

Original Research Article

A comparative study on risk factors, clinical presentation, recovery rates and cost burden of patients with ischemic and hemorrhagic stroke

Femi S V^{®1}*, Nakshathra R Nath^{®1}, Amaya Prasannan^{®1}, Anurag Maniyath^{®1}, Susheela Rani^{®1}, E. Satheesh Kumar^{®1}, Smita^{®2}, Padma²

¹Dept. of Pharmacy Practice, Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India ²Dept. of Pharmacology, Sapthagiri Institute of Medical Sciences & Research Center, Bangalore, Karnataka, India



ARTICLE INFO

Article history: Received 24-10-2024 Accepted 04-12-2024 Available online 28-12-2024

Keywords: Cerebrovascular accidents Ischemic stroke Hemorrhagic stroke Recovery rates Clinical presentation Risk factors

ABSTRACT

Background: Stroke is a significant cause of morbidity and mortality worldwide, with ischemic and hemorrhagic strokes being the two major types. Understanding their distinct risk factors, clinical presentations, recovery rates, and cost burden is crucial for optimizing patient management and healthcare resource allocation.

Aim: To evaluate and compare the risk factors, clinical presentation, recovery rates, and cost burden associated with ischemic and hemorrhagic strokes in patients admitted to a tertiary care hospital.

Materials and Methods: A comparative observational study was conducted on 300 stroke patients admitted to a tertiary care hospital, adhering to predefined inclusion criteria. Detailed demographic data, clinical presentation, comorbid conditions, and treatment costs were collected. Daily progress of inpatients was reviewed to assess recovery rates. The cost burden was calculated based on prescription costs for antistroke and other medications over a 5-day period.

Results: Among the 300 participants, 192 (64%) were diagnosed with ischemic stroke and 108 (36%) with hemorrhagic stroke. Hypertension was the most prevalent comorbidity, affecting 72% of ischemic stroke patients and 68% of hemorrhagic stroke patients. Clinical presentations varied, with hemiparesis being the most common symptom in ischemic strokes (45%) and severe headaches more frequent in hemorrhagic strokes (52%). Recovery rates were higher in ischemic stroke patients, with 70% showing significant improvement compared to 58% of hemorrhagic stroke patients within the study period. The mean prescription cost for inpatient treatment over 5 days was 973.4 INR for general drugs and 679.24 INR for stroke-specific therapies. For outpatients, the mean prescription cost was 98.73 INR for stroke-specific drugs and 18.3 INR for other medications.

Conclusion: This study highlights the differences in risk factors, clinical presentation, recovery rates, and cost burden between ischemic and hemorrhagic strokes. Addressing these factors can aid in tailoring therapeutic strategies to improve patient outcomes and reduce healthcare expenses.

This is an Open Access (OA) journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

A cerebrovascular accident (CVA) is an acute disruption of cerebral blood flow. Approximately 85% of cases are ischemic (caused by blockages), and 15% are hemorrhagic (resulting from blood vessel ruptures). Early recognition and timely treatment are critical to minimizing morbidity and mortality. $^{1-3}$

https://doi.org/10.18231/j.ijpp.2024.034 2393-9079/© 2024 Author(s), Published by Innovative Publication.

^{*} Corresponding author. E-mail address: dr.narendra8951@gmail.com (Femi S V).

1.1. Types of stroke

- 1. **Ischemic Stroke:** The most common type, caused by blood clots obstructing blood vessels, preventing oxygen and nutrients from reaching the brain. Subtypes include:
 - (a) Embolic Stroke: Blood clots traveling from other body parts to the brain.¹
 - (b) Thrombotic Stroke: Blood clots forming directly within the brain's blood vessels.¹
- 2. **Hemorrhagic Stroke:** Caused by the rupture of blood vessels, leading to bleeding within the brain. Common causes include aneurysms and arteriovenous malformations (AVMs).^{1,2}

1.2. Symptoms

- 1. **Ischemic Stroke:** Sudden dizziness, headache, nausea, vomiting, double vision, trembling, poor coordination, difficulty speaking or swallowing, and unconsciousness.^{3,4}
- 2. **Hemorrhagic Stroke:** Sudden severe headache, loss of consciousness, nausea, vomiting, dizziness, balance issues, confusion, and unilateral weakness or numbness. ^{3,5,6}

1.3. Risk factors

- 1. **Modifiable:** High blood pressure, smoking, high cholesterol, diabetes, obesity, physical inactivity, excessive alcohol use, and drug misuse.^{1,2}
- 2. **Non-modifiable:** Age (55+ years), race (African, American, Hispanic), sex (higher risk in males), and family history.^{4,7}

1.4. Diagnosis

Physical examinations and diagnostic tools such as blood tests, carotid ultrasound, angiography, computed tomography (CT)/magnetic resonance imaging (MRI) scans, echocardiograms, and electrocardiograms (ECGs) are used to identify the type and location of a stroke.^{1,2,8}

1.5. Treatment

1.5.1. Ischemic stroke

- 1. Medications: Tissue plasminogen activator (tPA) (within 3-4.5 hours), anticoagulants like aspirin or clopidogrel.^{1,9,10}
- 2. Procedures: Thrombectomy, angioplasty, stenting, or carotid endarterectomy.⁸

1.5.2. Hemorrhagic stroke

1. Medications: Blood pressure management, cessation of anticoagulants, and administration of vitamin K.^{8,10}

2. Procedures: Aneurysm surgery, coil embolization, drainage of excess fluid, or treatment of AVMs. ^{1,6,8}

Rehabilitation and RecoveryRecovery often involves a multidisciplinary team comprising physicians, nurses, therapists, social workers, and psychologists. Interventions include:

- 1. Physical Therapy: To restore movement and strength^{11–13}
- 2. Occupational Therapy: To assist with activities of daily living ^{12,13}
- 3. Speech and Language Therapy: To improve communication and swallowing functions ^{12,13}
- 4. Cognitive and Emotional Support: Addressing memory deficits, depression, and anxiety ^{3,5,7,11–13}

2. Materials and Methods

Sources of data and materials

- 1. Patient case sheet.
- 2. Medication chart.
- 3. Laboratory data.
- 4. Progress reports.
- 5. Neurological assessment reports (standardized and self-designed).
- 6. Suitable self-designed data collection form.

2.1. Inclusion criteria

- 1. Inpatients diagnosed with CVA in the neurological department
- 2. Patients of either sex above 18 yrs of age

2.2. Exclusion criteria

Pregnant and lactating women.

2.3. Method of collection of data

A comparative study was conducted on the patients according to the inclusion criteria after obtaining the consent form. All the inpatients were reviewed daily for their progress. The Patient demographic details such as name, age, gender, weight, educational status, lifestyle, economic status, social status, date of admission, complaints on admission, history of previous, comorbidities illness and medication, social history, nutritional data , progress data were collected.

The patient data were collected from medical records and the recovery data were collected from the progress charts and interviewing the patient with open ended questions. Collected data were recorded in a selfdesigned patient data collection form and were assessed by neurological assessment charts and with standard neurological assessment and stroke severity assessment scale (Glasgow coma scale, NIH stroke scale).

The data collected included the data obtained from the doctor's notes, nurses notes, physiotherapists notes, nutritional assessment reports, laboratory investigational reports, drug interaction charts, adverse drug reaction charts and through open ended questions.

2.4. Statistical analysis

Data were collected and entered into Microsoft Excel 2019 software and interpreted with descriptive statistics which then provided for analysis of the report and expressed as counts and percentages in the form of tables, charts and graphs.

Statistical analysis of the collected data was done using IBM SPSS version 26 statistical software.

2.5. Ethical clearance

The study was ethically approved by the study site's ethics council. The research was conducted using officially sanctioned surveillance data for analysis purposes.

3. Results

3.1. Categorization of patients based on the type of stroke.

A total of 300 patients were enrolled, with 129 (43%) diagnosed with hemorrhagic stroke and 171 (57%) with ischemic stroke. Ischemic stroke cases were notably higher than hemorrhagic (Table 1).

Table 1:	Categorization	of patients	based on the	type ofstrokes.
----------	----------------	-------------	--------------	-----------------

Type of Stroke	Number of stroke patients	Percentage (%)
Haemorrhagic stroke	129	43
Ischaemic stroke	171	57
Total	300	100

3.2. Categorization of patients based on their age

Patients were divided into seven age categories, ranging from 35 to 105 in intervals of 10 years. Among the 300 patients, those aged 65-75 had the highest stroke incidence, while those aged 95-105 had the lowest (Table 2).

3.3. Comparative categorization of patients based on their age

Among the 300 patients, the 65-75 age group had the highest stroke incidence, with 35% in hemorrhagic and 49% in ischemic strokes. The 95-105 age group had the lowest, with only 0.58% in ischemic strokes (Table 3).

Table 2: Categorization of patients based on the age.

Patient [,] s age Categorization	Frequency	Percentage (%)
35-45	22	7.3
45-55	44	14.7
55-65	75	25.0
65-75	84	28.0
75-85	56	18.7
85-95	18	6.0
95-105	1	0.3
Grand Total	300	100

	•	v	•		•
Patient's	sFrequen	cyHaemorr	ha ger centag	geIschaen	nidPercentage
Age			(%)		(%)
35-45	22	8	6.2	14	8.19
45-55	44	26	20.2	18	10.53
55-65	75	33	25.6	42	24.56
65-75	84	35	27.1	49	28.65
75-85	56	20	15.5	36	21.05
85-95	18	7	5.4	11	6.43
95-	1	0	0.0	1	0.58
105					
Grand Total	300	129	100	171	100

3.4. Categorization of patients based on their gender

Of the 300 patients enrolled, 66% were male, showing a higher diagnostic rate for cerebrovascular accidents compared to females at 34% (Figure 1).

PATIENTS BASED ON GENDER DISTRIBUTION



Figure 1: Categorization of patients based on the gender

3.5. Comparative categorization of patients based on their gender

In comparing stroke types, hemorrhagic stroke showed a higher prevalence in males (75.2%) than females (24.8%).

For ischemic stroke, males also had a higher rate (59.06%), while females accounted for 48.54% (Table 4).

Gender	Freq- ueny	Haem- orrhagic	Perce- ntage (%)	Ischaemic	Perce- ntage(%)
Male	198	97	75.2	101	59.06
Female	102	32	24.8	70	40.94
Total	300	129	100	171	100

Table 4: Comparative categorization of patients based on gender

3.6. Categorization of patients based on the length of hospital stay

Among the 300 patients, 9 had the longest hospital stays (3%), while 15 had the shortest (5%). The most common length of stay was 7 days, with 62 patients (20.7%), followed by 9 days (59 patients, 19.7%) and 10 days (44 patients, 14.7%). Other notable stays included 8 days (40 patients, 13.3%), 6 and 11 days (22 patients each, 7.3%), and shorter stays of 5 days (15 patients, 5%). The fewest stays were 13-15 days, representing under 3% each (Table 5).

 Table 5: Categorization of patients based on the length of stay in hospital

Number of days	Number of patients	Percentage
5	15	5.0
6	22	7.3
7	62	20.7
8	40	13.3
9	59	19.7
10	44	14.7
11	22	7.3
12	14	4.7
13	7	2.3
14	6	2.0
15	9	3.0
Grand Total	300	100.0

3.7. Comparative categorization of patients based on the length of hospital stay

In ischemic stroke (171 patients), 1.75% had the longest stay, 7.60% the shortest, and 7 days was the most frequent duration (24.57%). In hemorrhagic stroke (129 patients), 4.65% had the longest stay, 1.55% the shortest, and 8 days was most frequent (20.15%). Ischemic strokes had higher enrollment with shorter frequent stays (Figure 2).

3.8. Comparative categorization of patients with and without comorbidities

Out of the patients being enrolled in the study, on comparison between Haemorrhagic and Ischaemic strokes,



Figure 2: Length of hospital stay

out of the 129 Haemorrhagic patients, 33 (25.58 %) patients were seen without comorbidities and 96 (74.42%) patients were seen with comorbidities (Figure 3).



Figure 3: Comparative categorization of patients with and without comorbidities.

3.9. CNS examination of patients being enrolled

On admission, 286 patients were alert, 267 had anxiety, 131 had sensory neglect, 106 were lethargic, and 124 showed right-left confusion. Language, attention, and memory issues were seen in 130, 138, and 133 patients, respectively (Table 6).

Table 6: CNS examination of patients being enrolled

Cns examination	Count	Туре
Count of mental status examination	286	Alert and awake
Count of mood	267	Anxiety
Count of neglect and constrictions	131	Sensory neglect
Count of consciousness	106	Lethargic
Count of others	124	Right left confusion
Count of language	130	Comprehension
Count of orientation	138	Attention
Count of memory	133	Recent memory

Table 7: Possible risk factors observed in patients

Risk factor	Yes	%	NO	%
High BP	114	49.1	15	57.7
Diabetes	118	50.9	11	42.3
Coronary Heart Disease	55	13.9	74	19.6
Atrial Fibrillation	110	27.8	19	5.0
Heart Valve Disease	44	11.1	85	22.5
Carotid Artery Disease	69	17.4	60	15.9
High LDL	65	16.4	64	16.9
Brain Aneurysms/AVMs	53	13.4	76	20.1
Lupus	58	26.4	71	24.0
RA	34	15.5	95	32.1
COVID-19	36	16.4	93	31.4
Age	92	41.8	37	12.5
Young Man	31	23.0	98	25.7
Women on Birth Control/Hormone Therapy	13	9.6	116	30.4
Race and Ethnicity	19	14.1	110	28.9
Family History and Genetics	72	53.3	57	15.0
Depression	4	2.3	125	36.4
High Stress Levels	6	3.5	123	35.9
Air Pollution Exposure	88	50.9	41	12.0
Bleeding Disorders	17	5.9	112	18.3
Sleep Apnoea	18	6.2	111	18.1
Kidney Disease	53	18.3	76	12.4
Migraine Headaches	46	15.9	83	13.5
Sickle Cell Disease	56	19.3	73	11.9
Blood Thinners	48	16.6	81	13.2
Overweight and Obesity	52	17.9	77	12.6
Unhealthy Eating	78	12.9	78	23.9
Physical Inactivity	95	15.7	34	10.4
Alcohol Consumption	98	16.2	31	9.5
Oversleeping	70	11.6	59	18.1
Drug Use	84	13.9	45	13.8
Smoking	99	16.4	30	9.2
Other Factors	80	13.2	49	15.0

3.10. Possible risk factors observed in patients

Heart diseases (e.g., atrial fibrillation, 20.8%) were major risk factors, with high BP and diabetes common in hemorrhagic stroke. Lifestyle factors like obesity, and smoking were more significant in ischemic stroke, highlighting lifestyle's role in stroke risk (Table 7).

3.11. Pre-assessment of stroke severity

Among 171 ischemic stroke patients, admission showed severe impairment in most (120 NIH, 104 artery occlusion, 106 comatose). At discharge, 161 had minor strokes (NIH), 156 no occlusion, and 165 were normal (MMSE) (Figure 4).

3.12. Post assessment of stroke severity

At discharge, 171 ischemic stroke patients showed significant improvement: 161 had minor strokes (NIH), 156 had no artery occlusion (Standard Scale), 164 showed the



Figure 4: Pre-assessment of stroke severity

best response (Glasgow), and 165 were normal (MMSE) (Figure 5).



Figure 5: Post Assessment of stroke severity.

3.13. Comparison of pre and post stroke severity

- 1. **Pre-Assessment of Stroke Severity:** Upon admission of 171 ischemic stroke patients, 120 exhibited severe impairment on the NIHSS, 104 had artery occlusion, and 106 were comatose.
- Post-Assessment of Stroke Severity: At discharge, 161 patients had minor strokes on the NIHSS, 156 showed no artery occlusion, and 165 were assessed as normal on the MMSE, indicating significant recovery.

3.14. Drug interactions with percentage

On the study performed, total of 42 drug interactions were reported . 9 Major drug - drug interactions with 21.4% has been reported which is been followed by 30 minor drug - drug interactions with 71.4% and the least of it being the moderate drug - drug interactions with 7.1% reported in 3 patients (Figure 6).



Figure 6: Drug interactions

3.15. Comparison of cost burden in patients with hemorrhagic and ischemic stroke

The cost burden comparison between hemorrhagic and ischemic stroke patients showed a higher burden in ischemic stroke, though no significant statistical difference was observed between the two types of stroke (Table 8).

4. Discussion

Stroke remains a leading cause of morbidity and mortality globally, highlighting the need for better understanding and management. This study provides valuable insights into ischemic and hemorrhagic stroke profiles, severity, and recovery. Our findings show that ischemic strokes (57%) are more prevalent than hemorrhagic strokes, in line with global trends, and age, especially 65-75 years, is a significant risk factor. The higher incidence of stroke in males (66%) supports previous studies on gender differences in stroke types.

Ischemic stroke patients generally had shorter hospital stays and significant improvement in severity, which emphasizes the effectiveness of early interventions. Comorbidities like hypertension, diabetes, and smoking were identified as key risk factors, underlining the importance of a multidisciplinary approach to care. Additionally, 42 drug interactions, including nine major ones, highlight the need for careful medication management.

Although ischemic stroke patients incurred slightly higher costs, the economic burden of stroke care is substantial. This study underscores the importance of early detection, personalized treatment, and comprehensive poststroke care to improve outcomes and reduce healthcare costs.

4.1. Categorization of stroke type

Out of 300 patients, 43% had hemorrhagic strokes and 57% had ischemic strokes, with ischemic strokes being more common, in line with global trends.^{2,14}.

Age distributionThe majority (28%) of patients were in the 65-75 years age group, with a noticeable decrease in incidence among those aged 95-105 years, highlighting age as a significant risk factor.

Age and Stroke Type:The 65-75 years age group had the highest incidence of both stroke types, with ischemic strokes being more frequent than hemorrhagic strokes in all age groups.^{9,10}

Gender Categorization of Stroke Type:

Out of 300 patients, 43% had hemorrhagic strokes and 57% had ischemic strokes, with ischemic strokes being more common, in line with global trends.^{2,14}

Table 8: Comparison of cost burden in patients withhemorrhagic and ischemic stroke

Statistics for Hem	orrhagic Stroke				
Variables	Medical cost /day	Non - medical cost	Total cost (investigational reports)	Total medical cost	Total cost burden of the patient
Total patients enrolled.	300	300	300	300	300
Sum	173803	3591140	3087424.0	1439837	8123031
Statistics for Isch	emic Stroke				
Variables	Medical cost /day	Non - medical cost	Total cost(investigational reports)	Total medical cost	Total cost burden of the patient
Total patients enrolled.	300	300	300	300	300
Sum	183803	3591140	3047424.0	1539837	8124031

4.2. Age distribution

The majority (28%) of patients were in the 65-75 years age group, with a noticeable decrease in incidence among those aged 95-105 years, highlighting age as a significant risk factor.

4.3. Age and stroke type

The 65-75 years age group had the highest incidence of both stroke types, with ischemic strokes being more frequent than hemorrhagic strokes in all age groups.^{9,10}

4.4. Gender distribution

66% of stroke patients were male, indicating a higher stroke incidence in males compared to females.¹¹

4.5. Gender and stroke type

Hemorrhagic strokes were more common in males (75.2%) compared to females (24.8%). Similarly, ischemic strokes also had a higher male prevalence (59.06%).⁷

4.6. Hospital Stay Duration

Most patients had hospital stays of 6-10 days, with a significant portion staying for 7 or 9 days.⁵

4.6.1. Stay duration by stroke type

Ischemic stroke patients tended to have shorter stays, with 24.57% staying for 7 days, while hemorrhagic stroke patients had slightly longer stays.³

4.6.2. Comorbidities

74.42% of hemorrhagic stroke patients had comorbidities, with similar trends observed in ischemic stroke patients, indicating the complexity of managing patients with multiple health conditions.

4.7. CNS examination on admission

Most patients were alert on admission, with common neurological deficits including anxiety, sensory neglect, and lethargy.⁵

4.7.1. Risk factors

Hypertension, diabetes, and heart diseases like atrial fibrillation were key risk factors. Lifestyle factors such as anxiety and smoking were linked to ischemic strokes.^{9,10}

4.7.2. Pre-assessment severity

At admission, ischemic stroke patients showed significant neurological impairment, which improved by discharge, with most showing mild strokes.⁵

4.7.3. Post-assessment severity

Most ischemic stroke patients showed improvement, with many scoring as mild on the NIHSS and normal on the MMSE by discharge.³

4.7.4. Drug interactions

42 drug interactions were identified, mostly minor, with nine major interactions, emphasizing the need for careful medication management.¹¹

4.7.5. Cost comparison

Ischemic stroke patients incurred slightly higher costs than hemorrhagic stroke patients, though the difference was not significant, highlighting the economic burden of stroke care.^{5,7}

Distribution:66% of stroke patients were male, indicating a higher stroke incidence in males compared to females.¹¹

5. Conclusion

Our study compared hemorrhagic and ischemic strokes, revealing key findings: ischemic stroke had a higher prevalence (57%), and patients with ischemic strokes recovered faster than those with hemorrhagic strokes. Lifestyle factors such as smoking and alcohol use were identified as primary risk factors for ischemic strokes. The cost burden was similar for both stroke types, highlighting the significant economic impact of stroke care. Additionally, stroke rehabilitation and counseling played a crucial role in improving patient outcomes, emphasizing the importance of these interventions in enhancing recovery and informing effective stroke management strategies.

6. Ethical Approval

Ref no.: SIMS&RC/EC/15/2023

7. Conflict of Interest

None.

8. Source of Funding

None.

References

- Khaku AS, Tadi P. Cerebrovascular Disease. and others, editor. StatPearls Publishing; 2023. p. 947.
- 2. Organization WH. Regional Office for the Eastern Mediterranean. Available from: https://www.emro.who.int/index.html.
- Spronk E, Sykes G, Falcione S, Munsterman D, Joy T, Tatuene JK. Hemorrhagic transformation in ischemic stroke and the role of inflammation. *Front Neurol*. 2021;12:661955.
- Andersen KK, Olsen TS, Dehlendorff C, Kammersgaard LP. Hemorrhagic and ischemic strokes compared: stroke severity, mortality, and risk factors: Stroke severity, mortality, and risk factors. *Stroke*. 2009;40(6):2068–72.
- Ayehu GW, Yitbarek GY, Zewdie EA, Amsalu BT, Abie Y, Atlaw D, et al. Risk profile, clinical presentation, and determinants of stroke subtypes among patients with stroke admitted to public referral hospitals, Northwest Ethiopia in 2021: A cross-sectional study. . *Front Neurol.* 2022;13:988677.
- Sayedahmed AMS, Alkhair MSA. Comparative study of risk factors in young adults and elderly stroke patients in Sudan. *Interdiscip Neurosurg*, 2021;23:100955.
- 7. Grefkes C, Fink GR. Recovery from stroke: current concepts and future perspectives. *Neurol Res Pract*. 2020;2(1):17.
- Fekadu G, Chelkeba L, Kebede A. Risk factors, clinical presentations and predictors of stroke among adult patients admitted to stroke unit

of Jimma university medical center, south west Ethiopia: prospective observational study. *BMC Neurol.* 2019;19(1):187.

- Mayo Clinic. Stroke; 2023. Available from: https://www.mayoclinic. org/diseases-conditions/stroke/symptoms-causes/syc-20350113.
- Care24seven. What are the 7 Stages of Stroke Recovery?; 2023. Available from: https://care24seven.com/what-are-the-7-stages-ofstroke-recovery/.
- 11. Stroke rehabilitation: What to expect as you recover; 2023. Available from: https://www.mayoclinic.org/diseases-conditions/stroke/in-depth/stroke-rehabilitation/art-20045172.
- Chugh C. Acute ischemic stroke: Management approach. Indian J Crit Care Med. 2019;23(2):140–6.
- Herpich F, Rincon F. Management of acute ischemic stroke. Crit Care Med. 2020;48(11):1654–63.
- 14. Webmd. Types of stroke. Atlanta (GA;.

Author's biography

Femi S V, Pharm D Student D https://orcid.org/0009-0002-1730-5778

Nakshathra R Nath, Pharm D Student ^(b) https://orcid.org/0009-0004-1610-1591

Amaya Prasannan, Pharm D Student (2) https://orcid.org/0009-0009-4423-8735

Anurag Maniyath, Pharm D, Student D https://orcid.org/0009-0005-7374-1154

Susheela Rani, Guide D https://orcid.org/0009-0009-9813-4659

E. Satheesh Kumar, Head in https://orcid.org/0009-0001-6226-6280

Smita, Co Guide D https://orcid.org/0009-0003-5455-2599

Padma, Professor and HOD

Cite this article: Femi S V, Nath NR, Prasannan A, Maniyath A, Rani S, Kumar ES, Smita, Padma. A comparative study on risk factors, clinical presentation, recovery rates and cost burden of patients with ischemic and hemorrhagic stroke. *Indian J Pharm Pharmacol* 2024;11(4):205-212.