BMC Neurology

RESEARCH

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# Missed golden hours of stroke patients at Zweditu Memorial Hospital in Addis Ababa, Ethiopia

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## Abstract

**Background** Seeking medical attention promptly after an acute stroke is essential for effective treatment and improved patient outcomes. However, delayed medical intervention after acute stroke contributes to increased mortality and morbidity. This study explored factors that contribute to the delayed appearance of stroke patients at the emergency department.

**Methods** A prospective cross-sectional study was conducted for 9 months at a referral hospital in Addis Ababa. Data was collected using questionnaires administered to stroke patients or their caregivers upon their arrival at the emergency department. Electronic medical records were further reviewed, and the treating physicians described the subsequent management of the patient after their arrival at the emergency department. Data was analyzed using descriptive and analytic parameters.

**Results** Only 33.3% (n = 30) arrived at the emergency department within 4.5 h. Hemorrhagic stroke was a statistically significant predictor of early presentation to the emergency department (OR = 3.182; 95% CI (1.258–8.046); p = 0.036). The absence of any substance was another marginally significant predictor for early appearance (OR = 2.555; 95% (0.936–6.970); p = 0.067). One of the marginally significant predictors for late presentation was low drug adherence (OR = 0.224; 95% CI (0.48–1.044); p = 0.057). The other factors attributed to the time of arrival, though not statistically significant, were level of education, perception of stroke as a serious illness, and prior number of health visits before arrival to the emergency department.

**Conclusion** The study found that many of the factors that cause delays in getting to the hospital can be changed, except for the type of stroke. Time spent in the hospital could also be positively impacted by the intervention from the appropriate authorities.

**Keywords** Stroke, Delayed appearance, Emergency department, Addis Ababa, Ethiopia

## Introduction

The Global Burden of Disease Study for 2019 reveals that stroke is the second most common cause of death worldwide and the third leading cause of premature death and disability when measured in terms of Disability Adjusted Life Years [1]. Africa is becoming burdened by stroke disproportionately due to population growth, poor and underdeveloped healthcare systems, unchecked industrialization, and the increased adoption of Western diets [2–4]. In Ethiopia, stroke is a frequent cause of mortality and morbidity. It is the most common neurological condition seen in patients admitted to general hospitals in Ethiopia. Cerebrovascular accident (CVA) was

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reported to account for 23.6% of all neurological admissions in Tikur Anbessa Specialized Hospital (TASH) [5]. According to different studies conducted in Ethiopia, the majority of strokes were due to hemorrhage compared to strokes due to arterial blockage [5]. This is unusually opposite to most of the literature, which showed that ischemic stroke is the most common. Despite the availability of some studies on stroke done in Ethiopia, there is still limited information available about the epidemiology of stroke and its prevalence in population-based studies. Africa is facing this global burden with a lot of health system gaps and without comprehensive data on the patterns and magnitude of the barriers to timely presentation and management. Significant delays during the prehospital or in-hospital phases of care, augmented by insufficient management of cases in the country, are also making the prognosis of stroke patients very poor [6]. While most hospitals in Addis Ababa do not currently have the capacity for thrombolysis and lack CT scans (Computed tomography) in the hospital compound (except Tikur Anbessa and some private centers), in other developing countries, despite its availability, there are still low rates of stroke thrombolysis [7]. This is mainly because of time delays in patient presentation to the hospital, as well as in-hospital delays such as protracted times in obtaining a CT scan. Without addressing these crucial limiting factors, first and foremost, establishing stroke centers with expensive therapy will be wasting the limited resources of the country. In general, both patient- and system-related factors play a major role in shaping patient timely arrival and medical intervention [8]. To the best of our knowledge, we did not get any comprehensive publications in Ethiopia that focus on the factors associated with delayed presentation and delays in emergency departments on acutely presenting stroke patients. We, therefore, sought to evaluate these factors associated with delays in prehospital and in-hospital settings. This study can be used by policymakers and stakeholders as an input. It will help in management strategy and prevention measures. It will improve care and decrease mortality. It will contribute to literature provision. It will recommend strategies on how to improve patient factors, utilize prehospital care, and improve the referral process to shorten the time of arrival to the ED (Emeregncy department) and improve CT scan usage.

## Methods

A prospective cross-sectional study was conducted at a single-center tertiary hospital in Addis Ababa, namely Zewditu Referral Hospital. Permission to conduct the study was granted by institutional ethical committees from both Zewditu Hospital and the Addis Ababa University emergency department. Informed consent was taken from caregivers and patients who were diagnosed with acute stroke. Patients aged 18 years or older with a clinical diagnosis of acute stroke or a CT-confirmed stroke were included. The patients and their caregivers were treated as a unit. The exclusion criteria were patients who died before evaluation or within 24 h; patients without imaging; if the initial assessment or diagnosis of stroke was later changed; and lack of specification of time of onset. Data was collected for a period of 9 months from June to March 2023 G.C. The caregivers and patients were identified and approached during their arrival at the emergency department. The questionnaire was completed regarding the sociodemographic, participants' knowledge of stroke symptoms, and the time taken to get the patient to health care facilities. Information was also extracted from the electronic medical records review about the events on arrival. Further information about subsequent imaging and management was also elicited from the treating ED physician. The confirmation of stroke diagnosis was made by clinical and CT readings either from the emergency physician or radiologist. The questionnaire is uploaded in the supplimentary file. Data was entered into SPSS for analysis. Missing data was treated as missing during analysis. Data was analyzed for means and frequencies. Odds ratios were computed for factors associated with hospital arrival time according to early ($\leq$ 4.5 h) or late (> 4.5 h) hospital presentation. Determination of the independent predictors of early presentation was performed using a logistic regression model. Explanatory variables, which were identified by univariate analysis at $P < 0.2$, were selected and entered into a binary logistic regression model to identify predictors of early arrival. All the statistical analyses were performed using SPSS 21.

## Results

### Patient selection

Patient selection During the study period, 104 patients arrived at the emergency department (ED) with stroke. Of the 104 stroke patients, 90 patients were included; 4 patients were excluded because a diagnosis of death on arrival was made, and 4 patients were excluded as they presented with a history of trauma. Likewise, 3 patients were found to have other diagnoses and were thus excluded. No history was found in 3 patients (Fig. 1).

### Socio-demographic characteristics

A total of 90 patients during the study period were reviewed and analyzed for evaluation of factors associated with delayed appearance in stroke patients. Among them, 53 (58.9%) were male, and around one-third (35.6%) of the patients had never attended formal education. Most of the patients were married (n =63,73.3).

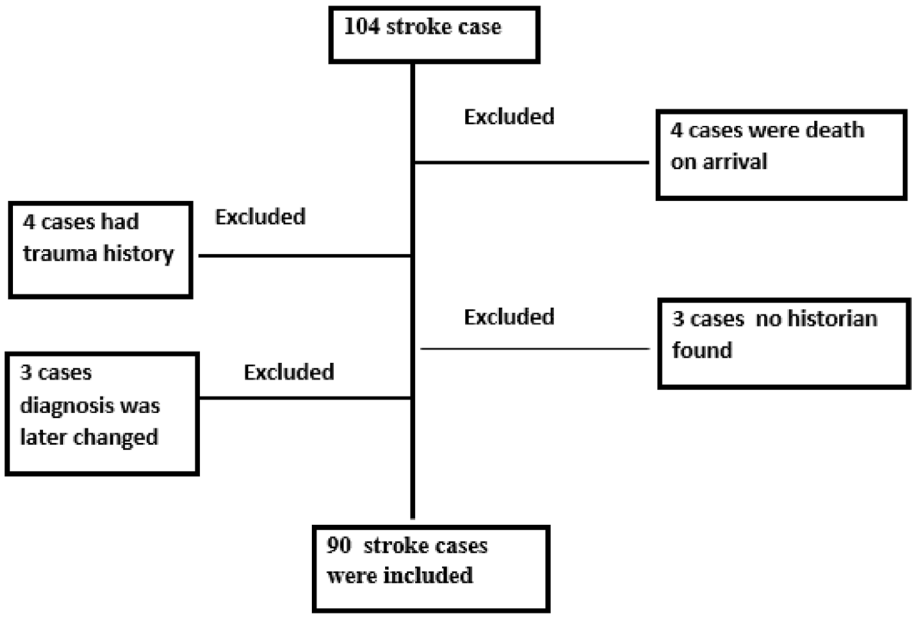


**Fig. 1** Selection process of stroke cases for study inclusion

The mean age of the study population was 58.44; 95% CI (55.45 to 61.67). A great portion of the patients live with either their family members (n = 52, 57.8%) or with their spouse (n = 22, 24.4%), and 12 (13.3%) of them live alone. Further results are detailed in Table 1.

#### Knowledge of stroke among patients/caregivers (n = 88)

Fifty-seven percent of the participants have no idea regarding risk factors for the possible causes of stroke (n = 50). Twenty-nine percent mentioned hypertension as the major risk factor. Thirty-six percent of the participants reported that they were able to recognize the symptoms of stroke by responding yes or no to a question on their ability to recognize the stroke symptoms. Forty-six percent perceived the stroke illness as being serious. The major source of knowledge about stroke was from a health professional. Table 2 provides further details on participants'knowledge regarding stroke.

#### Clinical profile and diagnosis

During the initial evaluation, patients presented with a wide variety of signs and symptoms, with the majority of them ($n$ = 70, 78%) presenting with hemiparesis as a chief complaint The major risk factor identified was hypertension ($n$ = 51, 56.7%). A large number of patients were without any identifiable risk factors ($n$ = 18, 21%). A large proportion of patients with hypertension were newly diagnosed. Few patients knew about their recent blood pressure status ($n$ = 7; 10.8%). All patients underwent CT scans, and the diagnosis of stroke was confirmed clinically and radiologically. Among the patients during the study period, 45 (50%) experienced an ischemic stroke, while 42 (46.7%) had a hemorrhagic stroke. In 75 (85.2%) patients, it was a first-time stroke event, whereas 13 (14.8%) patients suffered from recurrent stroke. The mean systolic blood pressure and diastolic pressure were 162.1 (SD 32.8) and 93.3 (SD 22.17), respectively. Table 3 provides a comprehensive overview of the remaining clinical profile findings.

#### Time intervals

##### *The referral process and the delays*

The median time to visit the first health facility after symptom onset was 2.3 h (IOR; 10). The majority of the patients experienced the symptoms while being at home and in the daytime (88.9% (n = 80) and 73.3% (n = 63), respectively). The most common reasons for delay at home were being alone and lack of readily available transport. After the onset of signs and symptoms, forty-eight (53.3%) patients initially visited a health center, 17 (18.9%) visited a private medium clinic, and 16 (17.8%) directly came to Zewditu Memorial Hospital. The most common utilized mode of transportation during initial health visits was a ride (private taxi), with 46 (51.1%) of patients using this method for their first health institution visit; only 6 patients used ambulances in their first health institution visit. 60 (66.7%) had visited one health institution before coming to ZMH and 15 (16.7%) had two center visits. Sixty patients (80.5%) came by ambulance during referral from another health

**Table 1** Sociodemographic characteristics of patients with stroke ($N = 90$)

| Demographic characteristics | Frequency (%) |
|---|---|
| Gender | |
| Male | 53 (58.9%) |
| Female | 37 (41.1%) |
| Marital Status | |
| Married | 66 (73.3%) |
| Divorced | 6 (6.7%) |
| Widowed | 11 (1 2.2%) |
| Never married | 7 (7.8%) |
| Living condition | |
| Alone | 12 (13.3%) |
| Spouse | 22 (24.4%) |
| Family member | 52 (57.8%) |
| Friends | 2 (2.2%) |
| Charity organization | 1 (1.1%) |
| Prison | 1 (1.1%) |
| Educational level | |
| No formal Education | 32 (35.6%) |
| Primary Education | 23 (25.6%) |
| Secondary Education | 26 (28.9%) |
| Graduate | 8 (8.9%) |
| Postgraduate | 1 (1.1%) |
| Occupational Status | |
| No work | 43 (47.8%) |
| Retired | 15 (1 6.7%) |
| Employed | 26 (28.9%) |
| Self-employed | 6 (6.7%) |
| Income Source | |
| Family | 46 (51 0.1%) |
| Self | 35 (38.9%) |
| AID | 1 (1.1%) |
| Prisoner | 1 (1.1%) |
| Pension | 5 (5.6%) |
| Husband | 2 (2.2%) |
| Community health insurance | |
| Yes | 46 (51 0.1%) |
| No | 44 (48.9%) |

**Table 2** Knowledge about stroke symptoms among patients/caregivers

| | Frequency (%) |
|---|---|
| Was Stroke Considered | |
| Yes | 33 (36.7%) |
| No | 55 (61.1%) |
| System | 2 (2.2%) |
| Ability to recognize stroke symptoms | |
| Yes | 32 (35.6%) |
| No | 57 (63.3%) |
| Missing | 1 (1.1%) |
| Perception Of Stroke Being as Serious | |
| Yes | 41 (45.6%) |
| No | 48 (53.3%) |
| Missing | 1 (1.1%) |
| Source of knowledge about stroke | |
| Community | 11 (12.2%) |
| Health Professional | 72 (80%) |
| Never Heard of It | 5 (5.6%) |
| Missing | 2 (2.2%) |
| Perceived Cause of Stroke | |
| Diabetes | 3 (3.3%) |
| Hypertension | 26 (28.9%) |
| Old Age | 1 (1.1%) |
| Clot | 7 (7.8%) |
| No Idea | 50 (55.6%) |
| Devil | 3 (3.3%) |

care facility.61 (79.2%) of the patients were told it was urgent. The majority of the patients, 64 (83.1%), were referred due to a lack of treatment in the institution they visited. From the patients who were referred from other health care facilities, 43 (59.5%) came delayed due to delay in the referral process, 12 (16.7%) were waiting for ambulances, 11 (15.3%) were due to multiple health care facility visits, 3 (4.2%) were due to their location outside Addis Ababa, 2 (2.8%) were not referred, and 1 (1.4%) were due to misdiagnosis. Table 4 provides a summary of the key findings.

#### *Appearance and evaluation time at the emergency department*

The median time from symptom onset to Zewditu ED presentation was 7 h (IOR; 10). Only 33.3% (n = 30) arrived within the time frame of thrombolytic administration (4.5 h). The longest delay was seen between the symptom onset and the first health facility visit. After arrival at the emergency department, all patients were evaluated by emergency residents, and the median time to evaluation was found to be 10 min (IOR; 20). (Described further in Table 5).

All patients were imaged with CT SCAN at private centers located outside of the hospital compound. The mean time to CT SCAN after arrival at the hospital was estimated to be 3.68 h (SD;3.63). (Described further in Table 5). The commonest reason for the delayed time to CT scan was the extended waiting time for the arrival of transportation mode to take patients to the imaging center. Only one patient's CT scan arrived within 25 min. None of the patients in the study received thrombolysis.

**Table 3** Clinical profile

| Characteristics | Frequency (%) |
|---|---|
| Underlying illness | |
| Hypertension | 51 (56.7%) |
| Diabetes | 3 (3.3%) |
| Cardiac | 4 (4.4%) |
| No Known Illness | 18 (20%) |
| Hypertension and Diabetes | 10 (11.1%) |
| Hypertension And Cardiac | 3 (3.3%) |
| Hypertension And HIV | 1 (1.1%) |
| Follow Up Status | |
| Yes | 34 (37.8%) |
| No | 23 (25.6%) |
| New | 33 (36.7%) |
| Drug Adherence Level | |
| Low | 15 (16.7%) |
| Medium | 6 (6.7%) |
| High | 26 (28.9%) |
| Not On Medication | 42 (46.7%) |
| Missing | 1 (1.1%) |
| Substance Use | |
| Chews Chat | 1 (1.1%) |
| Smoking | 6 (6.7%) |
| Alcohol | 3 (3.3%) |
| No | 73 (81.1%) |
| Chat, Smoking and Alcohol | 4 (4.4%) |
| Missing | 3 (3.3%) |
| Where Did the Symptoms Appear First | |
| Home | 80 (88.9%) |
| Workplace | 5 (5.6%) |
| Street | 2 (2.2%) |
| Prison | 2 (2.2%) |
| Missing | 1 (1.1%) |
| The Type Of Stroke | |
| Ischemic | 45 (50%) |
| Hemorrhagic | 42 (46.7%) |
| Missing | 3 (3.3%) |
| Was It the First Time | |
| First Time | 75 (83.3%) |
| Recurrent | 13 (14.4%) |
| Missing | 2 (2.2%) |
| Chief Complaint | |
| Hemiparesis | 70 (77.8%) |
| Failure To Communicate | 4 (4.4%) |
| Gait Abnormality | 1 (1.1%) |
| Headache | 1 (1.1%) |
| Missing | 3(3.3%) |
| Loss of consciousness | 6 (6.7%) |
| Seizure | 5 (5.6%) |

The biggest barrier was that patients arrived at the hospital after the thrombolysis window period and were therefore not eligible.

### Factors associated with delayed presentation to the emergency department

The shortest time to present to ED was 0.3 h, and the longest time to present to the hospital was 144 h. Hemorrhagic stroke was a statistically significant predictor of early presentation to the emergency department (OR = 3.182; 95% CI (1.258–8.046); p = 0.036). Absence of any substance use was another marginally significant predictor for Early appearance (OR = 2.555; 95% CI (0.936–6.970); p = 0.067). One of the marginally significant predictors for late presentation was low drug adherence (OR = 0.224; 95% CI (0.48–1.044); p = 0.057). The other factors attributed to the time of arrival, though not statistically significant were level of education, perception of stroke as a serious illness and prior number of health visits before arrival to the emergency department (Table 6).

## Discussion

The results of our study suggest that there is considerable pre-hospital delay among patients with acute stroke. Only 30 patients arrived within four and a half hours. More than half of the patients and caregivers were unaware of the possible risk factors for stroke, and the majority of patients failed to identify stroke symptoms. The perception of stroke as a serious illness was correlated with earlier arrival at the hospital. Other factors found to shorten the time of arrival, though not statistically significant, included the absence of current substance use and higher levels of education. Conversely, multiple health visits and low drug adherence were observed to delay the time of arrival. Only hemorrhagic stroke was a statistically significant predictor of early arrival.

The incidence of stroke amongst male patients is higher in our study; this was also reflected in other studies from China, Nigeria, Australia, England, and India [9–13]. In contrast, many of the studies showed female preponderance [7]. There is no clear explanation for this phenomenon. The median stroke age was similar to the other studies done elsewhere [7, 14]. Many of the findings from different studies led to the conclusion that stroke can no longer be considered a disease of the elderly since the burden of stroke is becoming higher in those age groups below 65. More than half of patients were married and lived with family members and spouses, which doesn't contribute to the early arrival of patients to the emergency department; similarly, being alone was not found to be a predictor of late arrival, contrary to different studies [10, 15–17].

**Table 4** The Stroke Events

| | Frequency (%) |
|---|---|
| First health facility visits | |
| Private medium clinic | 17 (18.9%) |
| Health Centre | 48 (53.3%) |
| Private Hospital | 7 (7.8%) |
| Directly to zewidtu | 16 (17.8%) |
| Organization clinic | 1 (1.1%) |
| Missing | 1 (1.1%) |
| Mode of transportation to the first health facility visit | |
| Private car | 22 (24.4%) |
| Public transport | 12 (13.3%) |
| Ambulance | 6 (6.7%) |
| Ride(private taxi) | 46 (51.1%) |
| Supported | 2 (2.2%) |
| Walking | 1 (1.1%) |
| Missing | 1 (1.1%) |
| Number Of health facility visits before arrival at Zewditu Hospital | |
| Zero | 14 (15.6%) |
| One | 60 (66.7%) |
| Two | 15 (6.7%) |
| Missing | 1 (1.1%) |
| Mode Of transportation on the referral Process | |
| Walking | 3 (3.3%) |
| Ambulance | 62 (68.9%) |
| PublicTaxi | 3 (3.3%) |
| Private car | 6 (6.7%) |
| Ride(private taxi) | 3 (3.3%) |
| Missing | 13 (14.4%) |

More than ninety percent of patients/caregivers attended their highest education below the secondary level. Taking this into account, the majority of the participants had no idea about the possible risk factors, and almost more than half of the patients were unable to reply correctly to the knowledge assessment section. Our findings resemble closely other studies. In Nigeria, Philip-Ephraim1 found that more than half of their participants did not know stroke symptoms [10]. Williams et al. found that 75% of stroke patients could not accurately identify their symptoms as stroke. Poor identification of stroke symptoms in developing countries, not regarding symptoms as serious due to lack of knowledge, was another reason for delay by patients [18]. In our study, despite most participants' low level of knowledge of stroke symptoms, only the perception of stroke as a serious illness, though not statistically significant, was correlated with the early appearance of stroke patients (p-value $<0.2$). Other knowledge assessments were not shown to contribute to the time of presentation to the emergency department.

There was an unusually high number of patients without any identifiable risk factors. A significant number of patients with stroke in this study were recently diagnosed with hypertension, and most were unaware of their recent blood pressure measurements. Even for the diagnosed patients, the follow-up and measurement were inadequate. However, none of these findings were related to the time of appearance to the ED. Low drug adherence was a marginally significant predictor of late presentation. Although previous research related to stroke has not yielded similar results, a meta-analysis by Lin et al. on coronary artery disease concluded that patients with lower drug adherence to their medication had a higher rate of emergency visits (A meta-analysis by Lin et al.). This conclusion might not seem congruent with our research, but the proposed explanation sounds acceptable to our findings. A higher rate of stroke occurrence, the unpredictability of stroke symptoms, and a lack of support systems among patients with low drug adherence sound like suitable explanations for their delayed appearance. Likewise, despite no similar finding done elsewhere, the absence of any kind of current substance use was also another marginally significant predictor of early arrival to the emergency department. Patients with substance use disorders may ignore symptoms or delay seeking medical attention

**Table 5** Time interval/delays

| Time Intervals | Mean; SD | Median; IOR | Min;Max |
|---|---|---|---|
| From Symptom onset to first health facility | 9.96 h;19.98 | 2.3;10 | (0.1 h –144 h) |
| The referral time | 7.56 h;16.94 | 2.0;4.475 | (0.0–96 h) |
| Total time from symptom onset to hospital arrival | 15.27 h;19.86 | 7.0;15 | (0.30–0.99 h) |
| Time to CT SCAN After hospital arrival | 3.68 h;3.63 | 3.0;2.0 | (0.16–24 h) |
| Time to evaluation After hospital arrival | 18.3 min;18 | 10;20 | (5–120 min) |
| Time to thrombolytic | ––- | ––– | ––––– |

*SD* Standard deviation, *IOR* Interquartile range

**Table 6** Factors Contributing to the Hospital Arrival time after the symptom onset

| Factors | | Time to Hospital Presentation | | | | |
|---|---|---|---|---|---|---|
| | | Early | | Late | | |
| | | (≤ 4.5 h) | (> 4.5 h) | COR95%CI | AOR 95%CI | P-Value |
| Type of Stroke | Ischemic | 20 | 35 | Reference | Reference | 0.036 |
| | Haemorrhagic | 10 | 22 | 3.182(1.258–8.046) | 3.350(1.079–10.396) | |
| Level of Education | No Education | 8 | 24 | Reference | Reference | |
| | Primary | 8 | 15 | 1.617(0.495–5.172) | 0.894(0.211–3.783) | 0.880 |
| | Secondary | 9 | 17 | 1.588(0.509–4.952) | 1.246(0.305–5.094) | 0.760 |
| | Graduate | 5 | 4 | 3.00(0.606–14.864) | 1.867(0.313–11.139) | 0.494 |
| Drug Adherence | High | 9 | 17 | Reference | Reference | |
| | Medium | 6 | 0 | 0.353(0.095–1.310) | 0.675(0.133–3.410) | 0.634 |
| | Low | 6 | 9 | 0.237(0.068–0.818) | 0.224(0.48–1.044) | 0.057 |
| | Not on Medication | 11 | 31 | 0.000 | 0.000 | 0.999 |
| Perception of stroke as serious Illness | Yes | 17 | 24 | Reference | Reference | |
| | No | 13 | 35 | 0.524(0.215–1.276) | 0.849(0.583-`1.237) | 0.395 |
| Number health visit | < Two | 27 | 47 | Reference | Reference | |
| | ≥ Two | 3 | 12 | 0.402(0.105–1.537) | 0.287(0.055–1.487) | 0.137 |
| Any substance uses | Yes | 7 | 10 | Reference | Reference | 0.067 |
| | NO | 23 | 50 | 1.725(0.572–5.20 | 2.555(0.0.9366.970) | |

*AOR* Adjusted Odds ratio, *COR* Crudes Odds ratio, *CI* Confidence Interval

due to comorbidities This could be comprehended similarly as explained earlier for the low drug adherence finding. The striking finding of our study was that hemorrhagic stroke was a statistically significant factor for early appearance in the emergency department within the time frame. Compared to ischemic strokes, hemorrhagic strokes are three times more likely to present earlier to the ED. Plenty of studies support our findings with adequate explanations. Hemorrhagic strokes often have a more sudden and dramatic onset with more severe neurologic symptoms like severe headache, loss of consciousness, and paralysis. This will typically require immediate medical attention. Despite the earlier presentation of hemorrhagic stroke patients, there is no place for thrombolysis. Unfortunately, this variable is not possible to influence and bring patients within the time frame. The most common presenting symptom was hemiparesis. These are the most common and easily identifiable stroke symptoms [5–8]. In this study, these factors were not necessarily associated with early presentation, in contrast to a study conducted by Gargano et al. [20]. Contrary to many studies, any other clinical presentations in our study, mentioned in the result section, were also not found to be associated with time of appearance.

**The delays**

Considering the concept that "time is brain," these patients should have the acute treatment option with IV thrombolytic, and other supportive care measures are also available in the country for stroke victims, including airway management, blood pressure control, to address dehydration, hypoxia, hyperglycemia, extreme hypertension, antiplatelet therapy, anticoagulation, and neurosurgical decompression for increased intracranial pressure, all of which can reduce the severity of long-term disability from stroke. The contraindication for thrombolytic therapy was high because the average delay in time of presentation to the hospital was more than the intended window period in our study setting. In our study, the delay to ED presentation was observed in a sequence of delays compounded in two stages, which were from the symptom onset to the first health facility and subsequent delay after the first health visit to hospital arrival (the referral delay). These factors were also assessed as patient/caregiver and system-related. Our study also touched on some of the factors hindering the timely initiation of management in hospital settings. The median time elapsed between the onset of stroke symptoms and the arrival to the study hospital was 7 h (IOR: 15 h), which is earlier as compared to studies in Jimma (Ethiopia) 27 h

[6], Gambia 8 h, Brazil 12.9 h, Libya 12 h, and Senegal 2 days [21–24]. Thirty patients (33.3%) came within 4.5 h, and our presentation time almost parallels middle-income and developed countries like China (25%), England (< 3 h presentation rate of 39.5%), and Australia (31.3% presenting within 4.5 h) [9, 11, 12]. Though the sample size in our study is smaller compared to the earlier studies, the patterns observed in the event of stroke symptoms in this study have nearly similar resemblances among the study population. More than seventy percent of patients' stroke symptoms occur during the day and at home, where the longest and first stage of the delay occurs. The median time to visit the first health facility after the onset of stroke was 2.3 h (IOR; 10). The most common reason for delay at home was being alone at the time of the event. The findings from Ali M. Al Khathaami showed living alone and lack of assistance were a statistically significant predictors of late arrival to the hospital [19]. Another second common reason for delay at home was the lack of readily available transport for stroke victims. Half of the participants' mode of transportation utilized at this stage was a private taxi (Ride). Only six used ambulances on the way from home to the first health facility visit. Different studies in developing countries showed similar gaps in the accessibility of ambulances and a lack of readily available transportation. [8, 13, 15, 16]. Ethiopian emergency medical services in the prehospital setting are poorly functioning [25]. For this reason, direct access to a public ambulance by stroke victims has been a luxury, with only a few private sector providers offering this service. The second stage of delay occurred after the first health facility visit and during the referral process to our study hospital. More than fifty percent of first health facility visits were to health centers (give an operational definition of a health center), followed by a direct visit to our study hospital (17.8%). Most health centers and other health facilities in the country don't have the capacity and resources to provide care for stroke victims. Failure to refer early was one of the common reasons for the second-stage delay. Another point worth mentioning is that seventeen percent of patients have multiple health facility visits (≥ two). It was one of the statistical predictors, though not significant, of late arrival at the hospital (P = 0.137). In Ethiopia, one study showed the most common reason for delayed arrival to the hospital was delayed referral [8]. Other studies reflected similar findings. In Nigeria, being referred from other facilities was significantly associated with late presentation to the hospital (P value −0.001) [10]. On the contrary, direct visits to hospitals were significantly associated with arrival within 3 h (P-value < 0.001) [10, 26]. Direct visits from symptom onset to stroke-treating centers with a well-functioning EMS system seem to alleviate this limitation. Despite the limitations at this stage, ambulance utilization by the referring center was encouraging and outstanding. Eighty percent of stroke patients arrived by public ambulance at our study hospital. This is contrary to numerous studies reporting that only a small number of patients arrived at the hospital by ambulance [8, 13, 15, 16].

### In-hospital delays

A median time to evaluation of 10 min with an IQR of 20 min is a positive indicator of efficient triage in the ED. However, further analysis and comparison to benchmarks are necessary to identify areas for improvement and ensure optimal patient care. The reliance on private imaging centers located outside the hospital compound may have contributed to the significant delays in obtaining a CT scan. The lack of efficient transportation options to and from the imaging centers created a bottleneck in the patient care process. The location of private imaging centers may be less convenient for patients, and coordinating care between the hospital and private imaging centers can be challenging, potentially leading to delays and inefficiencies. None of the patients in the study were given thrombolysis. The main reason for this was that the patients arrived at the hospital too late after having a stroke. As a result, they were no longer eligible to receive the treatment.

## Conclusion

One of the biggest problems for stroke patients is the delay in getting them to the hospital. Early arrival can lead to better outcomes because patients might be able to receive appropriate treatment. However, only 33.3% of the patients in this study arrived within the time frame of thrombolytic administration. The need to transport stroke patients to external private imaging facilities introduced significant logistical burden leading to delays in CT scan acquisition. The study found that many of the factors that cause delays in getting to the hospital can be changed, except for the type of stroke. Time spent in the hospital could also be positively impacted by the intervention from the appropriate authorities.

## Recommendation

Multi-center studies investigating the factors that hinder timely presentation in patients with strokes are recommended. Additionally, further research focusing on in-hospital delays and timely treatment is a promising

area for future exploration. To promote timely stroke intervention, it is recommended to implement widespread public awareness campaigns, including those employing the Face, Arms, Speech, Time (FAST) mnemonic, to highlight the urgent necessity of immediate hospital transport upon the recognition of stroke symptoms. We also recommend that the hospital establish on-site CT scan facilities. This will substantially reduce the time from patient arrival to diagnostic CT scan, facilitating quicker diagnosis and treatment.

## Limitations and strengths of the study

The strength of this study lies in its prospective analysis of a relatively large dataset collected over an extended period from one of Addis Ababa's largest tertiary hospitals. Moreover, it is one of the few reports on this topic within the country. However, the study has certain limitations that must be acknowledged. Being conducted at a single institution in the capital city, our findings may not accurately represent the experiences of stroke patients in other hospitals or rural areas. These limitations should be carefully considered when interpreting the study results.

### Abbreviations

| | |
|---|---|
| ED | Emergency Department |
| ZMH | Zewditu Memorial Hospital |
| AHA/ASA | American Heart Association/American Stroke Association. |
| ICH | Intracerebral hemorrhage |
| TASH | Tikur Anbessa Specialized Hospital |
| ICP | Intracranial pressure |
| GCS | Glasgow Coma |

### Acknowledgements

We would like to thank Professor Aklilu for their relentless motivation throughout the research process and A special thanks to Ms. Eden for her significant contributions to the preparation of the tables and figures.

### Data collection format

The questionnaire was developed for this study and uploaded in the supplementary file.

### Authors' contributions

R.S- served as the principal investigator of this study. He was responsible for developing the proposal, conceptual framework, and data collection tools before the study commenced. During the study, he conducted data collection, performed data analysis, and wrote the majority of the manuscript. He also prepared the tables for the publication T.T-was involved in this study from its inception, contributing to the development of the proposal. He actively participated in data collection and analysis and provided significant assistance with the writing of this manuscript, particularly the results section. M.K- primary role throughout the study was to provide advice and guidance from its inception. He offered technical support, assisted with data analysis, and supervised the overall study's progress.Revising the manuscript, providing valuable feedback, and giving corrections All authors reviewed the manuscript.

### Funding

There was no source of funding in any form or organization.

### Data availability

The research data is available in SPSS form,but not deposited in online Archive.

## Declarations

### Ethics approval and consent to participate

Human Ethics and Consent to Participate Declarations: Informed consent was taken from caregivers and patients who were diagnosed with acute stroke through written forms before the data collection process. Access to the collected data was restricted to the research team only.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

Received: 26 December 2024 Accepted: 28 April 2025
Published online: 03 May 2025

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