African Journal of Emergency Medicine 12 (2022) 216–224

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/afjem

Original article

Analysis of the demographic characteristics and clinical profile of acute ischemic strokes admitted to the emergency centre in the Somalia population

Ebubekir Arslan*, Osman Cetinkaya

Mogadishu Somalia Turkish Training and Research Hospital, Mogadishu, Somalia

ARTICLE INFO

Keywords:
Acute Ischemic stroke
Emergency department
Somalia
Sub-Saharan Africa

ABSTRACT

Background: Stroke is a leading cause of death and chronic disability worldwide. In Sub-Saharan Africa (SSA), which includes Somalia, stroke represents a significant part of the chronic disease burden. However, there is relatively little data on risk factors, demographics, and clinical profiles. This study aimed to define the etiological, demographic characteristics, classification of stroke and functional status of patients with acute ischemic stroke (AIS) admitted to the emergency centre, and to create projections to evaluate the incidence and genetic aspects of stroke.

Methods: The study population consisted of patients who applied to the emergency centre between 1 May 2017 and 1 May 2021 and were diagnosed with acute ischemic stroke (AIS). Patient demographics, season of onset, risk factors, laboratory data, imaging results, infarct location, AIS subtype and treatment outcomes were collected, and compared.

Results: A total of 3,968 patients diagnosed with ischemia stroke were included in the study. The mean age was 51.12 ± 16.43 years, and we reported male predominance (65.7%). While hypertension, hyperlipidaemia, Diabetes mellitus (DM) were more frequent among the risk factors, smoking history and alcohol consumption history were very low. HIV-infected ischemic stroke was detected at a high rate (20.9%) and was common in a relatively young age group (31.8 ± 14.3). Large-artery atherosclerosis (LAA) subtype was detected with a high rate of 67.7%. The most common clot localization was in Supratentorial location (74.3%), and according to OSCP classification, partial anterior circulation infarcts (PACI) subtype (56.3%) was the most common. And these results were again different from other studies.

Discussion: While the incidence of stroke and especially HIV-associated youthful ischemic stroke continues to increase rapidly in developing countries such as Somalia, with the addition of inadequate primary health care services, stroke has become a major public health problem in African countries regarding its costs at social, psychological, and economic levels.

African relevance

- Our study was aimed to create a predictive model for stroke incidence, etiology, and genetic direction.
- Extending these and similar epidemiological studies to other parts of the continent can guide clinicians with evaluation and follow-up of stroke patients.
- Findings of this study can assist projections for public health programs for stroke prevention and treatment.

Introduction

Stroke is a leading cause of death and chronic disability worldwide [1]. It accounts for approximately 5% of all life-years and 10% of all deaths adjusted for "long-term disability" [2]. 80-85% of stroke cases are ischemic and 15-20% are haemorrhagic [3]. While the incidence of stroke is decreasing in developed countries, it continues to increase rapidly in developing countries, including Africa ([4], [5]). With the addition of inadequate primary health care services, stroke has become a major public health problem and a real growing burden in African countries regarding its costs at social, psychological and economic levels [5–7]. However, approximately 85% of stroke-related deaths occur in low- and middle-income countries such as Somalia [8].

* Corresponding author,
E-mail address: ebuarslan@hotmail.com (E. Arslan).

https://doi.org/10.1016/j.afjem.2022.04.010
Received 24 November 2021; Received in revised form 20 March 2022; Accepted 22 April 2022

Healthcare planning and resource allocation for future stroke care and prevention can be made possible by up-to-date information that includes incidence and mortality trends. However, reported trends are meaningful only if they are based on studies with similar definitions, methods, and data presentation [9]. In this sense, the INTERSTROKE study, which aims to establish the relationship between known and emerging risk factors with stroke and its primary subtypes, and to evaluate the contribution of these risk factors to the stroke burden, is important. The findings of this study showed that ten identified risk factors (hypertension, smoking, diet risk score, diabetes mellitus, alcohol intake, cardiac causes, etc.) are associated with 90% of stroke risk. In addition, it has been emphasized that targeted interventions that reduce blood pressure and smoking, and promote physical activity and healthy eating will significantly reduce the burden of stroke [10]. In SSA, including Somalia, stroke represents a significant portion of the chronic disease burden [11]. In previous studies covering the Sub-Saharan Africa region (not including data from Somalia), the overall pooled prevalence of ischemic stroke among all strokes was 61.4%, with a mean age range of 55 – 62.8 [12]. In SSA, several non-modifiable risk factors for stroke such as age, gender, race, ethnicity, and heredity have been defined [12,13]. The combined prevalence of ischemic stroke risk factors was 62.8% for hypertension, 15.9% for DM, 13.7% for Hypercholesterolemia, 24.2% for alcohol use, 13.1% for smoking, 20.0% for HIV infection and 9.6% for AF [11]. However, data from the limited number of studies [12–15] covering Somalia and the SSA were not disaggregated by features such as age, gender, temporal trends, stroke classification (rather limited to standard incidence rates) and were not used to create an estimation model for stroke incidence.

HIV infection has been shown to increase the risk of stroke significantly and independently [16–19]. According to World Health Organization (WHO) data, there were an estimated 37.7 million (30.2–45.1 million) people living with HIV, of which 25.4 million (20.7–30.3 million), or more than two-thirds were in the WHO Africa Region at the end of 2020 [20]. Therefore, the impact of HIV on stroke risk in the SSA is particularly important due to the high risk of stroke in the general population in this region [5]. This study also obtained medical data on demographics, clinical presentations, and patient outcomes of HIV-related stroke patients with a high prevalence in Somalia. In this way, we aim to provide clinicians and public health programs in Somalia and Sub-Saharan Africa with preliminary guidance on the evaluation and follow-up of HIV-infected stroke patients and recommendations for stroke prevention and treatment.

With this study, we aim to describe the etiological, epidemiological, demographic characteristics, classification of stroke and functional status of patients with acute ischemic stroke (AIS) who applied to the emergency centre of Mogadishu-Somali Recep Tayyip Erdoğan Training and Research Hospital and we aim to create projections to assess the incidence and genetic aspect of stroke.

Methods

The descriptive study was planned retrospectively and included patients between May 1, 2017 and May 1, 2021. Mogadishu-Somali Recep Tayyip Erdoğan Training and Research Hospital is the only hospital in Mogadishu and even in Somalia where thrombolytic treatments and 3rd level intensive care services are provided, thus it's the only stroke centre. Patient data were obtained from the "Hospital Information Management System (HIMS)" medical records, where all records are kept electronically. Patient demographics, date and time of admission to the emergency centre, time of onset of symptoms, starting time of treatment, risk factors, history of drug use, detailed neurological examination at admission, laboratory data, imaging results (computed tomography, magnetic resonance, carotid vertebral Doppler ultrasonography, echocardiography), infarction site, treatments applied in the emergency centre, intensive care or neurology service, patient outcome (admission, re-stroke, discharge, referral, treatment rejection), NHHSS scores and modified Rankin Score (mRS) evaluation data determined by neurologists and recorded in the patient's file, Data containing the AIS subtype were collected in a combined form and processed into the data collection form. Patients who did not have ischemic stroke (subdural, epidural, intracranial hematoma, subarachnoid haemorrhage, mass, etc.) according to their file information were reconfirmed with cerebral CT images and excluded from the study. Magnetic resonance imaging (MRI) was used to confirm ischemic infarctions, their location and time of infarction, and patients without new and acute diffusion restriction on cerebral diffusion MRI were also excluded from the study. Apart from these, all patients with acute diffusion restriction reported in diffusion MRI were included in the study. This study with registry data was approved by the Institutional Ethics Committee of the Somali Recep Tayyip Erdoğan Training and Research Hospital.

Young adult stroke was defined as stroke with an age of onset less than 45 years. Intravenous thrombolysis window time (IVTWT) has been defined as the 3 and 4.5 hour period from symptom onset to thrombolysis [21, 22]. The severity of critical carotid artery arteriostenosis was calculated according to the carotid artery ultrasound results. Arteriostenosis was defined as >70% reduction in internal diameter, and occlusion was defined as no indication of blood flow. Anatomical infarct locations confirmed by MRI were classified as basal ganglia, cerebral lobe, brainstem, thalamus, cerebellum, and/or corona radiata regions. The supratentorial location included the basal ganglia, cerebral lobe, thalamus, and corona radiata regions, and the deep location included the basal ganglia and thalamus. When several positions were affected, they were all taken into account. The aetiology of ischemic stroke and the localization of the infarct are the most important factors affecting treatment selection, patient management, prognosis, and also determining the genetic aspect of stroke. Therefore, ischemic stroke subtype categorization systems such as TOAST (Trial of Org 10,172 in Acute Stroke Treatment) based on aetiology and OSCP (Oxfordshire Stroke Classification Project) based on infarct localization were used. In these classification systems, diagnosis is based on information obtained from tests such as clinical features, brain imaging (CT/MRI), cardiac imaging (echocardiography, etc.), imaging of extracranial arteries, arteriography, and laboratory investigations of conditions such as thrombosis predisposition [23].

Patients who received and did not receive IV rt-PA treatment were divided into two groups as good functional outcome and poor functional outcome according to the modified Rankin Score (mRS) after 3 months. it was described as "Good Functional Outcome": patients with between follow-mRS=0-2 at 3rd month after stroke and as "Poor Functional Outcome": patients with between follow-mRS=3-6 at 3rd month after stroke [24]. The post-stroke monitoring unit affiliated with the hospital stroke center invites stroke patients to the hospital and arranges their neurological follow-up and treatment (medical and physical therapy) periodically. 3-month mRS scores were based on examination findings recorded at the time of admission of patients to the post-stroke monitoring unit for neurological control and other reasons. The mRS at the end of the 3rd month of 82 of 115 patients who could not come to the post-stroke follow-up unit for control was determined by telephone interviews with the patient or their relatives. Thirty-three (0.8%) patients who could not be reached at all were excluded from the functional outcome analysis. "Medical treatment" was definition as patients who did not receive endovascular mechanical (thrombectomy) and/or thrombolytic (i.v. rtPA) stroke treatment (only Antihypertensive drugs, Antidiabetic drugs, Antihyperlipidemic drugs, ICP lowering drugs, Antiplatelet drugs, Anticoagulants given one or more).

Data were grouped for analysis. For statistical evaluation, the data were loaded into the IBM SPSS 21.0 (IBM, Armonk, NY, USA) software package and necessary analyses were made. Qualitative and quantitative variables were expressed as a percentage and mean ± standard deviation (SD), respectively. Categorical variables were compared using the chi-square ($\chi 2$) test. Continuous variables were examined using a two-sample t-test if they were normally distributed or otherwise with Wilcoxon rank sum test. The relationship between young ischemic

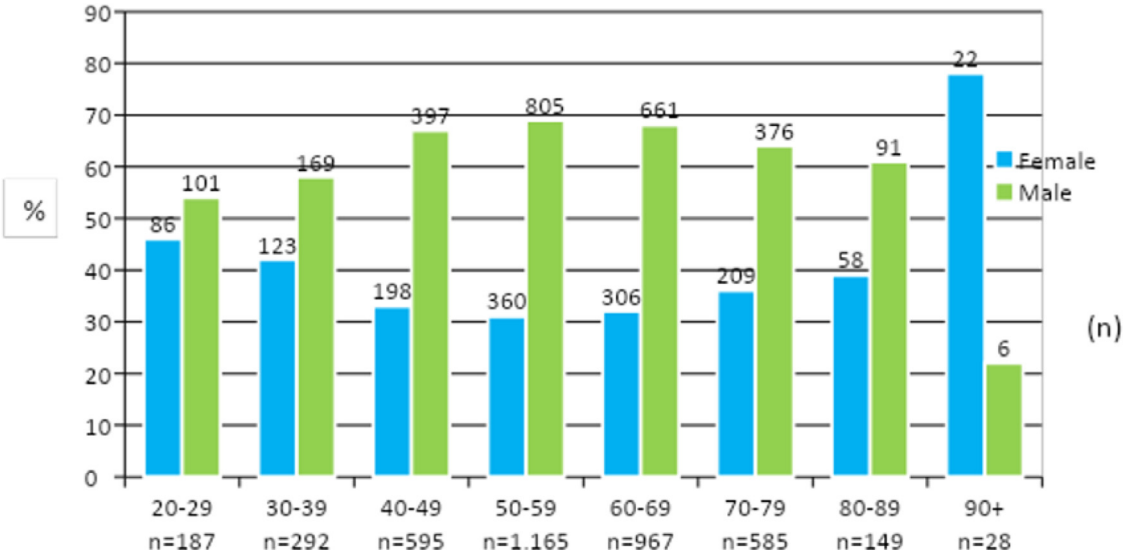

Fig. 1. Distribution of patients by age groups and gender.

stroke and prognosis was evaluated by multiple regression analysis. *P*-value < 0.05 was considered statistically significant.

Results

The study population consisted of patients who were diagnosed with acute ischemic stroke (AIS) in the Mogadishu-Somali Recep Tayyip Erdoğan Training and Research Hospital Emergency Service between May 1, 2017 and May 1, 2021. In a 4-year period, 403.368 patients were admitted to the emergency centre and constituted the study population. Among these patients, the rate of those diagnosed with stroke (haemorrhagic or ischemic) was 1.1% ($n = 4.560$), while the rate of ischemic stroke was 0.9%, and these patients were mostly male ($n = 2.860$ (62.7%). 87% ($n = 3.968$) of the patients diagnosed with stroke were ischemic stroke. 65.7% ($n = 2.606$) of ischemic strokes were male and the mean age was 51.12 ± 16.43 (24-91).

Comparison of patients by age groups and gender revealed that some age groups differed significantly from others (Fig. 1).

In general, ischemic strokes were significantly more common in the 50-69 age range ($n = 2.132$, 53.6%, $P = 0.006$) and the number of male patients was higher in all decades under the age of 90. On the other hand, when the incidences of stroke by age groups were compared, while the incidence of ischemic stroke was higher in men in the 40-69 age group than in women, the incidence of ischemic stroke was higher in women in all other age groups.

In general, while hypertension, hyperlipidaemia, diabetes mellitus (DM) was high among the ischemic stroke risk factors, smoking history and alcohol consumption history were very low. Since oral contraceptive use was close to zero, it was not included in the statistics as a risk factor. The distribution of risk factors in ischemic stroke patients is summarized in Table 1.

There was no statistically significant seasonal difference at the time of admission to hospital in patients with ischemic stroke ($P = 0.367$). The number of patients admitted within the intravenous thrombolysis treatment window ($n = 877$) was statistically significantly lower (22.1%, $P < 0.001$) compared to all ischemic stroke patients, and accordingly, the rate of patients who received thrombolysis was low (Table 2).

The number of HIV-infected ischemic stroke patients was 831 (20.9%). The mean age was 31.8 ± 14.3 (20-68). 56.2% (n: 467) of the patients were women (Fig. 2).

21.1% ($n = 838$) of the patients included in this study were aged 45 years or younger. While there was no significant gender difference in the younger patient group ($P = 0.151$), there was a high rate of male predominance in patients over 45 years of age (Table 3). When ischemic stroke patients under 45 years old and over 45 years old are compared in terms of risk factors, HIV-infected ischemic stroke patients aged 45 years and younger were statistically significantly higher (74.7%, $P < 0.0001$). When the relationship between youthful ischemic stroke and prognosis was examined in multiple regression analysis, a significant relationship was found with a low entry NIHSS score (odds ratio=2.2, 95% confidence interval (0.2-5.3), $P = 0.036$)

In general, while the most common clot localization was in the Supratentorial location (74.3%), according to TOAST classification, the most common LAAS subtype (67.7%), PACI subtypes related to OSCP classification (56.3%) were detected (Table 4).

In general, there was no significant difference between subtypes and gender distribution with respect to TOAST and OSCP classification, whereas anterior location was significantly more sensitive for infarction in HIV-infected patients (88.6%, $P <$ 0.001).

IV rt-PA was administered to 264 (6.7%) patients with ischemic stroke who accepted thrombolytic treatment (some of the relatives did not accept treatment for their patients due to their religious beliefs). A total of 147 patients refused treatment, of whom only 13 were outside the thrombolytic therapy time window.

The results in Table 5 are based on data obtained after 33 patients (whose mRS at 3 months could not be determined) were excluded from the functional outcome analysis. Neurological Good functional outcome (patients with between follow-mRS=0-2 at 3rd month after stroke) were obtained in 68.2% of patients who underwent thrombolysis, which was statistically significant ($P <$ 0.001). The rate of haemorrhagic transformation (intracerebral haemorrhage) was 4.2% ($n = 11$) in patients who underwent thrombolysis, and these were detected in the control cerebral CT at the 24th hour. Patients who developed haemorrhage after thrombolytic therapy had a statistically significantly neurological poor prognosis ($n = 9$ vs. $n = 2$, $P < 0.001$). Asymptomatic intracranial haemorrhage was found in 2 patients who developed haemorrhage after thrombolytic therapy but had good functional results. Statistically significant poor functional outcome (patients with between follow-mRS=3-6 at 3rd month after stroke) was detected in patients who only received "Medical treatment" (as patients who did not receive endovascular thrombectomy and/or thrombolytic stroke treatment; Those given one or more of the Antihypertensive drugs, Antidiabetic drugs, Antihyperlipidemic drugs, ICP-lowering drugs, Antiplatelet drugs, Anticoagulants) (73.4%, $P < 0.001$). However, subgroup analyses of patients who received "medical therapy" but had good functional outcome showed that antiplatelet and antihyperlipidemic (statin) therapy were more fre-

Table 1
Ischemic stroke risk factors and distribution by gender.

	Total*n* = 3.968, %100		Female*n* = 1.362, % 34.3		Male*n* = 2606, % 65.7		*P-value*
	n	%	n	%	n	%	
Hypertension	2.846	71.7	884	64.9	1.962	75.3	0.001
Diabetes mellitus	1.414	35.6	312	22.9	1.102	42.3	< 0.001
Hyperlipidaemia	2.247	56.6	693	50.9	1.554	59.6	0.113
Stroke/transient ischemic attack history	827	20.8	79	5.8	748	28.7	< 0.001
Atrial fibrillation	739	18.6	193	14.2	546	20.9	0.112
Coronary artery disease	1.008	25.4	153	11.2	855	32.8	< 0.001
Atrial Trombüs	67	1.6	20	1.4	47	1.8	0.231
Smoking history	84	2.1	8	0.5	76	2.9	< 0.001
Alcohol consumption history	32	0.8	3	0.2	29	1.1	< 0.001
Erythrocytosis	320	8.0	25	1.8	295	11.3	< 0.001
Critical carotid artery occlusion	778	19.6	214	15.7	564	21.6	0.110

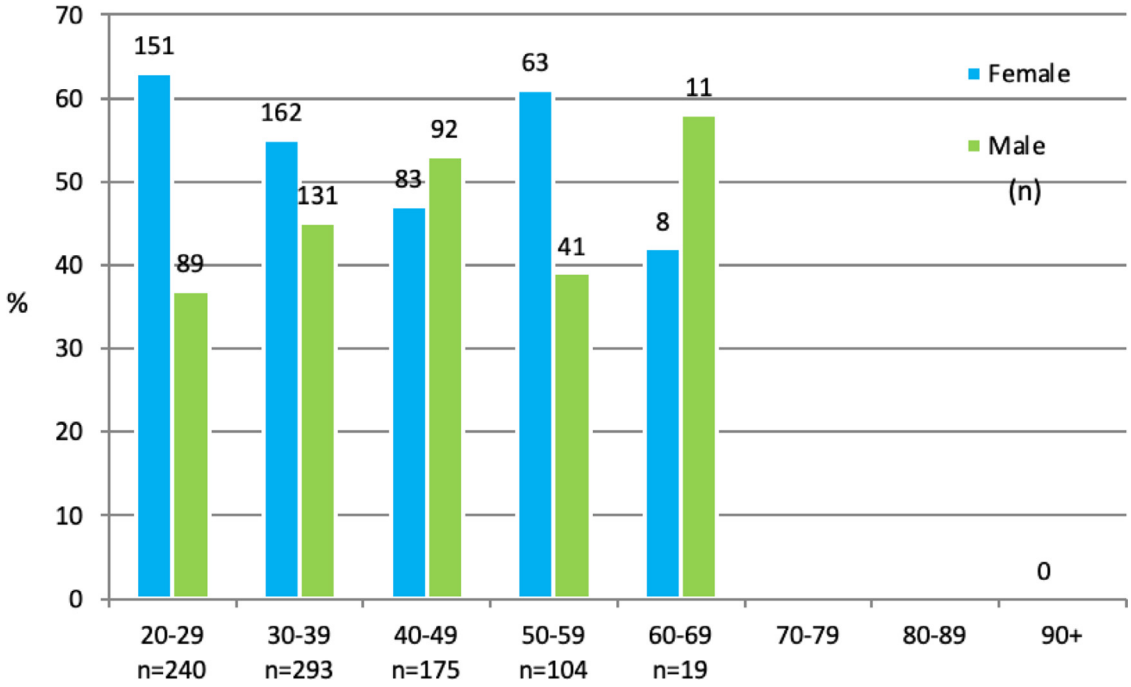

Fig. 2. Age and gender distribution of HIV-Associated Ischemic stroke cases.

Table 2
Temporal characteristics of patient applications.

	n	%	*P-value*
Seasonal Quarter Of Admission			0.367
July–Sept	1.083	27.3	
Oct–Dec	1.226	30.9	
Jan–Mar	933	23.5	
Apr–Jun	726	18.3	
Time of Admission			0.153
8AM–4PM	1.520	38.3	
4PM–12PM	1.591	40.1	
12PM–8AM	857	21.6	
Within IVTWT†	877	22.1	< 0.001

† Intravenous thrombolysis window time

quently prescribed to patients with Good Functional Outcome detected. Therefore, Antiplatelet and Statin therapy was associated with good prognosis after stroke.

There was no difference between the two groups in terms of total hospital stay ($P = 0.415$), but patients who stayed in the hospital for 6 days or less were more common in both genders (Table 6).

The inpatient mortality rate was 13.4% (532 patients) (Table 6). Deaths occurred more frequently in female patients (20.3% vs. 9.8%), but there was no statistically significant difference between the groups ($P = 0.524$). There was no significant difference in mortality rates between HIV-infected and non-HIV-infected ischemic stroke patients (20.3% vs 11.6%, $P = 0.622$). There was no significant difference in mortality rates between rtPA therapy administered ischemic stroke patients and not administered ones, too (10.6% vs 13.6%, $P = 0.714$).

Discussion

In the literature, it has been reported that 80-85% of stroke cases are ischemic and 15-20% are haemorrhagic [3]. In the INTERSTROKE study, this rate was found to be 78% [10]. In our study, this rate was found to be higher (87%) than in the literature. While the incidence of ischemic stroke is generally higher in men, the incidence of stroke is 2-3 times higher than women, especially between the ages of 55 and 64. This difference decreases towards the age of 85 [25]. In our study, 65.7% ($n = 2.606$) of patients diagnosed with ischemic stroke were male. Although men had a higher incidence of ischemic strokes in the 40-69 age group (31.7% versus 68.3%) than women, in all other age groups,

Table 3
Demographic and prognostic characteristics of young adult ischemic strokes.

	Forty-five years and younger ischemic strokes		Ischemic strokes over the age of forty-five years		*P-value*
	n	%	n	%	
Total	838	21.1	3130	78.9	<0,0001
Age, years, Mean ± SD	31.4±11.3		60.7±14.2		<0,0001
Gender					
Male	399	47.6	2207	70.5	0.151
Female	439	52.4	923	29.5	
Risk factors					
HIV Associated Ischemic Stroke	626	74.7	205	6.6	<0,0001
Hypertension	323	38.5	2.450	78.3	<0,0001
Diabetes mellitus	224	26.8	1.274	40.7	0.167
Dyslipidaemia	262	31.3	1.953	62.4	0.007
Atrial fibrillation	62	7.4	645	20.6	0,004
CAD	54	6.5	998	31.9	0.006
Critical carotid artery occlusion	205	24.4	548	17.5	0.148
History of stroke and/or TIA	96	11.5	698	22.3	0.247
Entry NIHSS, Mean ± SD	4,1 ± 3,6		6,9 ± 4,3		0,006
Follow-up mRS, Mean ± SD	1,1 ± 1,9		2,5 ± 2,3		0.005
Follow-up time, days, median	6(1-18)		5(2-18)		0.341
Mortality in hospital	8	0.9	551	17.6	<0,0001
Recurrent stroke	37	4.4	213	6.8	0.785

SD: Standard deviation, CAD: Coronary artery disease, TIA: Transient ischemic attack, NIHSS: National institutes of health stroke scale, mRS: modified Rankin scale score.

Table 4
Distribution of stroke subtypes and infarction location.

	Total*n* = 3.968, %100		Female*n* = 1.362, % 34.3		Male*n* = 2606, % 65.7		*P-value*
	n	%	n	%	n	%	
Infarction location							
Basal ganglion	982	24.7	372	27.3	610	23.4	0.643
Cerebral lobe	1.980	49.9	581	42.6	1.399	53.7	0.021
Corona radiata	1.290	32.5	138	10.1	1.152	44.2	< 0.001
Thalamus	469	11.8	101	7.4	368	14.1	0.003
Cerebellum	241	6.1	108	7.9	133	5.1	0.741
Brainstem	592	15.0	115	8.4	477	18.3	< 0.001
Supratentorial location	2.947	74.3	1060	77.8	1.887	72.4	0.067
Deep location	1.873	47.3	525	38.5	1.348	51.7	0.008
TOAST subtype							< 0.001
LAA	2.688	67.7	999	73.4	1.689	64.8	
SAO	740	18.6	70	5.1	670	25.7	
CAE	446	11.2	224	16.4	222	8.5	
Other †	179	4.5	43	3.1	136	5.2	
OSCP subtype							< 0.001
TACI	222	5.6	141	10.3	81	3.1	
PACI	2.234	56.3	955	70.1	1.279	49.1	
POCI	880	22.2	249	18.3	631	24.2	
LACI	774	19.6	164	1.2	610	23.4	

† Stroke of other determined cause and Stroke of undetermined cause.LAAS: Large-artery atherosclerosis, SAO: Small-artery occlusion, CAE: Cardio-aorticembolism, TACI: Total anterior circulation infarcts, PACI: Partial anterior circulation infarcts, POCI: Posterior circulation infarcts, LACI: Lacunar infarcts, TOAST: Trial of Org 10,172 in Acute Stroke Treatment, OSCP: Oxfordshire Stroke Classification Project

women had a higher incidence of ischemic stroke. Age is an important risk factor for stroke. It has been reported that approximately 70% of stroke survivors are over 65 years old and the mean age is 60±12 ([26], [27]). Yoneda et al. [28] found the mean age to be 70±11 years in their study, Reganon et al. [29] found 65.3 ± 8.2, Williams et al. [30] found 64 ± 3. Namale et al., on the other hand, found the mean age range of 55-62.8 in their stroke study [12] conducted in the Sub-Saharan Africa region, which doesn't include Somalia. In our study, on the other hand, younger age ischemic strokes were found that were not compatible with these findings.

The most common known risk factors for stroke are hypertension, diabetes, and high cholesterol [31]. In SSA, several non-modifiable risk factors for stroke such as age, gender, race, ethnicity, and heredity have been defined [13,14]. Hypertension continues to be the most important stroke risk factor not only in Africa but globally [32]. The combined prevalences in patients with ischemic stroke in Sub-Saharan Africa were 73.5% for hypertension, 15.9% for DM, 13.7% for Hypercholesterolemia, 24.2% for alcohol use, 13.1% for cigarettes, 20.0% for HIV infection, and 9.6% for AF. [12]. The INTERSTROKE study reported that the main risk factors for stroke in SSA were common: hypertension (37%), alcohol intake (11%), physical inactivity (12%), and DM (12%) [14]. When the results we found were evaluated, it was found that the rate of hypertension risk factor was compatible with the literature, DM, AF and hyperlipidaemia were higher, and the rates of smoking and alcohol use were much lower than the literature. While the risk factor for HIV infection was significantly higher than the general population, it was consistent with the rate in African studies. These results can be explained by several unchangeable risk factors for stroke such as race, eth-

Table 5
Efficiency of i.v. rtPA therapy.

	Total(All patients)		Good Functional Outcome (3rd month post-treatment mRS=0-2)		Poor Functional Outcome (3rd month post-treatment mRS=3-6)		*P-value*
	n	%	n	%	n	%	
i.v. rtPA therapy[†]	261	6.6	178	68.2	83	31.8	< 0.001
Time to rtPA, min[‡]	158±23		148±15		172±39		0.327
Medical Treatment[*]	3.674	92.6	977	26.6	2.697	73.4	< 0.001
Haemorrhagic conversion[**]	11	4.2	2	18.2	9	81.8	< 0.001

Data are n (%), mean (± standard deviation), or median (interquartile range). Data are complete except as indicated (n).
mRS=modified Rankin scale score
rtPA=recombinant tissue plasminogen activator.
[†] Without concomitant endovascular stroke therapy; Those given one or more of the Antihypertensive drugs, Antidiabetic drugs, Antihyperlipidemic drugs, ICP-lowering drugs, Antiplatelet drugs, Anticoagulants
[‡] Symptom-Needle Time (minutes); Mean±SD
[*] Without concomitant endovascular stroke therapy and i.v. rtPA therapy; Those given one or more of the Antihypertensive drugs, Antidiabetic drugs, Antihyperlipidemic drugs, ICP-lowering drugs, Antiplatelet drugs, Anticoagulants
[**] i.v. In patients treated with rtPA therapy

Table 6
Characteristics of death and utilization from hospital services by gender.

	Total*n* = 3.968, %100		Female*n* = 1.362, % 34.3		Male*n* = 2606, % 65.7		*P-value*
	n	%	*n*	%	*n*	%	
Intensive care hospitalization	985	24.8	479	48.7	506	51.3	0.617
Median (IQR)	4(1-8)		4(2-8)		3(1-6)		0.314
Length of stay							0.415
1-6 days	1.848	46.6	683	50.2	1.165	44.7	
7-14 days	939	23.7	266	19.6	673	25.9	
15 and above	542	13.7	194	14.3	348	13.4	
Median	5(1-18)		5(1-17)		6(1-18)		
Inpatient death							
Death	532	13.4	277	20.3	255	9.8	0.524
Inpatient death time							0.342
Within 1 day	224	42.1	103	37.2	121	47.5	
2-7 days	231	43.4	129	46.6	102	40.0	
8 and above	77	14.5	45	16.2	32	12.5	
Surgical procedures[†]	95	2.4	41	3.1	54	2.1	0.742

[†] Decompressive craniectomy.

nicity, and heredity, as well as the high sugar consumption and related DM prevalence in Somalia, irregular diet, protein-energy malnutrition, high HIV incidence, by prohibition of alcohol and smoking use due to religious beliefs, and most importantly by the inadequacy of basic health services and screening programs. In addition, despite the absence of two important stroke risk factors [33,34], such as smoking and alcohol use, the high incidence of stroke compared to the general population may indicate the effect of dominant risk factors such as hypertension, DM, hyperlipidaemia and HIV infection on the Somali population.

In our study, no significant difference was found between the seasonal admission times of the patients, but the most frequent applications were in the October-December quarter, which represents the winter months for Somalia and the air temperature is relatively low. In studies in the literature, the rate of admission to hospital within the first 3 hours of stroke patients varies between 21% and 48% [35–38]. This rate was found to be 22.1% in our study and was consistent with the results of the literature. The delay in the onset of acute stroke treatment develops at different stages, but the greatest timeframe is lost outside the hospital [39,40]. There is still no emergency response and ambulance system in Somalia, our hospital is the only centre for stroke treatments in Somalia, but there is difficulty in accessing it, and the fact that some of the patients are first taken to those who provide traditional treatment, causes delays in stroke applications.

In a study conducted among sex worker women in 2008, the HIV prevalence was found to be 0.6% in the Central South Region of Somalia (the state where our hospital is located) [41]. In 2002, the United Nations Program on HIV/AIDS (UNAIDS) estimated an average prevalence of 1% among adults [42]. There are differences between states. In 2014, 1,352 adult new infections were detected in the South Central region (named Somalia and the state where our hospital is located), and the incidence was 0.05% per 100 in 2014 (0.07% in Puntland, 0.07% in Somaliland and 0.04% in the south centre). [42]. It is well known that both HIV infection and antiretroviral therapy (ART) can potentially increase an individual's risk of stroke [43]. In our study, the number of HIV-infected ischemic stroke patients was 831 (20.9%). In a study conducted in Tanzania, the overall prevalence of HIV infection was found to be 20.9% in patients presenting with stroke [44]. A similar finding was observed in another study [45]. These results we obtained in the Somali population reveal the necessity of integrating care for non-communicable diseases such as stroke into communicable diseases such as HIV care programs, given the HIV infection epidemic and the increasing burden of stroke in the SSA [5]. In our study, HIV-infected ischemic stroke patients were found to be common in a very young age group. This result is compatible with studies in the literature ([46], [47]). Abdallah et al., in their systematic review in the Sub-Saharan Africa region in 2018, found the age range of HIV-infected stroke as 32-43 and the male:female ratio of 0.5-1.5: 1.0, and these results were consistent with the data in our study [48].

When ischemic stroke occurs under the age of 45, it is called juvenile ischemic stroke, and in previous studies, the incidence of juvenile ischemic stroke has been reported as 3.4-11.4/100,000 per 100,000 [49]. In our study, it was found at a high rate of 21.1%. Previous studies

investigating the relationship between young age ischemic stroke and risk factors was found that predominant risk factors for ischemic stroke, such as HT, DM, dyslipidaemia, alcohol and smoking were more common [50–52]. In our study, contrary to the predominant risk factors for ischemic stroke, HIV-infected ischemic stroke patients were found to be statistically significantly higher in patients aged 45 years and younger (74.7%, $P < 0.0001$).

Most cases of acute ischemic stroke are caused by thrombosis or thromboembolism. The TOAST classification and OCSP classification were created to better evaluate acute ischemic stroke according to its etiological mechanism and location, and previous studies had found different results [53–55]. In previous studies, Large Artery Atherosclerosis (LAA) lowest 13% and highest 37.3%, Cardioembolism (CAE) lowest 20.6% and highest 31%, Small Artery Occlusion (SAO) lowest 17% and highest high 23%, Other Cause (OK) lowest 2% and highest 10%, Undetermined Cause (UND) lowest 27% and highest 35% [53–55]. The data of our study were significantly different from other studies as the Large-artery atherosclerosis(LAA) subtype had a high rate of 67.7% and a very low rate of other causes (Stroke of other determined cause and Stroke of undetermined cause) 4.5%.

This study provided, for the first time, basic epidemiological data on the causes of ischemic stroke in the Somali and sub-Saharan African population, and found widely divergent results. Different risk factor profiles result in different etiologic stroke subtypes. Therefore, the heterogeneity observed in the aetiology of stroke in our study results may have resulted from local variations in the distribution of risk factors. From this point, our results also show that ischemic stroke should not be considered as a homogeneous disease state in epidemiological stroke studies. This information may represent a first step towards focused planning of primary prevention programs and the development of health strategies to reduce the burden of stroke imposed on underdeveloped societies such as Somalia.

Although thrombolytic treatment use is increasing day by day in the world, its use is still not at the expected level, especially in regions with low education level [56]. Although it depends on many factors, it is thought that the most common reason why IV rt-PA cannot be applied is due to pre-hospital delays [57]. In a study conducted in the USA, it was determined that there were significant regional differences (the highest 9.3% and the lowest 0%) regarding the rates of IV rt-PA administration in the treatment of acute ischemic stroke [56]. In our study, this rate was found to be 6.7% ($n = 264$). Although there were 877 (22.1%) patients who applied within the thrombolytic treatment window(3 and 4.5 hour period), the important reason for the low rate of IV rt-PA application was that there were patients who did not meet the criteria and that some of the relatives did not accept treatment for their patients due to their religious beliefs. The results of previous multicentre studies and meta-analysis found the rates of patients living independently (mRS:0-2) after 3 months (ranging from 30-50%) to be statistically significantly higher than the group that did not receive IV rt-PA treatment [58–60]. In the analyses of the same studies, it was emphasized that the earlier IV rt-PA treatment is administered, the better the results will be and the lower the complication rate will be. And, rates of symptomatic intracranial haemorrhage in the treated group ranged from 6% to 8.6% [58–60]. In our study, good functional results (mRS=0-2 at 3 months after treatment) were obtained with a rate of 68.2% in patients who underwent thrombolysis, and this was statistically significant ($P < 0.001$). In addition, the mean time of rtPA administration was 158±23 minutes in patients who underwent thrombolysis, and the time of rtPA administration was shorter in patients with good functional results compared to patients with poor functional results (172±39 versus 148±15). These results were in agreement with previous study results. We found the rate of haemorrhagic transformation (intracerebral haemorrhage) to be 4.2% in patients who underwent thrombolysis. This rate was lower than previous studies.

Previous studies found mortality rates at the end of 3 months in the range of 15.5%-17% and did not detect a significant difference between those who received rtPA therapy and those who did not [58,60]. In our study, the hospital mortality rate was 13.4% and there was no significant difference in mortality rates between rtPA therapy administered ischemic stroke patients and not administered ones. Two studies in sub-Saharan Africa compared stroke mortality rates in HIV-infected versus non-HIV-infected individuals. The first study found a significant difference in 30-day mortality rates between HIV infected and HIV uninfected patients (23% vs. 10.5%, $P = 0.007$) respectively [61]. The second study had a much longer follow up period and found no difference in mortality rates at 6 month and 1 year between HIV infected and HIV uninfected [45]. In our study results, was no significant difference in mortality rates between HIV-infected and non-HIV-infected ischemic stroke patients.

Our study has several potential limitations. These limitations are that it is retrospective and therefore limited access to some patient information parameters, it is a single-centre study, and hospital-based. The sparse distribution of the Somali population of 16,359,500 over a wide geographic area of 637,657 km2 is the biggest barrier to individuals' access to health care, and it is estimated that less than 15% of the rural population has access to any health care [62]. Because of these conditions, it is possible that a smaller proportion of stroke cases will apply to healthcare facilities in Somalia, and therefore to our hospital. Therefore, the data in our study may not be representative of all ischemic strokes in the population, and we estimate that the true incidence rate is much higher.

Our study was designed to include the distribution and comparison of data according to demographic characteristics, etiological risk factors, and stroke classification, apart from standard incidence rates. In this way, it is aimed to create a prediction model for stroke incidence and genetic direction. In this context, our study, which is the first and comprehensive review of the stroke literature in Somalia, presents different results from previous study data.

In our study, we reported the mean age of stroke 51.12 ± 16.43 and male predominance (65.7%). Consistent with previous studies, while hypertension, hyperlipidaemia, and Diabetes mellitus (DM) were found to be more common among risk factors, smoking history and alcohol consumption history were found to be at a very low rate. HIV-infected ischemic stroke was detected at a high rate (20.9%) and was common in a relatively young age group (31.8 ± 14.3). When the relationship between juvenile ischemic stroke and prognosis was examined in multiple regression analysis, a significant relationship was found with a low entry NIHSS score. While Large-artery atherosclerosis (LAA) subtype was detected with a high rate of 67.7%, the most common clot location was found in the Supratentorial location (74.3%), and partial anterior circulation infarcts (PACI) subtype (56.3%) was found to be the most common according to OSCP classification. And these results were again different from other studies.

Extending these and similar epidemiological studies to other parts of the continent can provide clinicians with a guide for the evaluation and follow-up of stroke patients and projections for public health programs for stroke prevention and treatment.

Authors' contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: EA contributed 75%; and OC 25%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Dissemination of results

Results from this study were presented to provincial authorities and have been informally shared with clinical staff at the data collection site.

Funding

The authors declare that this study has not received any funding resources.

Declaration of competing interest

The authors declare no conflict of interest associated with this publication.

Acknowledgment

None.

References

[1] Mathers C, Fat DM, Boerma JT. The global burden of disease: 2004 update. World Health Organization; 2008.
[2] Hay SI, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017;390:1260–344 https://doi.org/10.3410/f. 726827339.793524296.
[3] Lewandowski C, Barsan W. Treatment of acute ischemic stroke. Ann Emerg Med 2001;37:202–16.
[4] Streletz L, Mushtak A, Gad H, Abbasi S, Dimassi D, Akhtar N, Mahmoud Y, Dargham S, Abu Raddad L, Khattab AD. Epidemiology of stroke in the MENA region: a systematic review. Int J Neurol Neurol Disord 2017;1(1):10–21 https://bit.ly/2P1qr9h. Accessed 16 Dec 2018.
[5] Adeloye D. An estimate of the incidence and prevalence of stroke in Africa: a systematic review and meta-analysis. PLoS One 2014;9(6):e100724.
[6] Tran J, Mirzaei M, Anderson L, Leeder SR. The epidemiology of stroke in the Middle East and North Africa. J Neurol Sci. 2010;295(1–2):38–40.
[7] Campbell BC, Bladin CF, Donnan GA, Davis SM. Acute ischemic stroke. In: Handbook of neuroemergency clinical trials. Elsevier; 2018. p. 3–21.
[8] Truelsen T, Bonita R, Jamrozik K. Surveillance of stroke: a global perspective. Int J Epidemiol 2001;30:S11–16.
[9] Rand, et al. Fewer ischemic strokes, despite an ageing population: stroke models from observed incidence in Norway 2010–2015. BMC Health Serv Res 2019;19:705. doi:10.1186/s12913-019-4538-7.
[10] O'Donnell MJ, Denis X, Liu L, et al. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. Te Lancet 2010;376(9735):112–23.
[11] Bonita R, Mendis S, Truelsen T, Bogousslavsky J, Toole J, Yatsu F. The global stroke initiative. Lancet Neurol 2004;3(7):391–3.
[12] Namale Gertrude G, Kamacooko Onesmus O, et al. Risk factors for hemorrhagic and ischemic stroke in Sub-Saharan Africa. J Trop Med Volume 2018:4650851 https://doi.org/10.1155/2018/4650851.
[13] Connor MD, Torogood M, Modi G, Warlow CP. The burden of stroke in Sub-Saharan Africa. Am J Prev Med 2007;33(2):172–3.
[14] Lemogoum D, Degaute J-P, Bovet P. Stroke prevention, treatment, and rehabilitation in Sub-Saharan Africa. Am J Prev Med 2005;29(5):95–101 supplement 1.
[15] Walker RW, Jusabani A, Aris E, et al. Stroke risk factors in an incident population in urban and rural Tanzania: A prospective, community-based, case-control study. Lancet Glob Health 2013;1(5):e282–8.
[16] Chow FC, Regan S, Feske S, et al. Comparison of ischemic stroke incidence in HIV-infected and non-HIV-infected patients in a US health care system. J Acquir Immune Defic Syndr 2012;60(4):351–8 [PubMed: 22580566].
[17] Benjamin LA, Corbett EL, Connor MD, et al. HIV, antiretroviral treatment, hypertension, and stroke in Malawian adults: a case-control study. Neurology 2016;86(4):324–33 [PubMed: 26683649].
[18] Cole JW, Pinto AN, Hebel JR, et al. Acquired immunodeficiency syndrome and the risk of stroke. Stroke 2004;35(1):51–6 [PubMed: 14684782].
[19] Walker RW, Jusabani A, Aris E, et al. Stroke risk factors in an incident population in urban and rural Tanzania: a prospective, community-based, case-control study. Lancet Glob Heal 2013;1(5):e282–8.
[20] https://cdn.who.int/media/docs/default-source/hq-hiv-hepatitis-and-stis-library/key-facts-hiv-2020.pdf?sfvrsn=582c3f6e_13.
[21] Jauch EC, Saver JL, Adams HP Jr, Bruno A, Connors JJ, Demaerschalk BM, et al. Guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44:870–947. doi:10.1161/str.0b013e318284056a.
[22] Chen OT, He M. Intravenous thrombolysis with urokinase for acute cerebral infarctions. Chin J Neurol 2002;35:210–13.
[23] Adams HP Jr, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL, Marsh EE 3rd. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. Stroke 1993;24(1):35–41.
[24] Luan X, Qiu H, Hong X, Wu C, Zhao K, Chen H. High serum nerve growth factor concentrations are associated with good functional outcome at 3 months following acute ischemic stroke. Clin Chim Acta 2019;488:20–4. doi:10.1016/j.cca.2018.10.030.
[25] Goldstein LB, Adams R, ark Alberts MJ ve. Primary prevention of ischemic stroke: a guideline from the American Heart Association/American Stroke Association Stroke Council. Stroke 2006;37:1583–633.
[26] Thom T, Haase N, ark Rosamond W ve. Heart disease and stroke statistics- 2009 update. A report from the American Heart Association Statistics Committee and Stroke Statistics Subcommitee. Circulation 2006;113:85–151.
[27] Guzik M, Bushnell C. Stroke epidemiology and risk factor management. Continuum 2017;23:15–39.
[28] Yoneda Y, Okuda S, Hamada R, Toyota A, Gotoh J, Watanabe M, et al. Hospital cost of ischemic stroke and intracerebral hemorrhage in Japanese stroke centers. Health Policy 2005;73:202–11.
[29] Reganon E, Vila V, Martínez-Sales V, Vaya A, Lago A, Alonso P, et al. Association between inflammation and hemostatic markers in atherothrombotic stroke. Thromb Res 2003;112:217–21.
[30] Williams LS, Bruno A, Rouch D, Marriott DJ. Stroke patients' knowledge of stroke. Influence on time to presentation. Stroke 1997;28:912–15.
[31] Ringleb PA, Bousser MG, Ford G, et al. Guidelines for management of ischaemic stroke and t r a n s i e n t ischaemic attack 2008. Cerebrovasc Dis 2008;25(5):457–507.
[32] Seedat YK. Hypertension in developing nations in subSaharan Africa. J Hum Hypertens 2000;14(10–11):739–47.
[33] Tell GS, Polak JF, Ward BJ, Kittner SJ, Savage PJ, Robbins J. Relation of smoking with carotid artery wall thickness and stenosis in older adults: Te Cardiovascular Health Study. Circulation 1994;90(6):2905–8.
[34] Smith P. Smoking and stroke: a causative role. Br Med J 1998;317:962–3.
[35] Lacy CR, Suh DC, Bueno M, Kostis JB. Delay in presentation and evaluation for acute stroke: Stroke Time Registry for Outcomes Knowledge and Epidemiology (S.T.R.O.K.E.). Stroke 2001;32:63–9.
[36] Jorgensen HS, Nakayama H, Reith J, Raaschou HO, Olsen TS. Factors delaying hospital admission in acute stroke: the Copenhagen Stroke Study. Neurology 1996;47:383–7.
[37] Fogelholm R, Murros K, Rissanen A, Ilmavirta M. Factors delaying hospital admission after acute stroke. Stroke 1996;27:398–400.
[38] Azzimondi G, Bassein L, Fiorani L, Nonino F, Montaguti U, Celin D, et al. Variables associated with hospital arrival time after stroke: effect of delay on the clinical efficiency of early treatment. Stroke 1997;28:537–42.
[39] Evenson KR, Rosamond WD, Morris DL. Prehospital and in-hospital delays in acute stroke C are. Neuroepidemiology 2001;20:65–76.
[40] Ferro JM, Melo TP, Oliveira V, Crespo M, Canhão P, Pinto AN. An analysis of the admission delay of acute stroke. Cerebrovasc Dis 1994;4:72–5.
[41] Kriitmaa Kelsi, Testa Adrienne, et al. HIV prevalence and characteristics of sex work among female sex workers in Hargeisa, Somaliland, Somalia. AIDS 2010;24(suppl 2):S61–7.
[42] Progress report for Somali HIV and AIDS Response 2014-UNAIDS
[43] Sen S, Rabinstein AA, Elkind MS, Powers WJ. Recent developments regarding human immunodefciency virus infection and stroke. Cerebrovasc Dis 2012;33(3):209–18.
[44] Mlay M, Bakari M. Te prevalence of HIV among patients admitted with stroke at the Muhimbili National Hospital, Dar es Salaam, Tanzania. Tanzania J Health Res 2010;12(2):105–13.
[45] Heikinheimo T, Chimbayo D, Kumwenda JJ, Kampondeni S, Allain TJ. Stroke outcomes in Malawi, a country with high prevalence of HIV: a prospective follow-up study. PLoS One 2012;7(3):e33765.
[46] Singer EJ, Valdes-Sueiras M, Commins DL, Yong W, Carlson M. HIV stroke risk: Evidence and implications. Ther Adv Chronic Dis. 2013;4:61–70 [PubMed].
[47] Qureshi AI, Janssen RS, Karon JM, Weissman JP, Akbar MS, Safdar K, Frankel MR. Human immunodeficiency virus infection and stroke in young patients. Arch. Neurol. 1997;54:1150–3.
[48] Abdallah Amir, et al. Stroke in HIV-infected individuals in sub-Saharan Africa (SSA): a systematic review. J Stroke Cerebrovasc Dis 2018;27(7):1828–36 10.1016/j.jstrokecerebrovasdis.2018.02.016.
[49] Dash D, Bhashin A, Pandit AK, Tripathi M, Bhatia R, Prasad K, Padma MV. Risk factors and etiologies of ischemic strokes in young patients: a tertiary hospital study in north India. J Stroke 2014;16:173–7.
[50] Cerrato P, Grasso M, Imperiale D, Priano L, Baima C, Giraudo M, Rizzuto A, Azzaro C, Lentini A, Bergamasco B. Stroke in young patients: etiopathogenesis and risk factors in different age classes. Cerebrovasc Dis 2004;18:154–9.
[51] Ji R, Schwamm LH, Pervez MA, Singhal AB. Ischemic stroke and transient ischemic attack in young adults: risk factors, diagnostic yield, neuroimaging, and thrombolysis. JAMA Neurol 2013;70:51–7.
[52] Lipska K, Sylaja PN, Sarma PS, Thankappan KR, Kutty VR, Vasan RS, Radhakrishnan K. Risk factors for acute ischaemic stroke in young adults in South India. J Neurol Neurosurg Psychiatry 2007;78:959–63.
[53] Kolominsky-Rabas Peter L, Weber Margarete, et al. Epidemiology of ischemic stroke subtypes according to TOAST criteria. Stroke 2001;32(12) Pages 2735-2740. doi:10.1161/hs1201.100209.
[54] TOAST classification and risk factors of ischemic stroke in Lebanon. Acta Neurol Scand 2020;141:294–300. doi:10.1111/ane.13201.

[55] Trial of ORG 10172 in Acute Stroke Treatment (TOAST) classification and vascular territory of ischemic stroke lesions diagnosed by diffusion-weighted imaging. J Am Heart Assoc 2014;3:e001119. doi:10.1161/JAHA.114.001119.
[56] Skolarus LE, Meurer WJ, Shanmugasundaram K. Marked regional variation in acute stroke treatment among medicare beneficiaries. Stroke. 2015;46(7):1890–6. doi:10.1161/STROKEAHA.115.009163.
[57] Hess DC, Wang S, Hamilton W, Lee S. REACH: clinical feasibility of a rural telestroke network. Stroke 2005;36(9):2018–20 (doi: 10.1161/01.STR. 0000177534. 02969.e4).
[58] The National Institute of Neurological Disorders rt-PA Stroke Study Group. Tissue plasminogen activator for acute ischemic stroke. N Engl J Med 1995;333:1581–7.
[59] Wardlaw J, Berge E, del Zoppo G, Yamaguchi T. Thrombolysis for acute ischemic stroke. Stroke 2004;35:2914–15.
[60] Wahlgren N, Ahmed N, Davalos A. SITSMOST Investigators. Thrombolysis with alteplase for acute ischemic stroke in the Safe Implementation of Thrombolysis in Stroke Monitoring Study (SITSMOST): an observational study. Lancet 2007;369(9558):275–82.
[61] Gnonlonfoun D, Adjien KC, Adoukonou TA, et al. Human Immunodeficiency Virus Infection(HIV), Stroke Severity and Mortality Predictive indicator in centre National Hospitalier Et Universitaire-Hubert Koutoukou Maga(CNHU-HKM) Cotonou, Benin. African J Neurol Sci 2013;32(2):14–21.
[62] Data for better life tomorrow, population estimations survey. Somalia: UNFPA PRESS; 2014. https://somalia.unfpa.org/sites/default/files/pub-pdf/Population-Estimation-Survey-of-Somalia-PESS-2013-2014.pdf. Date of access: 01.04.2018.