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Patient Demographics, Characteristics, and Intrahospital Mortality of Different Ischemic Stroke Subtypes in a Tertiary Hospital during Five-Year Period †

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Abstract: *Background and Objectives.* Ischemic stroke (IS) is one of the leading causes of disability, morbidity, and mortality worldwide. The goal of the study was to evaluate patient demographics, characteristics, and intrahospital mortality among different ischemic stroke subtypes. *Materials and Methods.* A retrospective observational non-randomized study was conducted, including only ischemic stroke patients, admitted to Pauls Stradins Clinical university hospital, Riga, Latvia, from January of 2016 until December 2020. Ischemic stroke subtypes were determined according to Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria as a stroke due to (1) large-artery atherosclerosis (atherothrombotic stroke (AS)), (2) cardioembolism (cardioembolic stroke (CS)), (3) small-vessel occlusion (lacunar stroke (LS)), (4) stroke of other determined etiology (other specified stroke (OSS)), and (5) stroke of undetermined etiology (undetermined stroke (US)). The data between different stroke subtypes were compared. *Results.* There was a slight female predominance among our study population, as 2673 (56.2%) patients were females. In our study group, the most common IS subtypes were cardioembolic stroke (CS), 2252 (47.4%), and atherothrombotic stroke (AS), 1304 (27.4%). CS patients were significantly more severely disabled on admission, 1828 (81.4%), and on discharge, 378 (16.8%), $p < 0.05$. Moreover, patients with CS demonstrated the highest rate of comorbidities and risk factors. This was also statistically significant, $p < 0.05$. Differences between the total patient count with no atrial fibrillation (AF), paroxysmal AF, permanent AF, and different IS subtypes among our study population demonstrated not only statistical significance but also a strong association, Cramer's V = 0.53. The majority of patients in our study group were treated conservatively, 3389 (71.3%). Reperfusion therapy was significantly more often performed among CS patients, 770 (34.2%), $p < 0.05$. The overall intrahospital mortality among our study population was 570 (12.0%), with the highest intrahospital mortality rate noted among CS patients, 378 (66.3%), $p < 0.05$. No statistically significant difference was observed between acute myocardial infarction and adiposity, $p > 0.05$. *Conclusions.* In our study, CS and AS were the most common IS subtypes. CS patients were significantly older with slight female predominance. CS patients demonstrated the greatest disability, risk factors, comorbidities, reperfusion therapy, and intrahospital mortality.

Keywords: ischemic stroke; demographics; intrahospital mortality; cardioembolic stroke; atherothrombotic stroke; lacunar stroke; computed tomography; reperfusion therapy; conservative therapy

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1. Introduction

Ischemic stroke (IS) is the fifth leading cause of adult disability, cognitive dysfunction, and mortality, with an immense economic burden worldwide, especially in the increasingly older population [1,2]. It is known that in the United States, 795,000 people every year develop stroke, with 610,000 of them being first strokes [3].

According to available country statistics, stroke incidence in Latvia is reported as one of the highest among other European countries. It is known that in Latvia, the death rate associated with stroke is estimated at around 203 cases on 100,000 people every year, while the approximate death rate in other European Union countries is estimated at around 64 cases a year [4]. For instance, in Estonia, the death rate associated with stroke is reported at around 56 cases a year, while in Russia, it is around 94 cases a year [4].

Every year, around 8000 patients are admitted to hospitals in Latvia with acute stroke, where 20% of patients die from stroke or develop severe disability [4].

In Latvia, there is a high percentage of patients with cardioembolic strokes. Nevertheless, until now, there has never been a study examining stroke patient profiles in Latvia.

Many risk factors for IS development have been reported encompassing nonmodifiable and modifiable conditions. Nonmodifiable risk factors include patient age, sex, race, ethnicity, family history of stroke or transient ischemic attacks (TIA), and history of migraine attacks [5,6], whereas diabetes mellitus, atrial fibrillation, heart failure, valvular disease, hypercholesterolemia, lifestyle issues as excessive alcohol intake, smoking, illicit drug use, sedentary lifestyle, obesity, oral contraceptive use are modifiable risk factors with the highest importance of arterial hypertension[7]. Nevertheless, IS is considered a preventable entity if the population's modifiable risk factors can be addressed appropriately.

Studies among different populations have been performed suggesting regional variabilities concerning the distribution of IS types and the prevalence of their risk factors. Early mortality rate 30 days after IS has been estimated at around 15% [8]. The causes of death after IS may be influenced by numerous factors, including not only patient risk factors but also access to healthcare resources, medical treatment, economic support, medical costs, etc. [9].

The goal of the study was to evaluate patient demographics, characteristics, and intrahospital mortality among different ischemic stroke subtypes.

2. Materials and Methods

A retrospective observational non-randomized study was conducted, including only ischemic stroke patients, admitted to Pauls Stradins Clinical university hospital, Riga, Latvia, from January of 2016 until December 2020. Data were obtained from the Latvian Stroke Registry, which has operated since 2009 and contains data of more than 14,000 stroke patients.

Data of patient demographics, comorbidities, stroke etiology, length of patient intrahospital stay, and death were recorded. All patients were evaluated using the Glasgow Coma Scale (GKS), Latvian adaption of National Institute of Health Stroke Scale (NIHSS-LV) [10], and Modified Rankin Scale (mRS) on admission and at the time of discharge. Ischemic stroke subtypes were determined according to Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria [11] as a stroke due to (1) large-artery atherosclerosis (atherothrombotic stroke (AS)), (2) cardioembolism (cardioembolic stroke (CS)), (3) small-vessel occlusion (lacunar stroke (LS)), (4) stroke of other determined etiology (other specified stroke (OSS)), and (5) stroke of undetermined etiology (undetermined stroke (US)). The data between different stroke subtypes were compared.

All data were analyzed using Microsoft Excel and IBM Statistical Package of the Social Sciences (SPSS) 23.0. In statistical analysis, data were expressed as absolute numbers and percentage, median, and interquartile range where appropriate. Independent samples t-test, one-way analysis of variance (ANOVA), post-hoc tests, Kruskal–Wallis test, Tukey's test, and chi-square tests were performed where appropriate. In this study, five different IS

subtypes were compared to each other. Multinominal logistic regression was not applicable. The primary aim of our study was to evaluate patient demographics, characteristics, including their comorbidities, and intrahospital mortality among patients with different IS subtypes and to compare them within these groups. In order to perform these tasks, univariate tests in statistical analysis were used. As we conducted a retrospective observational non-randomized study, our main interest included patient clinical characteristic differences within each IS subtype. One of the main goals of this study was to conclude the possible associations between five IS subtypes and other variables such as comorbidities, etc. In our study, we did not use any regression analysis as our primary goal was not to modulate GCS, mRS, NIHSS-LV, and mortality; our goal was to compare patient groups. Therefore, multivariate analysis was not performed.

We used interquartile range in our study as the data were not normally distributed. A p-value < 0.05 was considered statistically significant.

In our study, independent samples t-test, one-way analysis of variance (ANOVA), post-hoc tests, Kruskal–Wallis test, Tukey's test, and chi-square tests were performed where appropriate. In this study, five different IS subtypes were compared to each other. Multinominal logistic regression was not applicable. We used interquartile range in our study as the data were not normally distributed. Independent samples t-test and Tukey's test were used when comparing the means of two sets of our data, determining whether there was statistical evidence that these means are significantly different. One-way analysis of variance (ANOVA) was used when we analyzed patient Glasgow Coma Scale, patient Modified Rankin score, and NIHSS-LV score both at the admission and before discharge from the hospital, as well as patient in-hospital stay in each IS subtype. A post-hoc test was used to uncover specific differences in Glasgow Coma Scale score and NIHSS-LV between five IS subtypes as a one-way analysis of variance (ANOVA) F test was significant. Kruskal–Wallis test was used when we analyzed patient in-hospital stay in each IS subtype. Chi-square test was used when we analyzed the Modified Rankin score. Therapy received, patient comorbidities, including smoking status, arterial hypertension, atrial fibrillation, coronary heart disease, acute myocardial infarction, chronic heart disease, chronic kidney disease, pathologies in brachiocephalic and transcranial blood vessels, alcohol abuse, dyslipidemia, adiposity, diabetes mellitus, oncology, history of previous cerebrovascular events, in each IS subtype.

This study was approved by the Local Ethical Committee of Riga Stradins University, Riga, Latvia. Patient personal data were not included in the study.

3. Results

3.1. Baseline Patient Demographic Data

In the time from 2016 to 2020, a total of 4753 patients were admitted to the tertiary university hospital with the diagnosis of acute IS.

Median patient age among our study population was 75 (interquartile range (IQR) = 66–82) years old with CS patients being older as their median age was 78 (IQR = 71–84) years old, while all other IS subtype patients were younger, as their median age was as follows: among AS patients, 72 (IQR = 64–80) years old, LS patients, 70 (IQR = 60–79) years old, OSS, 63 (IQR = 48–76) years old, and US patients, 71 (IQR = 60–80) years old, and this was statistically significant, $p < 0.05$ (see Table 1).

Table 1. Median patient age and female distribution among our study population.

	CS	AS	LS	OSS	US	p-Value
Median patient age, IQR	78 (IQR = 71–84)	72 (IQR = 64–80)	70 (IQR = 60–79)	63 (IQR = 48–76)	71 (IQR = 60–80)	<0.05
Sex, F—females	F: 1442 (64.0%)	F: 610 (46.8%)	F: 212 (47.0%)	F: 58 (50.4%)	F: 351 (55.6%)	<0.05

CS—cardioembolic stroke. AS—atherothrombotic stroke. LS—lacunar stroke. OSS—other specified stroke. US—undetermined stroke.

There was a slight female predominance among our study population, $n = 2673$ (56.2%). The highest percentage of female patients were noted among CS patients, 1442 (64.0%), and these differences were statistically significant, $p < 0.05$ (see Table 1).

3.2. Patient Evaluation Data on Their Admission and Their Intrahospital Stay

On admission, all patient level of consciousness was evaluated using GCS. Among all patients, median GCS was 15 (IQR 13–15). Median GCS in CS patients was lower than the median GCS among all patients as it was 14 (IQR = 11–15). Median GCS, among other IS subtypes, are demonstrated in detail in Table 2.

Table 2. Patient evaluation data on admission and their history of cerebrovascular events.

	CS	AS	LS	OSS	US	*p*-Value
Admission GCS	14 (IQR = 11–15)	15 (IQR = 14–15)	15 (IQR = 15–15)	15 (IQR = 14–15)	15 (IQR = 13–15)	<0.05
NIHSS-LV on admission	10 (IQR = 5–16)	6 (IQR = 3–10)	4 (IQR = 2–5)	6 (IQR = 3–10)	6 (IQR = 3–12)	<0.05
mRS on admission:						
1. Slight disability (0–2)	1. 197 (8.8%)	1. 219 (16.8%)	1. 165 (36.7%)	1. 23 (20.0%)	1. 116 (18.4%)	<0.05
2. Moderate disability (3)	2. 220 (9.8%)	2. 213 (16.3%)	2. 103 (22.9%)	2. 15 (13.0%)	2. 96 (15.2%)	
3. Severe disability (4–5)	3. 1828 (81.4%)	3. 871 (66.8%)	3. 182 (40.4%)	3. 77 (67.0%)	3. 419 (66.4%)	
Cerebrovascular events						
1. First-ever stroke episode	1. 1633 (72.5%)	1. 960 (73.6%)	1. 333 (73.8%)	1. 93 (80.9%)	1. 495 (78.4%)	<0.05
2. Transient ischemic attack	2. 7 (0.3%)	2. 12 (0.9%)	2. 4 (0.9%)	2. 0 (0.0%)	2. 2 (0.3%)	
3. Recurrent stroke	3. 612 (27.2%)	3. 332 (25.5%)	3. 114 (25.3%)	3. 22 (19.1%)	3. 134 (21.2%)	

CS—cardioembolic stroke. AS—atherothrombotic stroke. LS—lacunar stroke. OSS—other specified stroke. US—undetermined stroke. NIHSS—LV—Latvian adaption of National Institute of Health Stroke Scale. mRS—Modified Rankin Scale.

Moreover, on admission, all patient impairment by stroke was objectively quantified using NIHSS-LV. The median NIHSS-LV score among all patients in our study group was 7 (IQR = 4–14). In patients with CS, median admission NIHSS-LV score was higher as it was 10 (IQR = 5–16), but in all other IS subtypes, the median NIHSS-LV score on admission was lower than the median NIHSS-LV score among all patients in our study group. This was statistically significant, $p < 0.05$. Detailed NIHSS-LV is noted in Table 2.

All patients were evaluated on admission not only using GCS and NIHSS-LV score, but the degree of disability and/or dependence in daily activities was evaluated using Modified Rankin score (mRS). Patient functional status on admission using mRS was defined as "slight disability" (0–2), "moderate disability" (3), and "severe disability" (4–5). In our study group, 720 (15.2%) patients presented with slight disability, while 647 (13.6%) patients had moderate disability on admission, but the majority of patients, 3377 (71.2%) patients, were severely disabled. Detailed patient mRS is demonstrated in Table 2.

- Among patients with slight disability at the admission, 197 (8.8%) were CS patients, that being statistically significantly less to compare with all patients who presented with slight disability in our study population, $p < 0.05$;
- Moreover, 220 (9.8%) CS patients presented with moderate disability, and this was also noted significantly less than among all patients who presented with moderate disability, $p < 0.05$;
- Majority of patients presented with severe disability. Statistically significantly, the highest prevalence of severely disabled patients on admission in our study group was found in CS patients as 1828 (81.4%) of them were severely disabled. These differences were statistically significant, $p < 0.05$ (see Table 2).

In our study, we also included patients without a history of cerebrovascular events, patients with transient ischemic attack (TIA), and patients with anamnesis of previous stroke. A total of 3514 (73.9%) patients demonstrated no history of cerebrovascular events; therefore, these were cases of first-ever stroke episodes. A total of 25 (0.5%) were patients

with TIA, but 1214 (25.5%) patients had an anamnesis of previous stroke; therefore, these were cases of recurrent stroke. In our study, differences between the total amount of patients with first-ever stroke episode, TIA, recurrent stroke, and different IS subtypes were statistically significant, $p < 0.05$. Detailed displays of patients with a history of cerebrovascular events, patients with TIA and patients with anamnesis of previous stroke are noted in Table 2.

3.3. Patient Intrahospital Stay and Their Evaluation Data on Discharge

Median patient intrahospital stay among our study population was 10 (IQR = 7–14) days. For a detailed assessment of patient intrahospital stay among our study population, see Table 3.

Table 3. Patient intrahospital stay and their evaluation data on discharge.

	CS	AS	LS	OSS	US	*p*-Value
Intrahospital stay, days	10 (IQR = 7–15)	10 (IQR = 7–13)	8 (IQR = 6–10)	10 (IQR = 7–14)	9 (IQR = 6–13)	<0.05
NIHSS-LV on discharge	4 (IQR = 2–10)	3 (IQR = 2–6)	2 (IQR = 1–3)	3 (IQR = 1–6)	3 (IQR = 1–6)	<0.05
mRS on discharge:						
1. Satisfactory outcome (0–2)	1. 655 (29.1%)	1. 495 (38.0%)	1. 295 (65.4%)	1. 49 (42.6%)	1. 269 (42.6%)	
2. Moderate disability (3)	2. 337 (15.0%)	2. 255 (19.6%)	2. 85 (18.8%)	2. 22 (19.1%)	2. 94 (14.9%)	<0.05
3. Severe disability (4–5)	3. 882 (39.2%)	3. 455 (34.9%)	3. 68 (15.1%)	3. 34 (29.6%)	3. 188 (29.8%)	
4. Dead (6)	4. 378 (16.8%)	4. 99 (7.6%)	4. 3 (0.7%)	4. 10 (8.7%)	4. 80 (12.7%)	

CS—cardioembolic stroke. AS—atherothrombotic stroke. LS—lacunar stroke. OSS—other specified stroke. US—undetermined stroke. NIHSS—LV—Latvian adaption of National Institute of Health Stroke Scale. mRS—Modified Rankin Scale.

All patients were repeatedly evaluated using NIHSS-LV score before discharge from the hospital (see Table 3). The median NIHSS-LV score at the time of patient discharge from the hospital in our study group was 3 (IQR = 1–7), $p < 0.05$.

All patients' degree of disability and/or dependence in daily activities were repeatedly evaluated before they were discharged from the hospital mRS. Among our study population, 1763 (37.1%) patients reached satisfactory outcomes. On the other hand, there were 793 (16.7%) patients with moderate disability, but severe disability was present in 1627 (34.2%) patients. Unfortunately, 570 (12.0%) patients died in our study population.

- 655 (29.1%) CS patients reached satisfactory outcomes, that being significantly less to compare with all patients in our study who reached satisfactory outcomes, $p < 0.05$;
- Moderate disability at the time of patient discharge was noted in 337 (15.0%) CS patients, $p < 0.05$;
- CS patients statistically significantly more often reached a level of severe disability, but patients with LS were statistically significantly less frequent as 882 (39.2%) $p < 0.05$.
- Among patients who died, there were significantly more CS patients, 378 (16.8%), while those with LS died significantly less often as 3 (0.7%) of them died. These differences were statistically significant, $p < 0.05$ (see Table 3).

3.4. Patient Treatment and Their Intrahospital Mortality

In our study population, 1364 (28.7%) patients received reperfusion therapy (RT), and the majority of them were CS patients, 770 (34.2%). RT was less often performed among LS patients, as only 59 (13.1%) LS patients received RT, $p < 0.05$ (for detailed assessment of patients who received RT see Table 4).

Table 4. Patient treatment and their intrahospital mortality.

KERRYPNX	CS	AS	LS	OSS	US	*p*-Value
Reperfusion therapy (RT)	770 (34.2%)	318 (24.4%)	59 (13.1%)	23 (20.0%)	194 (30.7%)	<0.05
Received therapy:						
1. Conservative therapy	1. 1482 (65.8%)	1. 986 (75.6%)	1. 392 (86.9%)	1. 92 (80.0%)	1. 437 (69.3%)	
2. IVT	2. 440 (19.5%)	2. 219 (16.8%)	2. 57 (12.6%)	2. 11 (9.6%)	2. 133 (21.1%)	<0.05
3. MTE	3. 97 (4.3%)	3. 38 (2.9%)	3. 2 (0.4%)	3. 4 (3.5%)	3. 14 (2.2%)	
4. IVT + MTE	4. 233 (10.3%)	4. 61 (4.7%)	4. 0 (0.0%)	4. 8 (7.0%)	4. 47 (7.4%)	
Intrahospital mortality	378 (66.3%)	99 (17.4%)	3 (0.5%)	10 (1.8%)	80 (14.0%)	<0.05

CS—cardioembolic stroke. AS—atherothrombotic stroke. LS—lacunar stroke. OSS—other specified stroke. US—undetermined stroke. IVT—intravenous thrombolysis. MTE—mechanical thrombectomy.

The majority of patients did not receive reperfusion therapy: 3389 (71.3%); therefore, these patients were treated conservatively, $p < 0.05$. The distribution of different IS patients who received IVT, MTE, and both IVT and MTE among our study population are demonstrated in Table 4.

The overall intrahospital mortality among our study population was 570 (12.0%). The highest intrahospital mortality rate was detected among CS patients, as 378 (66.3%) CS patients died, but the lowest rate was noted among LS patients, 3 (0.5%), respectively. $p < 0.05$ (see Table 4).

3.5. Patient Comorbidities and Risk Factors

In total, AH was found in 3972 (83.6%) patients in our study group, $p < 0.05$. Detailed distribution of different IS patients with AH among our study group are demonstrated in Table 5.

Table 5. Patient comorbidities and risk factors.

	CS	AS	LS	OSS	US	*p*-Value
Arterial hypertension	1893 (84.1%)	1115 (85.5%)	393 (87.1%)	75 (65.2%)	496 (78.6%)	<0.05
Atrial fibrillation (AF):						
1. No AF	1. 356 (15.8%)	1. 1231 (94.4%)	1. 376 (83.4%)	1. 107 (93.0%)	1. 546 (86.5%)	<0.05
2. Paroxysmal AF	2. 539 (23.9%)	2. 35 (2.7%)	2. 26 (5.8%)	2. 4 (3.5%)	2. 32 (5.1%)	
3. Permanent AF	3. 1357 (60.3%)	3. 38 (2.9%)	3. 49 (10.9%)	3. 4 (3.5%)	3. 53 (8.4%)	
Coronary heart disease	522 (23.2%)	220 (16.9%)	57 (12.6%)	9 (7.8%)	87 (13.8%)	<0.05
Angina pectoris	169 (7.5%)	76 (5.8%)	20 (4.4%)	1 (0.9%)	34 (5.4%)	<0.05
Acute myocardial infarction	27 (1.2%)	9 (0.7%)	2 (0.4%)	2 (1.7%)	8 (1.3%)	=0.33
Chronic heart failure	1224 (54.4%)	355 (27.2%)	92 (20.4%)	22 (19.1%)	186 (29.5%)	<0.05
Chronic kidney failure	149 (6.6%)	46 (3.5%)	22 (4.9%)	4 (3.5%)	21 (3.3%)	<0.05
BTBV						
1. Normal BTBV	1. 1997 (88.7%)	1. 807 (61.9%)	1. 390 (86.5%)	1. 104 (90.4%)	1. 558 (88.4%)	<0.05
2. Endarterectomy and/or stenting operations	2. 6 (0.3%)	2. 6 (0.5%)	2. 1 (0.2%)	2. 1 (0.9%)	2. 2 (0.3%)	
3. 50% stenosis	3. 18 (0.8%)	3. 5 (0.4%)	3. 5 (1.1%)	3. 0 (0.0%)	3. 2 (0.3%)	
4. >70% stenosis	4. 231 (10.3%)	4. 486 (37.3%)	4. 55 (12.2%)	4. 10 (8.7%)	4. 69 (10.9%)	
Smoking	43 (1.9%)	118 (9.0%)	24 (5.3%)	3 (2.6%)	52 (8.2%)	<0.05
Alcohol abuse	20 (0.9%)	32 (2.5%)	5 (1.1%)	4 (3.5%)	17 (2.7%)	<0.05
Dyslipidemia	769 (34.1%)	626 (48.0%)	215 (47.7%)	39 (33.9%)	224 (35.5%)	<0.05
Adiposity	141 (6.3%)	86 (6.6%)	35 (7.8%)	8 (7.0%)	36 (5.7%)	=0.72
Diabetes mellitus	186 (8.3%)	138 (10.6%)	41 (9.1%)	5 (4.3%)	38 (6.0%)	<0.05
Oncology	127 (5.6%)	57 (4.4%)	21 (4.7%)	23 (20.0%)	30 (4.8%)	<0.05

CS—cardioembolic stroke. AS—atherothrombotic stroke. LS—lacunar stroke. OSS—other specified stroke. US—undetermined stroke. AF—atrial fibrillation. BTBV—brachiocephalic and transcranial blood vessels.

In our study, we included patients with no history of AF, paroxysmal AF, and permanent AF (see Table 5). In our study, differences between the total patient count with no AF, paroxysmal AF, permanent AF, and different IS subtypes among our study population were

statistically significant, $p < 0.05$. Moreover, this association was strong, Cramer's V = 0.53 (see Table 5).

CHD was found in 895 (18.8%) patients in our study group, $p < 0.05$. Detailed distributions of different IS patients with CHD in our study population are demonstrated in Table 5.

In total, 300 (6.3%) patients in our study group had AP, $p < 0.05$ (see Table 5).

In general, AMI was observed in 48 (1.0%) patients among our study group, but this difference was not statistically significant, $p = 0.33$ (see Table 5).

Among our study population, 1879 (39.5%) patients demonstrated a history of CHF. A total of 1224 (54.4%) CS patients had a history of CHF. This difference was statistically significant to compare with the total CHF patient count, $p < 0.05$; the distribution of CHF among other IS subtypes is noted in Table 5.

In general, CKF was noted in 242 (5.1%) patients, $p < 0.05$ (see Table 5).

In our study, we included patients without abnormalities in BTBV, patients with anamnesis of endarterectomy and/or stenting operations, stenosis of 50% in BTBV, and at least 70% stenosis in these blood vessels, $p < 0.05$. Detailed display of patients without abnormalities in BTBV, patients with anamnesis of endarterectomy and/or stenting operations, stenosis of 50% in BTBV, and at least 70% stenosis in these blood vessels are noted in Table 5.

In total, 240 (5.0%) patients in our study population were smokers, $p < 0.05$ (see Table 5).

Moreover, in our study population, a history of alcohol abuse was found in 78 (1.6%) patients, $p < 0.05$ (see Table 5).

Dyslipidemia was found in 1873 (39.4%) patients among our study population, $p < 0.05$ (see Table 5).

In general, adiposity was present in 306 (6.4%) patients in our study group. There was no statistically significant difference observed between the total patient count with adiposity, and different IS subtypes among our study population, $p = 0.72$ (see Table 5).

In our study group, diabetes mellitus (DM) was noted in 408 (8.6%) patients, $p < 0.05$ (see Table 5).

In total, a history of oncology was observed in 258 (5.4%) patients, $p < 0.05$ (see Table 5).

4. Discussion

This was an observational non-randomized study enrolling a large number of mostly elderly patients admitted to a tertiary university hospital during a five-year period, demonstrating CS as the most common IS subtype with the highest prevalence of severely disabled patients both, on admission, 1828 (81.4%), and on discharge, 882 (39.2%) patients, with the greatest intrahospital mortality, 378 (66.3%), despite having the highest reperfusion rate, 770 (34.2%) patients.

A prospective cohort study was performed in Switzerland in 2010, reporting CS as the most frequent IS subtype, as it was noted in 28.5% cases where 47.9% were female patients [12].

Moreover, a retrospective cross-sectional study in Indonesia was conducted in 2016 [13]. In their study, 59.1% of patients were males demonstrating a slight male predominance. The most prevalent risk factor for IS where AH, as it was observed in 83.4% of patients, followed by dyslipidemia, present in 50.6% of patients, and diabetes mellitus, noted in 48.5% of patients. In their study, AS was the most common IS subtype as it was seen in 59.6% of patients[13]. In our study, the most prevalent IS subtype was CS, 2252 (47.4%), followed by AS, 1304 (27.4%), but the rarest IS subtype was OSS, 115 (2.4%) patients.

On the contrary, several studies on stroke patients have been performed in Japan, revealing LS as the most common IS subtype [14]. The most common risk factors for LS among the Japanese population included arterial hypertension (AH), ECG abnormalities, diabetes mellitus, obesity, and smoking [14]. Moreover, among LS patients, these risk factors were present more frequently to compare with CS and AS patients [14].

Among our study population, both the prevalence of AH and adiposity were the highest among LS patients, 393 (87.1%) and 35 (7.8%) patients, respectively. Interestingly, among smokers, the greatest prevalence was noted in AS patients as 118 (9.0%) of them were smokers, followed by US patients, 52 (8.2%) patients, respectively, but among LS patients, 24 (5.3%) patients were smokers.

Numerous studies suggest that there may be an independent association between LS and AH compared to other IS subtypes with similar clinical severity. Blood pressure differences between different IS subtypes may not be related to the clinical severity of stroke but rather to the underlying cause of IS [15].

Atrial fibrillation (AF) is a very common cardiac arrhythmia with significant cardiovascular morbidity and mortality. It is one of the leading preventable causes of IS for which early detection and treatment are critical [16]. Moreover, AF also contributes to higher morbidity and mortality when compared with non-AF-related strokes. Strokes due to AF are very common and associated with very poor outcomes, as 70%–80% die or become disabled [16]. A study performed on AF and IS in Canada in 2013 revealed that among patients with acute IS, AF was present in 17.2% of patients. Overall, in their study, patients with AF had a significantly higher risk of death at 30 days (22.3% versus 10.2%), 12 months (37.1% versus 19.5%), and death or disability at discharge (69.7% versus 54.7%) [17].

To compare with our study, the majority of patients in our study group did not have AF, as it was absent in 2616 (55.0%) patients. On the other hand, paroxysmal AF was present in 636 (13.4%) patients, but permanent AF was noted in 1501 (31.6%) patients, $p < 0.05$. Both paroxysmal and permanent AF was present mostly among CS patients, 539 (23.9%) and 1357 (60.3%) patients, respectively. These differences between the total patient count with no AF, paroxysmal AF, permanent AF, and different IS subtypes among our study population were statistically significant, $p < 0.05$, and this was the only association that was strong in our study group, Cramer's V = 0.53.

Furthermore, several studies have been performed revealing stroke as a major public health issue with the increasing incidence among younger patients [18]. However, the etiology of IS among these patients often remains unclear; therefore, further research on factors contributing to stroke at a younger age is warranted.

A study on stroke patient recanalization in Spain was performed and published in 2020. In their study, 19.6% of AS patients received effective recanalization therapy while 31.1% of patients received recanalization therapy that was not effective, while 22.8 patients did not receive recanalization therapy [19].

To compare with our study, 986 (75.6%) AS patients were treated conservatively. In our study, 219 (16.8%) AS patients received IVT, 38 (2.9%) received MTE, and in 61 (4.7%) patients, both IVT and MTE were performed. In the study conducted in Spain, 34.8% of CS patients were treated conservatively, but 45% of CS patients received reperfusion therapy. To compare with our study, 1482 (65.8%) CS patients received conservative treatment, but 440 (19.5%) CS patients received IVT, 97 (4.3%) received MTE, and in 233 (10.3%) CS patients both, IVT + MTE were performed.

In other countries, patient intrahospital mortality for stroke patients has been reported to be at about 13% [20]. Moreover, a research study in China on causes of death for severe stroke patients was performed in 2018, revealing brain herniation, multiple organ failure, community acquired-lung infections, the use of mechanical ventilation, hypoproteinemia, and a history of hypertension, as well as hospital-acquired pneumonia as the most important causes for death among stroke patients [9].

In our study, 570 (12.0%) patients died, that being a relatively high intrahospital mortality rate. High mortality among our study population was associated with patient comorbidities, the high prevalence of severely disabled patients due to stroke and mistakes in the organization of national health care, as well as many other factors. The highest intrahospital mortality among our study population was noted among CS patients, 378 (66.3%), but the lowest intrahospital mortality rate was noted among LS patients, as only 3 (0.5%) LS patients died.

5. Conclusions

IS is one of the leading causes of disability, cognitive dysfunction, and mortality with great public health importance, growing incidence among younger patients, and an immense economic burden worldwide.

In our study population, IS was identified mostly as elderly patients with a slight female predominance. The two most common IS subtypes among our study population were CS and AS, but OSS was the rarest IS subtype.

Among our study group, CS patients demonstrated the highest rate of comorbidities and risk factors for IS, and this was statistically significant.

Differences between the total patient count with no atrial fibrillation (AF), paroxysmal AF, permanent AF, and different IS subtypes among our study population demonstrated not only statistical significance but also a strong association. This was the only comorbidity to display a strong association.

No statistically significant difference was observed between acute myocardial infarction and adiposity.

The majority of patients in our study group were treated conservatively, while among patients who received reperfusion therapy significantly more often than other patients were CS patients.

Unfortunately, the greatest intrahospital mortality was also noted among CS patients, but, on the other hand, LS patients demonstrated the lowest intrahospital mortality rate.

Further research is warranted to assess factors contributing to higher mortality among IS patients.

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Informed Consent Statement: Patient personal data were not included in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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