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Predictors of pre-hospital delay among stroke patients in Yekatit-12 hospital Addis Ababa, Ethiopia: unmatched case-control study



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Abstract

Background Timely detection and early medical interventions are critical in reducing complications and mortality related to stroke. The duration from onset to hospital presentation is an essential factor in determining the outcome of stroke treatment. The sooner a stroke patient receives medical attention, the better the chances of preventing long-term complications. Pre-hospitalization delays can significantly decrease the chances of successful therapy and recovery from stroke.

Objective The study aims to assess predictors of delayed hospital presentation after a stroke attack.

Method An unmatched case-control study was conducted from September 2021 to November 2023 at Yekatit 12 Hospital Medical College. Descriptive statistics were used to describe study variables. Bivariable and multivariable logistic regression were used to identify the predictors of delay hospital presentation after stroke attack. All statistical tests were run with a significance threshold of 5%.

Result A total of 83 cases (presenting after four hours) and 166 controls (presenting within four or fewer hours) of an acute stroke patients were included in this study. The median duration of symptoms from the onset of stroke to hospital arrival were 24 h (IQR, 12 h) and 2 h(IQR, 1 h) for cases and controls respectively. The study found that age 60 or less (AOR 1.75, 95% CI 1–3.09, p < 0.05), living outside of Addis Ababa (AOR 3.55, 95% CI 1.33–9.46, p < 0.011), onset of stroke happening at night (AOR 1.75, 95% CI 1.2–3.1, p < 0.05) and not having health insurance (AOR 0.43, 95% CI 0.23–0.8,p < 0.007) were identified as predicting factors of late presentation to hospital in stroke patients.

Conclusion This study highlights key predictors of delayed hospital presentation in stroke patients. Specifically, age, place of residence, health insurance, and stroke onset time were significantly influence the timeliness of seeking medical care. Recognizing and addressing the predicting factors can improve the health care treatment outcome and help to design targeted health policies that reduce barriers to timely presentation of stroke patients.

Ethiopia

Keywords Stroke, Hospital delay, Adult stroke, Cerebrovascular accident, Low resource setting

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Introduction

The World Health Organization (WHO) defines stroke as "a rapidly developing clinical sign of focal or global disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin" [1]. Stroke is a major global cause of death and disability, particularly in older people. Depending on the severity and location of the stroke, individuals may experience paralysis, speech difficulties, memory loss and other long-term disabilities that can significantly impact their quality of life. To reduce stroke damage and enhance recovery chances, early detection and timely interventions are essential [2, 3].

WHO's Global Stroke Factsheet, which was released in 2022, reveals that the risk of having a stroke during one's lifetime has increased by 50% in the last 17 years. Currently, it is estimated that 1 in 4 people will experience a stroke at some point in their lives. Furthermore, stroke is responsible for 86% of deaths and 89% of DALYs (disability-adjusted life years) on a global scale [4]. The study showed 316 stroke cases per 100,000 person-years and 1,460 stroke cases per 100,000 person-years in Africa [4, 5]. From studies conducted in Ethiopia, it has been found that the pooled prevalence of ischemic stroke and hemorrhagic stroke were 51.40% and 46.42% respectively [6]. Moreover, a study done in Ethiopia also found a significant percentage of stroke patients admitted to inpatient wards had poor treatment outcomes [6, 7]. Specifically, the study done in the eastern part of the country found that 59.3% of stroke patients had poor stroke treatment outcomes [7].

In the diagnosis and treatment of many medical illnesses, patient delay is a crucial element. Patient delay describes the interval of time between the onset of symptoms and the first visit to the doctor. Few studies done in developing countries, mainly in India, Pakistan, Bangladesh and Sri Lanka showed that Prehospital delay was the main contributor to delayed initiation of treatments [8]. Moreover, another study showed that physicians faced significant challenges related to environmental, emotional and organization in delivering pre-hospital care [9]. Conversely, the pre-hospital delay in stroke refers to the amount of time that passes between the onset of stroke symptoms or awakening and hospital admission. The duration of prehospital delay is an essential factor in determining the outcome of stroke treatment. The sooner a stroke patient receives medical attention, the better the chances of preventing long-term complications. One of the factors that has been identified as contributing to an increase in stroke morbidity and mortality is late hospital presentation following the commencement of the stroke. The studies shown that a prehospital delay of more than 4 h can have a significant impact on the stroke patient's prognosis and treatment outcome [2, 10, 11].

In cases where patients require thrombolysis and thrombectomy therapy, their chances of benefiting from the treatment increase significantly if they arrive at the hospital within the therapeutic window. This means that prompt medical attention and intervention are crucial in achieving optimal outcomes for such patients [2]. For acute stroke patients who need recanalization therapy, immediate intervention is essential while, delays before hospitalization can drastically reduce the likelihood of successful therapy and recovery more over the extent of the brain damage increases with time, highlighting the importance of immediate evaluation and therapy for individuals suffering acute stroke [11].

While few studies have been conducted in low- and middle-income countries to determine the factors that contribute to delayed presentation in patients with stroke. There is limited data in the study area that accounts for different socio-economic status, access to health care, transportation to the hospital, health insurance, and awareness of stroke symptoms of the patient. These factors could potentially hinder the timely diagnosis and treatment of acute stroke, which is crucial for ensuring better outcomes and reducing the risk of complications [2, 10, 12]. Therefore, this study aimed to identify predictors of delayed arrival at the hospital following a stroke in Ethiopia. To the best of our knowledge, this is the first study conducted in Ethiopia to assess the predictors that contribute to stroke patients' pre-hospital delays. This evaluation is crucial for strengthening and revitalizing current healthcare policies and strategies, reducing the burden of stroke, maximizing treatment outcomes and identifying areas where stroke patient care needs to be improved.

Materials and methods

Study design and study area

The study was conducted at Yekatit 12 Hospital Medical College, which is among the six regional hospitals in Addis Ababa, Ethiopia. The hospital provides service for more than 3,000,000 people living in its catchment area. A retrospective unmatched case-control study design was adopted at the hospital for acute stroke patients who were hospitalized in the adult emergency department between September 2021 and November 2023. The study included all individuals who were at least eighteen years old and had a clinical diagnosis of stroke confirmed by an MRI or CT scan. Participants aged less than 18 years, diagnosed with Transient ischemic attack (TIA) and with incomplete or missing medical information such as, stoke on set time, arrival time, absence of neuroimaging documentation and patients who developed stroke while in hospital were excluded from this study.

Sample size determination

The minimum sample size of the participants required for this study was 210 (70 cases and 140 controls) using Open Epi software by providing all the required information. By assuming a 1:2 ratio of the number of cases to controls (r=2), the proportion of exposure in controls(≤ 4 h) with time of stroke onset was 31.3% (main exposure variable), $Z(1-\alpha/2) = 1.96$ (for two-sided significance test with 0.05 level of significance) and 80% power to detect an odds ratio of 2.6 which was estimated from another study [2]. Accordingly by adding 15% of the nonrespondent rate. Participants were recruited and classified into cases and controls based on their time of arrival for seeking treatment. This classification was determined from the start to the end of the data collection. The final sample size was 249 (83 cases + 166 controls). Cases were consecutively recruited during the study period, the next immediate two correspondent controls were selected by simple random sampling procedures separately from the total list of controls.

Variable of study

The outcome variable of the study was a delay in hospital arrival, defined based on the time interval of presentation at the hospital and time of symptom discovery, among adult acute stroke patients. **Cases** were stroke patients aged \geq 18 years who delayed more than four hours without consulting and presenting the health center following the onset of stroke-related symptoms. **Controls** were patients with similar inclusion criteria as cases except those who sought timely care within four hours onset of symptoms. We used a four-hour cutoff delay on the treatment to classify cases and controls based on a study done in a similar setting in Somalia and India that depicted four hours in delay as a turning point and became critical for the intervention and to improve the treatment outcome [2, 13].

The potential predictor variables were selected by reviewing different literature and scientific reports [8, 9]. For this study, socio-demographic characteristics (i.e., age, sex, marital status and district of residence), clinical factors (i.e., stroke-specific symptoms, patient stroke history, presence of stroke risk factors such as Hypertension, Diabetes Mellitus and Heart diseases), health system factors (place of residency related to tertiary facility, availability of health insurance for medical care, referral system, means of transport used to tertiary health facility) and duration from symptom onset to hospital arrivals were used as predictor variables.

Operational definition

Stroke

Stroke is defined by the WHO as "rapidly developing clinical signs that result in focal or global disturbance of cerebral function, lasting 24 hours or longer, or leading to death with no known cause other than vascular origin [7].

Glasco coma scale (GCS)

The measurement scale used to measure the level of consciousness of patients with stroke. Mild brain injury/ alert, GCS if the patient has GCS between [14–16] or moderate brain injury/Drows between GCS [9–12], and severe brain injury/unconscious if the patient had GCS (≤ 8) [7].

Data collection and analysis

The data collection tools were adopted from different previous peer-reviewed studies [2, 8, 11, 12]. The completeness and consistency of the data were checked. The data were exported into SPSS version 26 for further analysis. Descriptive statistics were run using percentages for categorical data and median with IQR for continuous variables. To measure the association between each of the possible determinants and an outcome of interest, first unadjusted binary logistic regression was used. The p-values resulting from this regression were considered to identify the candidate determinants for the final model. An unadjusted logistic regression in this analysis was computed by considering the outcome of interest and one of the potential predicting factors at a time. Then, any variable having a significant pairwise test at a 25% level of significance was selected as a potential predictor for the final statistical model. For identifying the significant predicting factors, with hospital delay among the selected candidates, a multiple logistic regression model was used. All statistical tests were run with a significance threshold of 5%.

Results

A descriptive study of the participant

In this study, 166 stroke patients arrived at the hospital between 0 and 4 h after the first signs and symptoms of stroke (considered the control group), whereas 83 stroke patients were unable to attend the hospital within 4 h from the onset of symptoms (considered the case group). Table 1, presents the description of the socio-demographic characteristics of patients included in the study. There were 38 (46%) and 88 (53%) female stroke patients among the 166 controls and the 83 cases, respectively. The median age of patients in cases and controls were 59yrs, (43-75 years) and 63yrs (48-78 years) respectively. The majority of the patients in the case group (76%) and the control group (70%) were married. Of the patients in cases and controls admitted to the hospital, 50 (60.2%) and 94 (56.6%) were referred from other medical facilities, while the remaining patients in cases and controls came directly to the hospital. The mode of transportation

Variables		Case: >	Control: ≤	Р	
		4 hr.,	4 hr.,	value	
		n,%	n,%		
Sex	Female	38 (45.8)	88 (53.0)	0.282	
	Male	45 (54.2)	78 (47.0)		
Age	<=60	48 (57.8)	73 (44.0)	0.039	
	>60	35 (42.2)	93 (56.0)		
Marital	Single	12 (14.5)	31 (18.7)	0.055*	
status	Married	63 (75.9)	116 (69.9)		
	Divorced	4 (8)	14 (8.4)		
	Widowed	4 (8)	5 (3.0)		
Health	Yes	32 (38.6)	37 (22.3)	0.007**	
Insurance	No	51 (61.4)	129 (77.7)		
place of living	Addis Ababa	70 (84.3)	158 (95.2)	0.004**	
	Out of AA	13 (15.7)	8 (4.8)		
mode of arrival	Ambulance	36 (43.4)	70 (42.2)	0.856	
	Other ^a	47 (56.6)	96 (57.8)		
referral system	Health institution	50 (60.2)	94 (56.6)	0.586	
	Self	33 (39.8)	72 (43.4)		
stroke time	Day (6 am-6 pm)	43 (51.8)	106 (63.9)	0.05*	
onset	Night (6 pm-6 am)	40 (48.2)	60 (36.1)		

Table patients admitted to Yekatit 12 hospital ical college, addis Ababa, Ethiopia. N control 166, N cases 83.

*: P value < 0.05,**: P value 0.05 – 0.01, a: private or public transport (cars, bus, taxi.) AA: Addis Ababa

Table 2 Common clinical presentation and co-morbidities of case and control among admitted acute stroke patients. N control, 166, N _{cases}, 83.

Variables		Case: > 4 hr. n,%	Control: ≤ 4 hr. <i>n</i> ,%	P value
Body weakness	Yes	74 (89.2)	153 (92.2)	0.430
	No	9 (10.8)	13 (7.8)	
Difficulty in speaking	Yes	57 (68.7)	99 (59.6)	0.165
	No	26 (31.3)	67 (40.4)	
History of seizure	Yes	12 (14.5)	17 (10.2)	0.328
	No	71 (85.5)	149 (89.8)	
GCS	≤8	11 (13.3)	15 (9.0)	0.305
	>8	72 (86.7)	151 (91.0)	
DM	Yes	16 (19.3)	35 (21.1)	0.739
	No	67 (80.7)	131 (78.9)	
HTN	Yes	50 (60.2)	121 (72.9)	0.042*
	No	33 (39.8)	45 (27.1)	
Previous Stroke History	Yes	15 (18.1)	24 (14.5)	0.459
	No	68 (81.9)	142 (85.5)	
Heart disease	Yes	22 (26.5)	33 (19.9)	0.235
	No	61 (73.5)	133 (80.1)	

*: P value < 0.05, DM: diabatic mellites, HTN: Hypertension, GCS: Glasco coma scale

to the hospital is comparable in both case and control, about 36 (43.4%) of the patients in cases and 70 (42.2%) of the patients in controls used an ambulance. Merely 32 patients (38.6%) and 37 patients (22.3%) in the case and control groups used their health insurance to pay for their hospital stays respectively. The time of onset of stroke occurred during the day time were forty-three (51.8%) among cases while it was around 106 (63.9%) among the controls.

The common clinical characteristics of stroke patients in both case and control groups were presented in Table 2. Around one-fifth of cases, 16 (19.3%) and 35 (21.1%) controls had diabetes mellitus, while 50 (60.2%) of patients in the case group and 121 (72.9%) of patients in the control group had hypertension. A history of heart disease was found in 22 (26.5%) of the patients in the case group and 33 (19.9%) of the patients in the control group. On the other hand, a history of previous stroke was observed in 15 (18.1%) and 24 (14.5%) of the patients in the case and control groups respectively. The majority of the patients had body weakness with 74 (89.2%) in the case group and 153 (92.2%) in the control group, while difficulty in speaking was seen in 57 (68.7%) of the patients in cases and 99 (59.6%) of the patients in controls. The median time from the onset of stroke to hospital arrival for the case group was 24 h (IQR, 12 h) compared with 2 h (IQR, 1 h) for the control group.

Predicting factors of delayed in hospital presentation among stroke patients

The overall proportion of cases disaggregated by the different factors included in the final model was presented in Table 3. Bivariable logistic regression was used to assess the potential predicting factors for the outcome variable of the study. Accordingly, Age, place of living, HTN, difficulty of speaking, stork onset time, health insurance and heart failure were selected as candidate predicting factors for hospital delay in stroke patients using a P-value < 0.25. In multivariable logistic regression Age, health insurance, place of living and stroke onset time were the significant predicting factors for delay in hospital presentation of stroke patients. Being age 60 years or younger increased the odds of delayed presentation by almost two times compared with those older than 60 years (AOR 1.75, 95% CI: 1.01–3.09, p<0.05). This study also found that living outside of Addis Ababa increased the likelihood of delayed presentation to the hospital by around four folds (AOR: 3.55, 95% CI: 1.33-9.46, p < 0.011), and the onset of stroke occurring at night increased the risk of delayed presentation by nearly two times (AOR: 1.75, 95% CI: 1.2–3.1, p<0.05). Moreover, patients who covered their medical expenses out of pocket were 57% (AOR 0.43, 95% CI 0.23–0.8 *p* < 0.007) less likely to delay in hospital presentation than those with health insurance. The comorbidities such as HTN and Heart disease were not significantly associated with delay in hospital presentation.

e 1	Socio-demographic characteristics of acute stroke
nts	admitted to Yekatit 12 hospital medical college addis

Variables		Case: >	Control:	COR,95% CI	AOR,
		4 hr.	≤ 4 hr.		95%Cl
		n,%	n,%		
Age	≤60	48 (57.8)	73 (44.0)	1.75	1.75 (1.34–
				(1.03–2.97)	3.09)*
	>60	35 (42.2)	93 (56.0)	1	1
Health	Yes	32 (38.6)	37 (22.3)	1	1
Insurance	No	51 (61.4)	129 (77.7)	0.46	0.43 (0.23–
				(0.26–0.81)	0.8)**
place of	Out	13 (15.7)	8 (4.8)	3.67	3.55 (1.33–
living	AA			(1.45–9.25)	9.46)*
	AA	70 (84.3)	158 (95.2)	1	1
stroke time	Night	40 (48.2)	60 (36.1)	1.64	1.75 (1.20–
onset				(0.96–2.8)	3.10)*
	Day	43 (51.8)	106 (63.9)	1	1
Difficulty of	No	26 (31.3)	67 (40.4)	1	1
speaking	Yes	57 (68.7)	99 (59.6)	0.67	1.23
				(0.38–1.18)	(0.67–2.25)
HTN	No	33 (39.8)	45 (27.1)	1	1
	Yes	50 (60.2)	121 (72.9)	1.77	0.62
				(1.02-3.1)	(0.34–1.14)
Heart	No	61 (73.5)	133 (80.1)	1	1
disease	Yes	22 (26.5)	33 (19.9)	0.69	1.37
				(0.37-1.28)	(0.70-2.69)

Table 3 A multivariable logistic regression analysis for identifying the predicting factors of hospital delay in stroke patients.

* P<0.05, ** P<0.05 – 0.01 AA: Addis Ababa, HTN: hypertension, AOR: adjusted odds ratio, COR: crud odds ratio, CI: confident interval

Discussion

This case-control study examined factors contributing to delayed presentation of acute stroke patients to the hospital, according to the findings of this study age 60 or less, place of living, health insurance, and stroke onset time were significantly associated with late presentation to the hospital.

The median time from onset of stroke to presentation to the hospital for controls was 2 h while it was 24 h for cases. The finding was consistent with the previous study reports [16, 17]. On the contrary, the median time in cases was 24 h which is much longer than the literature reported in south India 5 h [14], Italy 5.4 h [16], Taiwan 5.6 h [10], Pakistan 6 h [18], urban China,15 h [15], Mogadishu Somalia,16 h [2]. This variation may be explained by the difference in the study population, the health-seeking behavior, and the difference in the overall health system and healthcare service delivery across the countries. Several studies conducted in low- and middleincome countries showed that there was a high prevalence of prehospital delay. This indicates that prehospital delay remains a significant challenge in the management of stroke in low-middle-income countries including Ethiopia.

The study indicated that being age 60 or less was significantly associated with a delayed presentation to the hospital. A similar study reports from China and USA showed that elderly patients are more likely to arrive early at the hospital [15, 19]. This might account for the fact that most elderly patients likely had co-morbidities and that having greater prior medical experience made them more likely to seek treatment. In contrast, previous reports from Norway and Taiwan found that old age was associated with late presentation [11, 18]. Another study done in India showed that age has no significant association with hospital delay in stroke patients [20].

The study found that having a stroke attack at night was significantly associated with delayed presentation to the emergency unit. A similar study reports from Mogadishu Somalia, China and another multi-center study done in developed nations showed that night time stroke was significantly associated with late presentation [2, 15, 21]. Similarly a study report from Spain showed that individuals experiencing a stroke at night were seven times less likely to present at the hospital compared with those having a stroke in the daytime [22]. On the contrary, another study showed that the time of onset has no association with the time of hospital presentation [23]. This is due to the fact that getting to health care and transportation at night is challenging. Moreover, a study done in Nepal showed that decentralized emergency services and communication gaps were the main challenges in delivering effective emergency medical services (EMS) in pre-hospital care [22].

The study found that living outside of Addis Ababa increased the likelihood of delayed hospital arrival nearly fourfold compared with patients living in Addis Ababa. This result is in line with previous study reports from South India, Nepal, and Uganda showed that increased distance away from the tertiary hospital is a predictor of pre-hospital delay [14]. However, a study report from China showed no association with place of residence [15]. Anecdotally, poor road infrastructure, such as congested roads, and lack of access to a transport means may cause delays for stroke victims traveling outside of Addis Ababa. According to this study, individuals having health insurance 57% are less likely to present early to the Hospital. This can be explained by delays in obtaining approval from the administration and weak cost coverage from the insurance services might cause hospital delay. On the contrary, another study showed that health insurance has no association with the time of arrival [15]. The study found that comorbidity illnesses such as heart failure and hypertension had no significant association with delayed arrival at the hospital. This result is supported by the previous study report from China [24]. However, a study done in Kampala Uganda showed that patients with comorbid illnesses were less likely to have a pre-hospital delay [25]. This is due to a health education provided to patients in chronic care clinics may enhance

their capacity to recognize stroke symptoms. This study examines several potential factors linked with hospital delay although we acknowledge the limitation of the study in assessing some variables such as the knowledge of stroke symptoms and educational status of the participants because of the retrospective nature and the utilization of secondary data for the study.

Conclusion

According to the study findings, the median time of symptom onset to hospital presentation in cases was 24 h; in contrast, the median time of arrival in controls was 2 h. This study highlights key factors affecting delayed presentation of stroke patients. Specifically, the age of the participants, place of residence, health insurance, and stroke onset time were significantly influence the timeliness of seeking medical care. Recognizing and addressing the predicting factors that can improve the healthcare treatment outcome and guide in desiging of targeted health care policy interventions to address barriers in the timely presentation of stroke patients. Moreover, addressing the modifiable factors through improving healthcare access and avoiding delays in the early hospital entrance of these patients could improve the overall prognosis and survival of stroke.

Abbreviations

 AOR
 Adjusted Odds Ratio

 CI
 Confidence Interval

 COR
 Crud odds Ratio

 DALYs
 Disability-Adjusted Life-Years

 GCS
 Glasgow Coma Scale

 HTN
 Hypertension

 TIA
 Transient Ischemic Attack

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Author contributions

"B.T.M. and D.B.T.: was involved in the conception, design of the research protocol, methodology, supervision, data analysis, data interpretation, drafting of the original and reviewing the manuscript. M.G.A., F.G.G., A.M.D., Y.B.S., F.S.G.: involved in research design, manuscript writing and reviewing and data collection. Z.T.B.: involved in the design of the research protocol, methodology, data analysis, manuscript writing and review. All the authors have read and approved the final version of the manuscript."

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participants

Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee (IHRERC) of Addis Ababa Health Bureau (IRB ref no A/A/H9679/227). Official permission was obtained from Yekatit 12 hospital administration and Medical service. The participants' data was kept confidential, and the study was conducted under the basic principles of ethics. No individual identifier (fully anonymized) data was collected retrospectively from medical charts. Consent from the participants was waved because of the all analyses used anonymized data.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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