hematoma causes compression of tissue resulting in tissue injury. The clinical manifestations of a stroke depend on the type and areas of brain injury [35, 36]. In the current study, focal neurologic deficit (67.9%) was the most common clinical presentation followed by coma or altered mental status (29.6%). The finding is similar with the study done in a tertiary teaching hospital in northern Ethiopia [21]. In contrast, a higher proportion (61%) of stroke patients were presented with hemiplegia in another study [11]. Besides, loss of

consciousness (48%) and hemiparesis (47%) were the most common clinical presentations in another hospital-based study conducted in Tikur Anbessa Specialised Hospital, Ethiopia [26].

Physicians used different classes of drugs in the management of stroke based on the patient's condition and clinical presentation. Accordingly, antibiotics were the most routinely prescribed class of medication for stroke patients in this study. This can be related to a higher magnitude of infection among the complications in the current study. Moreover, statins and anti-hypertensive were the second and third commonly prescribed drugs,

Table 4 Clinical presentations, complications, and medical treatment of stroke in Debre Markos Referral Hospital, Northwest Ethiopia, 2017–2019

Characteristics	Categories	Frequency (%)
Clinical presentation	Focal neurologic deficit	110 (67.9)
	Coma or altered mental status	48 (29.6)
	Functional neurological disorder	14 (8.6)
	No symptoms recorded	12 (7.4)
Complication	Intracranial hemorrhage	10 (6.2)
	Seizure	23 (14.2)
	Infection	38 (23.5)
	Increased ICP	17 (10.5)
	Aspiration pneumonia	32 (19.8)
	Deep vein thrombosis	19 (11.7)
	Other serious complications	65 (40.1)
Medical treatment	Aspirin	52 (32.1)
	Anti-hypertension (nifedipine, enalapril)	59 (36.4)
	Anti-coagulant (heparin)	37 (22.8)
	Anti-convulsing (diazepam)	17 (10.8)
	Diuretics (furosemide, hydrochlorothiazide)	29 (17.9)
	Statins (atorvastatin, lovastatin, simvastatin)	62 (38.3)
	Antibiotics (ceftriaxone, vancomycin, metronidazole)	72 (44.4)

Percentage (%) cannot be 100% because it is based on multiple response questions

respectively. Anti-hypertensive and statins were prescribed for a higher proportion of patients in other similar studies [21, 25]. Cerebral activators and anticoagulants were the commonly prescribed drugs in a study done in India [37].

In this study, the majority (39.5%) of stroke patients were discharged with improvement, and about 33.3% of stroke patients were referred. The in-hospital case

fatality rate in this study was 8.6%, which is comparable with other studies [38, 39]. The in-hospital case fatality rate from other studies conducted in Ethiopia ranges between 11 and 30.1% [10, 11, 21–23, 25], which is higher than the finding of this study. The lower rate in our study might be due to the lack of diagnostic modalities and expertise. As a result, most patients with stroke were referred early to tertiary hospitals for better

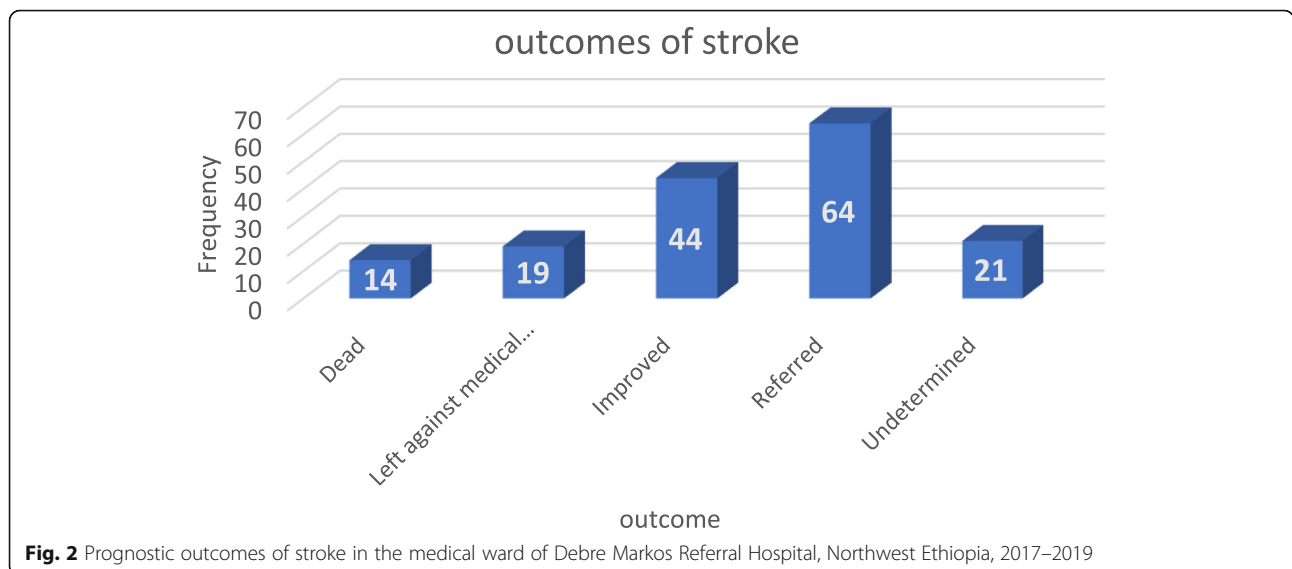


Fig. 2 Prognostic outcomes of stroke in the medical ward of Debre Markos Referral Hospital, Northwest Ethiopia, 2017–2019

Table 5 Outcomes of patients with stroke subtype admitted in the medical ward of Debre Markos Referral Hospital, Northwest Ethiopia, 2017–2019

Outcome of stroke patients	Stroke subtype		
	Ischemic, <i>n</i> (%)	Hemorrhagic, <i>n</i> (%)	Undetermined, <i>n</i> (%)
Dead	6 (7.4)	7 (14.3)	1 (3.1)
Left against medical advice	11 (13.6)	7 (14.3)	1 (3.1)
Improved	32 (39.5)	8 (16.3)	4 (12.5)
Referred	27 (33.3)	24 (49)	13 (40.6)
Undetermined	5 (6.2)	3 (6.1)	13 (40.6)

diagnosis and management. Additionally, it might be due to potentially missed cases that may have died soon after stroke while at home before coming to the hospital. However, in-hospital stroke mortality in our study was higher than reports from China, and Germany, where the overall in-hospital mortality rate was 2.3% and 4.9%, respectively [40, 41]. This disparity may be due to better diagnosis and management of stroke in these developed countries. In addition, in-hospital case fatality was higher among patients with hemorrhagic stroke as compared to ischemic stroke. This is in agreement with the report of other similar studies conducted in Ethiopia [10, 21] and other sub-Saharan African countries [42–44]. On the contrary, a study done in Kenya demonstrated higher in-hospital mortality in the ischemic stroke group [27]. However, no difference in mortality was observed between hemorrhagic and ischemic strokes according to the result of studies done in China [28] and three tertiary hospitals in Zimbabwe [45].

This study has certain strengths and limitations. It provides up-to-date and valuable information regarding the magnitude, risk factors, and outcomes of stroke, which is critical to understand its burden and immense public health impact. Identification of the risk factors, an important component of stroke prevention strategy, enables clinicians to focus on risk factor reduction during their routine stroke care. However, the small number of patients included in this study can be the limitation of this study. Furthermore, the current study was a hospital-based study and it may be difficult to generalize the findings to the community. Therefore, further large-scale community-based studies to assess the magnitude, risk factors, and outcomes of stroke are needed in Ethiopia.

Conclusions

The magnitude of stroke among patients admitted to the medical ward of DMRH, Ethiopia, was 7.7%. Sex (being female), hypertension, hyperlipidemia, and atrial fibrillation were the most commonly identified risk factors that were significantly associated with stroke. Furthermore, the in-hospital stroke case fatality was lower compared with previous studies conducted in other sub-Saharan

African countries. Therefore, the Federal Ministry of Health (FMoH) should design efficient hospital- and community-based stroke prevention strategies and programs to prevent, detect, and control the burden of stroke. Moreover, urgent awareness creation about stroke and its risk factors need to be implemented in the community to prevent important risk factors such as hypertension, hyperlipidemia, and heart diseases. Lastly, a large-scale community-based study is recommended to get the actual percentage of early death cases and to investigate additional risk factors.

Abbreviations

CI: Confidence interval; CT: Computed tomography; DMRH: Debre Markos Referral Hospital; FMoH: Federal Ministry of Health; GBD: Global Burden of Disease; ICP: Intracranial pressure; MRI: Magnetic resonance imaging

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Authors' contributions

HM, AY, NM, and DH have contributed to the design, data collection, data analysis, interpretation, and developing the first draft of the manuscript. GD, GMK, and TDH have contributed to the data interpretation and revision of the final manuscript. All authors read and approved the final draft of the manuscript.

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Availability of data and materials

All the data are available from the corresponding author upon a reasonable request.

Ethics approval and consent to participate

Ethical clearance was obtained from the ethical committee of school of medicine, Debre Markos University, on the 26th of March 2019, but Debre Markos University does not provide the approval reference number. Permission letter was submitted to Debre Markos Referral Hospital to get their willingness. Confidentiality and privacy were maintained by omitting personal identifier of stroke patients during the data extraction procedure.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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