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The magnitude of stroke and associated risk factors among young adults at a tertiary hospital in Ethiopia

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Abstract

Background: Stroke in young adults is becoming a significant global public health concern, with variations observed in different regions. But, there is a lack of reliable epidemiological data on stroke among young adults in Ethiopia. The aim of this study was to determine the magnitude and risk factors of stroke among adults at a tertiary university hospital in Addis Ababa, Ethiopia.

Methods: In this retrospective cross-sectional study, we determined a minimum sample size of 236 to estimate the frequency of stroke in adults aged 18-49 years among all adult stroke admissions. Demographic, clinical, and neuroimaging data were collected from medical records using structured data abstraction form. Data were analyzed using the Statistical Package for Social Science V.26.0 software.

Results: There were 399 adults with stroke admissions during the study period. Out of the 399 adults stroke admissions, 111 (27.8%) were classified as stroke-in-young. Among the stroke-in-young patients, 64.9% (72) were males. The mean (SD) age of the patients was 39.0 (±7.9) years, with an age range of 21-49 years. Ischemic stroke accounted for 64.9% (72) of stroke-in-adult cases while intracerebral hemorrhage, cerebral venous sinus thrombosis and subarachnoid hemorrhage accounted for 27.0%, 7.2% and 0.9%, respectively. In cases of ischemic stroke, hypertension was prevalent (61.5%), often accompanied by diabetes mellitus (33.3%), alcohol use (15.6%), and cigarette smoking (8.9%). In young adults with intracerebral hemorrhage, hypertension, and alcohol and recreational drug abuse occurred in 86.7%, 20.0%, and 13.3% of cases, respectively.

Conclusions: In our study, stroke-in-young accounted for 27.8% of adult admissions with stroke. Cardio-metabolic and lifestyle-related risk factors were common among stroke-in-young. Further research is needed for better understanding of stroke-in-young individuals.

Keywords: Stroke, Stroke in adults, Addis Ababa, Ethiopia

Background

Stroke-in-young, specifically those aged between 18 and 49, exhibits distinct characteristics that set them apart from older individuals. Stroke-in-young is commonly associated with unexplained pathophysiologic mechanisms and rare causes of stroke (1-3). Stroke is more likely to present with atypical and fluctuating symptoms in young adults than older people (1,4). In contrast with the elderly, stroke causes disproportionately greater long-term effects in young adults despite its favorable short-term clinical outcomes (1-3,5,6). Stroke in young adults is becoming increasingly more common and is a growing public health concern around the world (2,3).

However, the growing global burden is unevenly distributed across different geographic areas and population groups. Stroke is disproportionately common among young adults in low- and middle-income countries (LMIC) (2). Stroke in young adults is more common in economically disadvantaged and minority groups (2,6). In most African countries, the prevalence and incidence of stroke are higher among young people (7). The observed epidemiological differences can be partially explained by differences in the types and magnitudes of stroke risk factors among different ethnic and economic groups (2).

There is evidence suggesting that young adults in Africa exhibit unique epidemiological characteristics when it comes to stroke. The majority of young adults who experience stroke in Africa have risk factors that are linked to their lifestyle (7). However, there is still much that remains unknown about the magnitude and impact of stroke among young people in Africa (3,8). In Ethiopia, there is a lack of reliable and comprehensive epidemiological data on stroke in young individuals (9,10). To contribute towards addressing this gap, we conducted a study using adult inpatients with strokes at a tertiary hospital in Addis Ababa. The objectives of this study were to determine the magnitude and risk factors associated with stroke-in-young adult patients.

Methods and Materials

Study design, period, and setting

This was a retrospective cross-sectional study conducted from January 2016 to December 2020 at Zewditu Memorial Hospital. Zeweditu Memorial Hospital (ZMH) is one of the largest public hospitals in Addis Ababa, Ethiopia's economic and political capital. It consists of four major departments: internal medicine, surgery, gynecology-obstetrics, and pediatrics. Stroke patients are admitted to the inpatient services of the internal medicine department, which includes both the general ward and the medical intensive care unit (MICU). This department is affiliated with St. Paul's Hospital Millennium Medical College (SPHMMC) and has a total of 65 inpatient beds, with 59 beds in the general ward and 6 beds in the MICU. Annually, the inpatient services cater to approximately 1,290-1,420 medical patients, out of which around 150-210 are stroke patients. The care of neurological patients, including stroke cases, is overseen by a neurologist and a team of ten internists who work in the inpatient services of the internal medicine department. Additionally, internal medicine residents are involved in the care of patients admitted to this department.

Study population

The source population for our study included all adult stroke patients aged 18 years and older who were admitted to and discharged from the inpatient services of the internal medicine department at ZMH. We specifically considered adult stroke patients who were admitted to both the general ward and MICU of the internal medicine department as our target population for sampling. Throughout this five-year period, a total of 975 adults stroke patients were admitted to the internal medicine department at ZMH.

Sample size determination and sampling

The sample size for this study was calculated using the single population proportion formula at a 95% confidence level (Z=1.96), a 5% absolute precision level (d=0.05), and a finite population size of 975 (11). We assumed an expected proportion (p) of 28% for our sample size calculation. This was based on a previous study conducted in Ethiopia that reported 28% of all stroke admissions to public hospitals were attributed to stroke in young individuals (9).

A purposive sampling method was used and we consecutively sampled adults with stroke who were admitted to and discharged from the inpatient services of the internal medicine department until calculated sample size was achieved. These stroke patients were identified using their unique patient chart numbers from the Health System Management and Information System (HMIS) of the internal medicine department. To gather the necessary information, we retrieved their medical records (medical charts) from the patient record and registration room of ZMH.

Study variables

In this study, we collected data on the following variables: gender, age, residence, the number of adult stroke patients, the number of stroke-in-young patients, the number of stroke sub-types, and information related to clinical presentations of stroke, stroke risk factors and etiologies.

Operational definitions

Stroke: Clinical diagnosis of stroke supported by the presence of documented brain CT or MR imaging findings of acute stroke lesions, as interpreted by either a neuroradiologist or a general radiologist. The clinical diagnosis of stroke followed the definition provided by the World Health Organization (WHO), which defines stroke as a "sudden onset focal (or sometimes global) neurological impairment lasting at least 24 hours or leading to death, and presumed to be of vascular origin" (12).

Adult stroke case: An adult aged 18 and above who experienced a stroke, and was admitted and discharged from the inpatient services of the internal medicine department at ZMH during the study period.

Stroke-in-young: A young adults aged between 18 and 49 years who had a stroke, and was admitted to and discharged from the inpatient services of the internal medicine department at ZMH during the study period (3).

Stroke risk factor: A characteristic, condition, or behavior that increases an individual's likelihood of developing a stroke. Some key stroke risk factors include age, hypertension, diabetes mellitus, high cholesterol levels, atrial fibrillation, smoking, obesity, physical inactivity, and positive family history (having a close blood relative who has had a stroke).

Stroke etiology: Stroke etiology refers to the underlying cause or mechanism that results in the occurrence of a stroke. It is identified through diagnostic tests such as neuroimaging, vascular imaging, and laboratory studies. The various stroke etiologies include atherosclerosis, embolism, thrombosis, lacunar stroke, intracerebral hemorrhage, subarachnoid hemorrhage, as well as less common causes like arterial dissection, vasculitis, coagulopathies, and venous thrombosis.

Stroke sub-types: The stroke sub-types, determined based on the brain neuroimaging findings, include acute ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, and cerebral venous sinus thrombosis.

Data collection procedures and tool

The study data were collected using a pretested structured data collection form. This form includes questions pertaining to the sociodemographic characteristics of the participants, stroke sub-types, stroke risk factors, stroke clinical presentation, and brain neuroimaging results.

To ensure the accuracy of the stroke diagnosis, one of the authors (TN) reviewed the retrieved medical charts of the sampled adult stroke patients. Following this, two trained data collectors (medical students in their internship year) abstracted and documented the relevant study data from the medical charts of stroke-in-young adults with confirmed stroke diagnosis using the structured data collection form.

Data quality control

In order to ensure the accuracy and consistency of the collected data, the author (TN), conducted regular data quality audits. These audits involved reviewing a sample of the collected data to verify its accuracy and consistency.

Data processing and analysis

The data was entered into Statistical Package for Social Sciences (SPSS) version 26.0 for analysis. The proportion of stroke-in-young cases was reported as a percentage. For the stroke-in-young adults, we provided a summary of age using the mean with standard deviation (SD) and range. Age categories, gender, residence, stroke sub-types, stroke symptoms/signs, and stroke risk factors and etiologies in the stroke-in-young samples were reported using frequency and percentages.

Results

A total of 452 adult stroke patients with a documented stroke diagnosis at admission to the inpatient services of the internal medicine department at ZMH were identified in the HMIS. However, upon reviewing the medical charts of these patients, we found that 53 individuals (11.7%) had missing clinical or neuroimaging information, which prevented them from meeting the operational definition of stroke diagnosis used in our study. We decided to include the remaining 399 adult stroke admissions for further analysis. Although this number slightly exceeded the minimum calculated sample size, it had minimal impact on the overall cost of the study.

Out of the 399 adult stroke inpatients, 111 individuals (27.8%) were classified as stroke-in-young adults, aged 18-49 years. Among these stroke-in-young patients, 72 (64.9%) were male, and 109 (97.3%) resided in urban areas. The mean (SD) age for the stroke-in-young patients was 39.0 (±7.9) years. The stroke-in-young cases occurred across the age range of 21-49 years, with the following distribution: 31 (27.9%) in the 18-34 age category, 59 (53.2%) in the 35-45 age category, and 21 (18.9%) in the 46-49 age category.

Among the 111 stroke-in-young adults, 64.9% (72 individuals) were diagnosed with acute ischemic stroke (AIS). Additionally, 27.0% (30 patients) had intracerebral hemorrhage (ICH), one patient (0.9%) had subarachnoid hemorrhage (SAH), and 8 (7.2%) patients were diagnosed with cerebral venous sinus thrombosis (CVST). In terms of gender distribution, males accounted for 61.1% (44 out of 72) of AIS cases and 23 (76.7%) of ICH cases among the stroke-in-young patients. CVST occurred with equal frequency in both males and females. The mean ages for patients with AIS, ICH, and CVST were 39.6 years (SD=7.7), 39.6 years (SD=7.8), and 31.1 years (SD=6.6), respectively. (Table 1).

Table 1: Distribution of stroke-in-young sub-types by age groups at the medical inpatient services of Zewditu Memorial Hospital in Addis Ababa, Ethiopia (N=111).

Age categories (years)	AIS*, N (%)	ICH†, N (%)	SAH‡, N (%)	CVST§, N (%)
18-34	18 (25.0)	7 (23.3)	0 (0.0)	6 (75.0)
35-45	38 (52.8)	18 (60.0)	1 (100.0)	2 (25.0)
46-49	16 (22.2%)	5 (16.7)	0 (0.0)	0 (0.0)

**AIS acute ischemic stroke; †ICH intracerebral hemorrhage; ‡SAH subarachnoid hemorrhage; §CVST cerebral venous sinus thrombosis*

During the initial presentation, it was observed that stroke-in-young patients exhibited both focal and non-focal clinical features (Table 2). The most common presenting feature was focal neurological deficits, either alone or in combination with other clinical symptoms and/or signs, which were observed in 97 (87.4%) of the stroke-in-young patients in the study. At the time of presentation, high blood pressure (>140/90 mmHg) was recorded in 24 (80%) of ICH cases and 24 (33.3%) of AIS cases. Ten stroke-in-young patients (9.0%) passed away during their hospital stay, with 5 cases each attributed to AIS and ICH.

In our study, we identified several potential risk factors for stroke among the stroke-in-young patients. One young patient diagnosed with SAH had a history of hypertension, smoking, and substance abuse involving alcohol and recreational drugs.

Table 2: Presenting clinical features of stroke-in-young patients at the medical inpatient services of Zewditu Memorial Hospital in Addis Ababa, Ethiopia (N=111).

Symptoms and signs	All stroke types, N (%)	AIS*, N (%)	ICH†, N (%)	SAH‡, N (%)	CVST§, N (%)
Focal neurologic deficit (FND)	44 (39.6)	36 (50.0)	8 (26.7)	0 (0.0)	0 (0.0)
Headaches (HA)	3 (2.7)	0 (0.0)	1 (3.3)	0 (0.0)	2 (25.0)
Altered mentation (ALM)	2 (1.8)	1 (1.4)	1 (3.3)	0 (0.0)	0 (0.0)
Seizure (Sz)	3 (2.7)	3 (4.2)	0 (0.0)	0 (0.0)	0 (0.0)
FND plus HA	27 (24.3)	13 (18.1)	12 (40.0)	1 (100)	1 (12.5)
FND plus ALM	12 (10.8)	6 (8.3)	4 (13.3)	0 (0.0)	2 (25.0)
FND plus Sz	4 (3.6)	3 (4.2)	0 (0.0)	0 (0.0)	1 (12.5)
FND plus HA plus ALM	4 (3.6)	2 (2.8)	1 (3.3)	0 (0.0)	1 (12.5)
FND plus Sz plus ALM	2 (1.8)	1 (1.4)	1 (3.3)	0 (0.0)	0 (0.0)
FND plus HA plus Sz	4 (3.6)	3 (4.2)	1 (3.3)	0 (0.0)	0 (0.0)

**AIS acute ischemic stroke; †ICH intracerebral hemorrhage; ‡SAH subarachnoid hemorrhage; §CVST cerebral venous sinus thrombosis*

Among the patients with CVST, two (25%) patients had a diagnosis of antiphospholipid antibody syndrome, one patient (12.5%) had a family history of CVST, and another patient (12.5%) had a history of using oral contraceptive pills prior to the stroke presentation. In the case of ICH, potential risk factors such as hypertension, excessive alcohol consumption, and recreational drug abuse were found in 86.7% (26 patients), six (20.0%) patients, and four (13.3%) patients of the stroke-in-young patients, respectively. Additionally, antiphospholipid antibody syndrome and the use of oral contraceptive pills were identified as potential risk factors in two (6.7%) cases of ICH patients.

Table 3 provides an overview of the frequency of potential risk factors and etiologies for AIS in young adults based on our study. Among AIS patients, potential risk factors or etiologies were identified in 53 (73.6%) of cases. Hypertension was the most prevalent risk factor, often coexisting with diabetes mellitus in 15 (33.3%) patients, alcohol abuse in seven (15.6%) patients, and cigarette smoking in four (8.9%) patients of hypertensive patients.

Table 3: Frequency of risk factors-etiologies for ischemic stroke in young adults at the medical inpatient services of Zewditu Memorial Hospital in Addis Ababa, Ethiopia (N=72).

Risk Factors and/or Etiologies	Frequency (%)
Hypertension	45 (61.5)
Diabetes mellitus (DM)	21 (29.2)
Chronic rheumatic valvular heart diseases	3 (4.2)
Ischemic heart disease	1 (1.4)
Atrial fibrillation	1 (1.4)
Excessive alcohol use	9 (12.5)
Cigarette smoking	5 (6.9)
Anti-phospholipid antibody syndrome	2 (2.8)
Cancer	1 (1.4)
Oral contraceptive use	4 (5.6)
Positive family history (cardiovascular)	3 (4.2)
HIV/AIDS	2 (2.8)

Discussion

In this study, strokes in young adults represented 27.8% of all adult acute stroke hospital admissions. The occurrence of stroke in young adults was higher among males, accounting for 64.9% of cases, and the majority of strokes were of the ischemic sub-type, comprising 64.9% of cases. Among the risk factors identified in our study, hypertension was the most common, affecting 64% (71 out of 111) of young adults with stroke. Additionally, diabetes mellitus was present in 18.9% (21 out of 111) of cases, and excessive alcohol consumption was observed in 14.4% (16 out of 111) of cases. This study provided the most recent hospital-based estimate on the magnitude and risk factors of stroke in young patients.

Previous studies conducted nearly twenty years ago by Bekele et al. reported a frequency of 28% for stroke in young adults based on a retrospective case study from 1990-1996 (9). However, their study used age cutoffs (15 and 45 years) and clinical criteria for stroke diagnosis, which may introduce inaccuracies and make it difficult to compare their results with our estimated frequency (9). More recent cross-sectional studies conducted in public university hospitals in northern Ethiopia reported frequencies of 14.7% and 15% for stroke in young adults aged 18-49 (10,13). However, these studies utilized a combination of clinical and clinico-neuroradiological criteria to identify and classify stroke cases during 2012 to 2018, which may not accurately represent the current epidemiology of stroke in young individuals (10,13). In our current study, we determined the required sample size in advance and utilized clinicoradiologic criteria for stroke identification and sub-typing.

Our research provides a frequency estimate for stroke in young adults, which aligns with current literature. There is mounting evidence suggesting a growing burden of stroke in young adults, particularly in economically disadvantaged communities and developing countries (2,7,14). In high-income countries (HIC), stroke in young adults' accounts for approximately 10 to 15% of all adult stroke cases (2,14,15). This is in contrast to LMIC, where the proportion is significantly higher, ranging from 19 to 30% (16). In most hospital-based studies in Africa, stroke in young adults reportedly accounts for 24-30% of all stroke cases (7,9,17-20). In our current study, we found that stroke in young adults' accounts for 27.8% of all adult stroke hospital admissions. This frequency is consistent with previous reports from Africa and other LMIC similar to ours.

Stroke in young adults, like in older people, is associated with one or more modifiable stroke risk factors. A systematic review of 18 studies in 2022 revealed that body mass index (BMI), current smoking, hypertension, and diabetes significantly increased the risk of any stroke and ischemic stroke in young adults (21). High total cholesterol was also found to be linked to a higher risk of ischemic stroke (21). Other studies conducted in LMIC and among indigenous Africans have indicated that strokes in young adults are predominantly associated with lifestyle and cardio-metabolic risk factors including hypertension, diabetes, dyslipidemia, physical inactivity, smoking, and excessive alcohol use (2,3,7,18,22). Similarly, in our study samples of young adults with AIS, hypertension was the most prevalent risk factor, often coexisting with diabetes mellitus in 33.3%, alcohol abuse in 15.6%, and cigarette smoking in 8.9% of hypertensive patients. Our study also finds hypertension, excessive alcohol consumption, and recreational drug abuse as commonest risk factors for ICH in young adults.

The current study reveals limited stroke etiologies and non-modifiable risk factors among young adults with stroke. In contrast to older adults, the cause of AIS in young adults is more likely to be unknown (24-53%) (2). However, it can also be attributed to a range of common and rare underlying etiologies. Ischemic stroke in young adults is commonly attributed to cardiometabolism and cervicospinal dissection, accounting for 10-34% and 35% of all strokes in this population, respectively (2). Cardio-embolism can stem from conditions such as atrial fibrillation, valvular heart diseases, infective endocarditis, migraine with aura, and patent foramen ovale (PFO) (2). However, in our research, the occurrence of cardio-embolic causes (6.3%) in AIS cases was very low, indicating limited diagnostic investigations and potential under-reporting of non-modifiable risk factors and stroke causes in our study sample. Less common non-modifiable risk factors reported in our study include positive family history (7.2%), hereditary hypercoagulable states (5.4%), HIV-1 infection (1.8%), illicit drug use (7.2%), and malignancy (0.9%). Other common causes of ischemic stroke in young adults include vasculopathies, none of which we detected in our stroke patients (23). For young adults with ICH, vascular malformations are frequently the underlying causes (2). None of our ICH patients had documented brain vascular anomalies. In our study, we have found that stroke sub-types and risk factors are not evenly distributed among different age groups in young adults. Previous research has shown that young women have a

higher risk of ischemic stroke compared to men between the ages of 18 and 34 (2). However, after the age of 35, incident strokes of all types are more common in males than females (2). Our study aligns with these previous findings. We found that in the age group of 18-34 years, there were more women (61.5%, 11 out of 18) with AIS compared to men. However, after the age of 35, the proportion of first-ever ICH occurrences was predominantly in males (82.6%, 19 out of 23), as well as AIS occurrences (68.5%, 37 out of 54). This could be partially explained by the high prevalence of hypertension (82.8%, 48 out of 58), diabetes mellitus (64%, 16 out of 25), smoking (100%, 9 out of 9), and excessive alcohol use (87.5%, 14 out of 16) in males with stroke after the age of 35. We observed a peak in the incidence of ICH (60% of all ICH cases) between the ages of 34 and 45 years in our study, which parallels the peak prevalence of hypertension (81.8%) during this age range.

This study has several notable strengths that bolster the reliability and significance of our findings. In contrast to previous local studies, we employed a predefined sample size and rigorous clinico-neuroradiologic criteria for stroke case identification and sub-typing, enhancing the precision of our frequency determination and underscoring the importance of our research (9,10,13). Moreover, we utilized widely recognized age criteria (18-49) to define stroke in young adults, rendering our frequency estimate more comparable than previous report (9). Additionally, our study offers an update on risk factor profiles, including the influence of gender and age on the distribution of stroke sub-types and risk factors within the young stroke population.

However, it is important to acknowledge the limitations of our study, which may affect the validity and reliability of our findings. One notable limitation is our reliance on existing medical records, which could result in under-reporting of stroke risk factors and causes. It is worth mentioning that a significant number of stroke-in-young patients in our study did not undergo recommended laboratory investigations and studies to identify unusual non-atherosclerotic stroke risk factors and etiologies (24). Furthermore, it is essential to recognize that our study may not fully represent the target population, as there may be selection bias and bias due to the homogeneity of the sample obtained through convenience sampling. It is crucial to note that our research was a retrospective hospital-based study conducted at a single site, which introduces the possibility of referral bias. Generalizing our findings to the broader stroke-in-young patient population should be done with caution.

Conclusion

In conclusion, this study has thoroughly investigated the epidemiology of stroke in young adults in Ethiopia. This study revealed the magnitude and risk factors of stroke among adults, which offers valuable insights for practitioners, policymakers, and researchers. Our findings have important implications for clinicians who care for stroke patients, as well as policymakers and health managers who can use the information to design local stroke prevention strategies. Overall, this research lays the groundwork for future prospective analytical and community-based researches on stroke in young adults in Ethiopia.

Abbreviations

AIS: Acute ischemic stroke; CVST: Cerebral venous sinus thrombosis; HMIS: Health management information system; ICH: Intracerebral hemorrhage; MICU: Medical intensive care unit; SAH: subarachnoid hemorrhage; SPHMMC: St. Paul's Hospital Millennium Medical College; ZMH: Zeweditu Memorial Hospital

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Declarations

Ethical declaration

The study was approved by the Institutional Review Board (IRB) of SPHMMC and was conducted in accordance with the Declaration of Helsinki. Collected patient information was only used for this particular study and kept confidential.

Consent for publication

Not applicable.

Authors' contributions

TN and SGGM conceived and designed the study, performed data analysis, compiled the whole work, and prepared the manuscript. SGGM and SZ participated in the design, analysis, and review of the main document and took part in the critical revision of the manuscript. All authors had read and approved the final manuscript.

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Competing interest

The authors declare that they have no competing interests.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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