



A Study on Prehospital Factors Determining the Timely Arrival for Thrombolysis among Patients Presenting with Acute Ischemic Stroke at a Tertiary Care Center in South India

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ABSTRACT

Background: Among ischemic stroke patients, prehospital delay is the most common reason for underutilization of thrombolysis.

Aims: The study assessed prehospital factors contributing to delay and timely arrival among study participants.

Settings and design: A cross-sectional study was carried out at the casualty department of Government Stanley Medical College and Hospital, South India.

Materials and methods: We selected 212 study participants by consecutive sampling. Data were collected by interviewing patients or accompanying family members using a semistructured questionnaire.

Statistical analysis: Univariate analysis was followed by multivariate logistic regression to examine prehospital factors contributing to delay and timely arrival. Follow-up of eligible study participants for thrombolysis was performed using the National Institutes of Health Stroke Scale (NIHSS) and American Heart Association (AHA)-2019 checklist.

Results: The most common factors contributing to prehospital delay and timely arrival were found to be “unawareness regarding benefits of timely arrival among patients/relatives (48.7%)” and “apprehension of some serious health issue (50%),” respectively. The distance between the hospital and the place of onset of symptoms, stroke during sleep, mode of transport, National Institutes of Health Stroke Scale (NIHSS), and slurring of speech were found to have significant odds for timely arrival for intravenous thrombolysis (IVT). Among those who arrived on time ($n = 60$), 13 study participants could not undergo thrombolysis. The most common reason for this was refusal of thrombolysis (4, 6.7%), and other criteria, such as minor neurological deficits (4, 6.7%), rendered them ineligible for it.

Conclusion: The study highlights factors associated with timely arrival at the hospital and further reasons for not undergoing IVT despite timely arrival among cases of acute ischemic stroke (AIS). There is also a need to generate awareness and disseminate information on the benefits of IVT, timely arrival, and prehospital factors; provide training in stroke preparedness; and strengthen the referral system to ensure maximum eligibility and utilization.

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INTRODUCTION

In terms of mortality, stroke is the leading cause of death after heart disease. Stroke is also the third leading cause of morbidity worldwide.¹ The World Health Organization projects that disability-adjusted life years (DALYs) in India due to stroke contributed 2.67% (2010) and 3.37% (2020) to the global burden.² Acute ischemic stroke (AIS) is responsible for 50–85% of total stroke cases worldwide.³ The financial, social, and economic losses related to hospitalization, morbidity, and sickness due to stroke are substantial in India. A study conducted by Rajasulochna et al.⁴ (2017–2018) reported that the National Sample Survey Organization (NSSO) survey found that around 70% of total health expenditure in India is out-of-pocket expenditure, with the mean and median expenditure per

episode of stroke-related hospitalization being INR 40,360 (US\$ 539.75) and INR 17,140 (US\$ 229.22), respectively. The study also estimated that 58% of households incurred catastrophic health expenditure on hospitalization and 37% of households sold assets or borrowed money to finance hospitalization expenditure.⁴

Recombinant tissue plasminogen activator (rtPA), used in intravenous thrombolysis (IVT), has proven effective within 4.5 hours and remains the sole therapy approved by the Food and Drug Administration (FDA). By achieving timely reperfusion, thrombolysis improves functional recovery in 56–58% of patients suffering from AIS.^{5,6} However, there is a challenge in early hospitalization and the timely arrival of stroke patients to avail themselves of IVT. The most

common reasons for not receiving IVT are delay and unaffordability.^{7,8} Under the aegis of the Tamil Nadu government, a commendable initiative was launched through the Tamil Nadu Accident and Emergency Care Initiative (TAEI) in 2016, which envisages the free provision of thrombolysis for AIS.⁹ Similar research has been conducted in the literature. However, most studies conducted so far have focused on prehospital factors behind delays in arrival at tertiary care centers among stroke cases. The rationale for conducting this study was to identify the reasons not only for prehospital delay but also for timely arrival among exclusively ischemic stroke patients. Further, the study aimed to explore the factors causing ineligibility for IVT among those who arrived within the window period at Government Stanley Hospital, Chennai.

MATERIALS AND METHODS

The current study was carried out over a period of 1 year, from March 2022 to April 2023, with an observational cross-sectional design, and the study area was the emergency unit of the tertiary care services offered by Government Stanley Hospital in Chennai, India. The inclusion criteria were patients with stroke symptoms confirmed by a noncontrast CT brain showing no evidence of bleeding. Patients

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younger than 18 years and those unwilling to participate in the study were excluded. Before enrolling any patient in the study, the purpose of the study was explained, and written consent was obtained from either the patient or an accompanying family member. A total of 212 patients presenting with AIS symptoms were enrolled, and a detailed hybrid structured questionnaire was administered through a face-to-face interview conducted by a neurology resident after clinical examination and workup. An intensive review of the scientific literature and past studies formed the basis for the preparation of the questionnaire.^{10,11}

Variables

The duration between the first appearance of stroke symptoms and the arrival time recorded in the casualty register was defined as the prehospital time. In-time arrival was established as any arrival earlier than or equal to 4.5 hours from the appearance of stroke symptoms to presentation at the casualty department. If any patient was found to have awakened from sleep with stroke symptoms, it was referred to as a case of wake-up stroke. In such cases, the time of the first appearance of symptoms was determined as the latest time when the patient was known to be normal before sleep. Refusal of thrombolysis was defined as the nonprovision of voluntary written informed consent for IVT by the participant or accompanying family member.

The pro forma included a semistructured questionnaire on general patient details, clinical history, and prehospital reasons behind in-time or delayed presentation at the casualty department. Lastly, the questionnaire included the American Heart Association (AHA)-2019 checklist for eligibility for IVT, along with the NIHSS, which was used to assess eligibility for IVT therapy among those who arrived on time at the tertiary care center.

Data Analysis

Frequency distributions, percentage tables, median, and interquartile range were calculated to summarize categorical and qualitative variables. The association between prehospital factors and in-time presentation at the casualty department was assessed using appropriate statistical tests (Chi-square/F-test). Bivariate analysis was used to identify variables significantly associated with timely presentation at the casualty department ($p < 0.05$). Further, a multivariate regression model was developed using these variables to identify the independent predictors of in-time

arrival; a p -value < 0.05 was considered significant.

Ethical Considerations

The institutional ethical certificate was obtained from the Ethics Committee of Government Stanley Medical College and Hospital, Chennai (Certificate Number: ECR/131/Inst/TN/2013/RR-19).

RESULTS

Sociodemographic details: The current study had a sample size of 212 ischemic stroke cases. The mean age was 56.84 years, with a standard deviation of ± 11.3 years. Of these, 63.2% were male and 36.8% were female.

The proportion of in-time arrival for thrombolysis: Out of 212 study participants, 60 (28.3%; 95% CI, 0.2–0.3) arrived in time for thrombolysis at the tertiary care center. The median duration for in-time arrival was 120 minutes (IQR = 120–180), as depicted in Figures 1 and 2.

Among study participants with late arrival for thrombolysis, the most common reason for delayed transportation was found

to be long distance between tertiary care center and place of onset of stroke as shown in Figure 3.

Further 98 (46%) of study participants visited local clinic, however among them 59 (28%) had arrived at local clinic within window period but only 23 (11%) managed to reach at tertiary care center for thrombolysis as described in Figures 4A and B. Our study found that 13 (21.7%) out of 60 study participants who arrived within window period were found to be ineligible for thrombolysis. Further, reason for eligibility were explored and reported in Figure 5.

The mean age was 56.84 years, with a standard deviation of ± 11.3 years. Of these, 63.2% were male and 36.8% were female as described in Table 1.

Distribution of stroke symptoms and their association with in-time arrival: Among the stroke symptoms, hemiparesis (p -value = 0.007), slurring of speech (p -value = 0.004), and giddiness (p -value = 0.027) were found to be associated with in-time presentation at the tertiary care center (Tables 2 and 3).

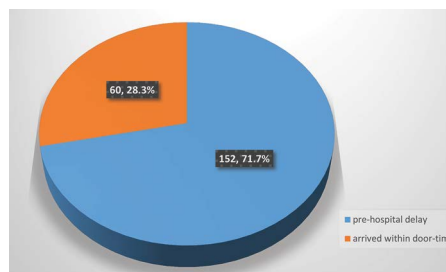


Fig. 1: Prevalence of prehospital delay in arrival for management of stroke among study participants with AIS at the tertiary care center (N = 212)

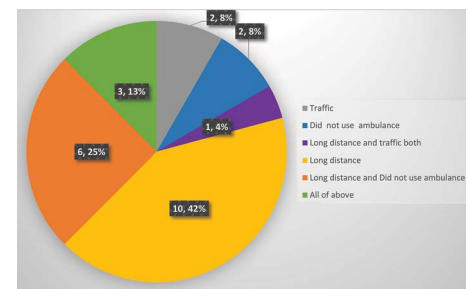


Fig. 3: Reasons for Delayed transportation leading to late arrival for thrombolysis among study participants with acute ischemic stroke at the tertiary care center (N = 24)

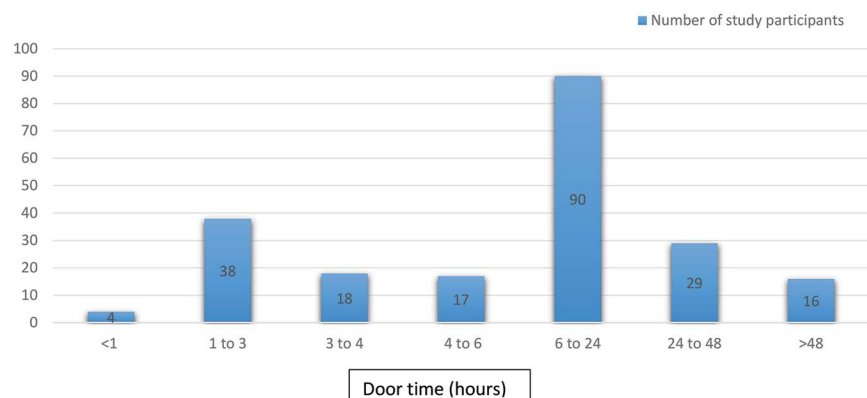


Fig. 2: Bar chart showing the onset-to-door time (arrival time) among study participants with AIS at the tertiary care center (N = 212)

DISCUSSION

India has witnessed a gradual rise in the use of IVT for AIS; yet overall utilization

remains low, as shown in the Indo-US Collaborative Stroke Project.^{12,13} In our study, 28.3% of patients arrived within the therapeutic window, a finding consistent

with studies across India.^{10,14–19} Improving this proportion requires reducing delays at both the community and facility levels, as well as strengthening systems that facilitate timely presentation for stroke care. Previous studies have highlighted the role of prior stroke awareness, distance from the hospital, stroke severity, and comorbidities in India.^{14,16} Our findings corroborate the importance of distance, ambulance use, higher NIHSS scores, and speech-related symptoms in promoting timely arrival (Fig. 3). These patterns emphasize the need to strengthen emergency transport and referral mechanisms, particularly for rural and vulnerable populations, such as the geriatric population and those with comorbidities. Wake-up stroke emerged as a barrier to IVT eligibility in our study, consistent with previous reports,²⁰ given the limited access to magnetic resonance imaging (MRI)-based diffusion-weighted imaging–fluid-attenuated inversion recovery (DWI-FLAIR) mismatch techniques (WAKE-UP trial) and computed tomography (CT) perfusion techniques in the public sector.²¹ This reveals a diagnostic inequity in which technological gaps directly translate into treatment exclusion. In our study, ambulance transport was found to be associated with a 5.5-fold higher likelihood of arriving on time. Hence, the study warrants exploration of the accessibility of emergency transport and variations in stroke preparedness across rural and urban areas in India.

Our results also show that visits to nearby clinics before reaching a stroke center remain a major source of avoidable delay, consistent with a few previous studies.^{14,15} This underscores systemic fragmentation at the first point of contact. Strengthening primary care facilities with FAST/BE-FAST screening, mandatory referral protocols, and telestroke linkages could help prevent such delays. Evidence from telestroke networks demonstrates significant reductions in onset-to-needle time when primary care units are integrated with stroke-ready hubs.²²

BE-FAST awareness campaigns may be systematically rolled out under the National Programme for Noncommunicable Diseases (NP-NCD) to advocate increased public literacy in the BE-FAST method (Balance, Eyesight, Facial drooping, Arm weakness, Speech difficulty, Timely emergency service) as a strategy for stroke prevention, awareness, and early detection. This will help emphasize community-level stroke awareness and response readiness. Our study reported that only 47 (22.2%) of the total study participants were eligible for

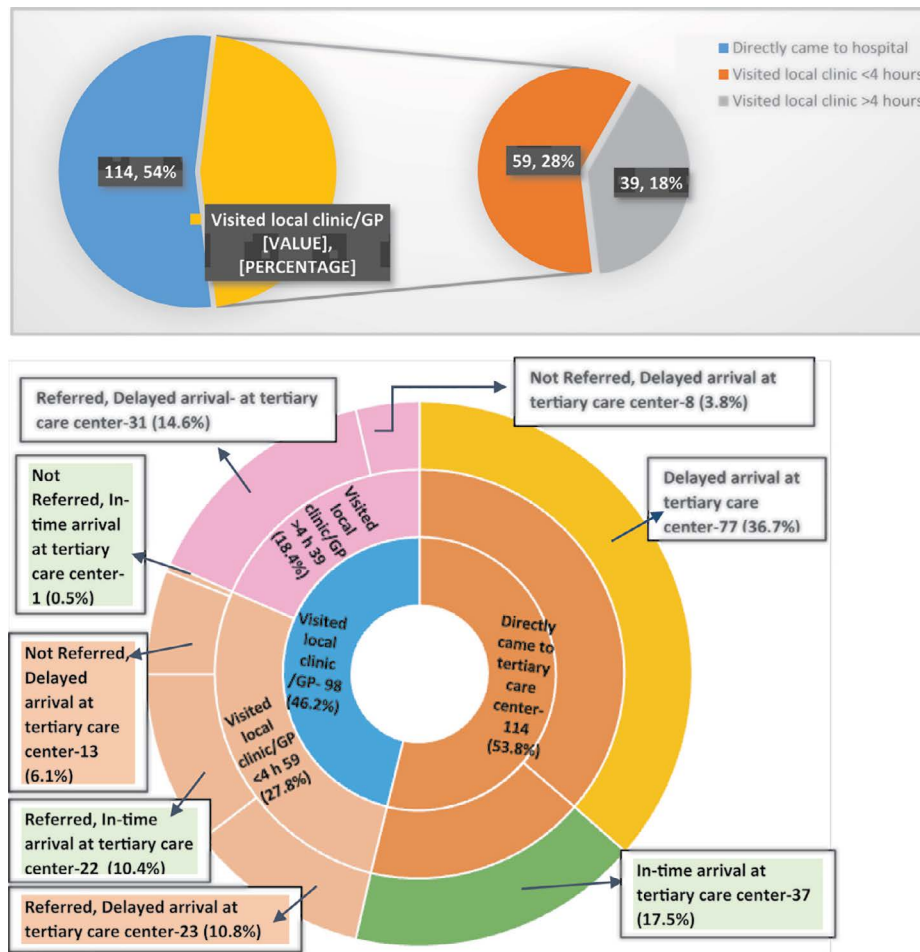


Fig. 4A and B: A: Prevalence of study participants who visited local clinic/General practitioner among study participants with acute ischemic stroke at the tertiary care centre (N = 212); B: Distribution of study participants according to course of arrival status to tertiary care centre among study participants with acute ischemic stroke at the tertiary care centre (N = 212)

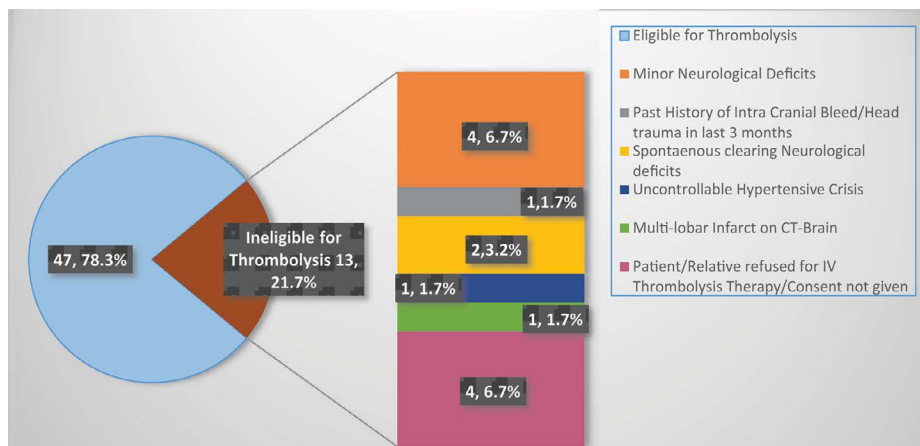


Fig. 5: Distribution of Factors leading to ineligibility for IV Thrombolysis according to the thrombolysis Checklist for tPA among study participants who arrived in time with acute ischemic stroke at the tertiary care centre (N = 60)

Table 1: Sociodemographic factors and their association with in-time arrival among study participants with AIS (N = 212)

S. no.	Sociodemographic factors	n (%)	In-time arrival		p-value [§]
			No	Yes	
1	Age				
	18–30 years	2 (0.9)	1 (0.6)	1 (1.7)	0.504
	30–50 years	60 (28.3)	40 (26.3)	20 (33.3)	
	50–70 years	130 (61.3)	97 (63.8)	33 (55.0)	
	>70 years	20 (9.4)	14 (9.2)	6 (10.0)	
2	Gender				
	Male	134 (63.2)	93 (61.2)	41 (68.3)	0.331
	Female	78 (36.8)	59 (38.8)	19 (31.7)	
3	Marital status				
	Unmarried	4 (1.9)	3 (2.0)	1 (1.7)	0.938
	Married living with spouse	164 (77.4)	118 (77.6)	46 (76.7)	
	Widow/widower	44 (20.8)	31 (20.4)	13 (21.7)	
4	Educational level				
	Illiterate	55 (26.0)	46 (30.3)	9 (15.0)	0.131
	Primary	75 (35.4)	53 (34.9)	22 (36.7)	
	Secondary	43 (20.3)	26 (17.1)	17 (28.3)	
	Higher secondary	29 (13.7)	20 (13.2)	9 (15.0)	
	Graduate and above	10 (4.7)	7 (4.6)	3 (5.0)	
5	Occupation				
	Unemployed	65 (30.7)	46 (30.3)	19 (31.7)	0.276
	Unskilled	58 (27.4)	46 (30.3)	12 (20.0)	
	Skilled	68 (32.1)	44 (29.0)	24 (40.0)	
	Professional	16 (7.6)	11 (7.2)	5 (8.3)	
	Retired	5 (2.36)	5 (3.3)	0	
6	Family				
	Nuclear	204 (96.2)	147 (96.7)	57 (95)	0.690
	Joint	8 (3.8)	5 (3.3)	3 (5.0)	
7	Distance between location of acute stroke onset and the hospital				
	<15 km	111 (52.4)	70 (46.1)	41 (68.3)	0.003*
	>15 km	101 (47.6)	82 (54.0)	19 (31.7)	
8	Socio-economic status (BG Prasad 2019)				0.050*
	Lower	4 (1.9%)	2 (1.3)	2 (3.3)	
	Lower-middle class	69 (32.5%)	58 (38.2)	11 (18.3)	
	Middle class	83 (39.2%)	55 (36.2)	28 (46.7)	
	Upper middle class	46 (21.7%)	30 (19.7)	16 (26.7)	
	Upper class	10 (4.7%)	7 (4.6)	3 (5.0)	
9	Past history of stroke				
	Present	29 (13.7)	23 (15.1)	6 (10.0)	0.327
	Absent	183 (86.3)	129 (84.9)	54 (90.0)	
10	On medication for past history of stroke				
	Yes	12 (5.7)	9 (5.9)	3 (5.0)	0.633
	No (noncomplaint)	17 (8.0)	14 (9.2)	3 (5.0)	
	Not applicable	183 (86.3)	129 (84.9)	54 (90.0)	
11	Comorbidities				
	Hypertension				
	Yes	123 (58.0)	96 (63.2)	27 (45.0)	0.016*
	No	89 (42.0)	56 (36.8)	33 (55.0)	

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S. no.	Sociodemographic factors	n (%)	In-time arrival		p-value [§]
			No	Yes	
	Diabetes mellitus				
	Yes	99 (46.7)	79 (52.0)	20 (33.3)	0.014*
	No	113 (53.3)	73 (48.0)	40 (66.7)	
	Obesity				
	Yes	7 (3.3)	5 (3.3)	2 (3.3)	1.000
	No	205 (96.7)	147 (96.7)	58 (96.7)	
	Dyslipidemia				
	Yes	7 (3.3)	3 (2.0)	4 (6.7)	0.085
	No	205 (96.7)	149 (98.0)	56 (93.3)	
	CAD/valvular disease/arrythmia				
	Yes	28 (13.2)	17 (11.2)	11 (18.3)	0.166
	No	184 (86.8)	135 (88.8)	49 (81.7)	
	Coagulation disorder/polycythemia				
	Yes	3 (1.4)	2 (1.3)	1 (1.7)	0.846
	No	209 (98.6)	150 (98.7)	59 (98.3)	
12	Smoking				
	Yes	59 (27.8)	43 (28.3)	16 (26.7)	0.812
	No	153 (72.2)	109 (71.7)	44 (73.3)	
13	Alcohol/illicit drug abuse				
	Yes	78 (36.8)	54 (35.5)	24 (40.0)	0.543
	No	134 (63.2)	98 (64.5)	36 (60.0)	
14	Family history of stroke				
	Yes	12 (5.7)	12 (7.9)	0 (0.0)	0.21
	No	200 (94.3)	140 (92.1)	60 (100)	
15	Place of onset				
	At home	189 (89.2)	137 (90.1)	52 (86.7)	0.469
	Others (street, workplace, etc.)	23 (10.8)	15 (9.9)	8 (13.3)	
16	Stroke onset time				
	6 AM to 12 PM	64 (30.2)	43 (28.3)	21 (35.0)	0.648
	12 PM to 6 PM	68 (32.1)	49 (32.2)	19 (31.7)	
	6 PM to 12 AM	63 (29.7)	46 (30.3)	17 (28.3)	
	12 AM to 6 AM	17 (8.0)	14 (9.2)	3 (5.0)	
17	Wake-up stroke				
	No	176 (83.0)	117 (77.0)	59 (98.3)	<0.001*
	Yes	36 (17.0)	35 (23.0)	1 (1.7)	
18	Visited local doctor/clinic	98 (46.2)	75 (49.3)	23 (38.3)	0.148
	Directly reaching the hospital	114 (53.8)	77 (50.7)	37 (61.7)	
19	Mode of transport				
	Ambulance	50 (23.6)	23 (15.1)	27 (45.0)	<0.001*
	Own vehicle	11 (5.2)	7 (4.6)	4 (6.7)	
	Other's vehicle	8 (3.8)	7 (4.6)	1 (1.7)	
	Commercial	143 (67.4)	115 (75.7)	28 (46.7)	
20	NIHSS on admission				
	1–4	39 (18.4)	32 (21.0)	7 (11.7)	0.011*
	5–15	159 (75.0)	115 (75.7)	44 (73.3)	
	16–20	11 (5.2)	4 (2.6)	7 (11.7)	
	21–42	3 (1.4)	1 (0.7)	2 (3.3)	

[§]p-value: Chi-square/Fisher's exact; *Indicates statistical significance at $p < 0.05$

Table 2: Distribution of stroke symptoms and their association with in-time arrival among study participants with AIS (N = 212)

S. no.	Stroke symptoms	n (%)	In-time arrival		p-value [§]
			No	Yes	
1	Hemiparesis				
	Yes	165 (77.8)	111 (73.0)	54 (90.0)	0.007*
	No	47 (22.2)	41 (27.0)	6 (10.0)	
2	Monoparesis				0.325
	Yes	22 (10.4)	18 (11.8)	4 (6.7)	
	No	190 (89.6)	134 (88.2)	56 (93.3)	
3	Facial droop				0.081
	Yes	76 (35.8)	49 (32.2)	33 (55.0)	
	No	136 (64.2)	103 (67.8)	27 (45.0)	
4	Slurring of speech/speech disturbances				0.004*
	Yes	81 (38.2)	49 (32.2)	32 (53.3)	
	No	131 (61.8)	103 (67.8)	28 (46.7)	
5	Loss of sensations				0.17
	Yes	20 (9.4)	19 (12.5)	1 (1.7)	
	No	192 (90.6)	133 (87.5)	59 (98.3)	
6	Visual disturbance/hemianopia				0.195
	Yes	7 (3.3)	7 (4.6)	0 (0.0)	
	No	205 (96.7)	145 (95.4)	60 (100.0)	
7	Slurring of speech				0.785
	Yes	18 (8.5)	14 (9.2)	4 (6.7)	
	No	194 (91.5)	138 (90.8)	56 (93.3)	
8	Giddiness				0.027*
	Yes	23 (10.9)	21 (13.8)	2 (3.3)	
	No	189 (89.1)	131 (86.2)	58 (96.7)	
9	Seizure				1.000
	Yes	1 (0.5)	1 (0.07)	0 (0.0)	
	No	210 (99.5)	150 (99.3)	60 (100.0)	
10	Headache				1.000
	Yes	2 (0.9)	2 (1.3)	0 (0.0)	
	No	210 (99.1)	150 (98.7)	60 (100.0)	
11	Ataxia				1.00
	Yes	2 (0.9)	2 (1.3)	0 (0.0)	
	No	210 (99.1)	150 (98.7)	60 (100.0)	
12	Loss of consciousness				0.728
	Yes	10 (4.7)	8 (5.3)	2 (3.3)	
	No	202 (95.3)	144 (94.7)	58 (96.7)	

[§]p-value: Chi-square/Fisher's exact; *Indicates statistical significance at $p < 0.05$

IVT, which shows a temporal trend in the utilization of IVT across India.^{23–26} However, despite this, refusal of IVT was one of the most common reasons for not receiving IVT despite arriving on time at the tertiary care center. The gap between eligibility and actual IVT administration persists largely because of modifiable factors such as refusal to consent, delayed consent, and underrecognition of time-sensitive symptoms.²⁷ This “last-mile treatment gap” has been underexplored in Indian research and requires measures such as counseling

and advocacy regarding the treatment benefit-to-risk ratio. Further, improving this patient–provider communication gap represents a potential area for future research. Beyond lack of knowledge, many patients expressed fear, uncertainty about risks, or reliance on nonallopathic advice. These findings reinforce the need for structured consent protocols, culturally tailored communication tools, and real-time counseling support in emergency settings. During interviews, our study identified reasons similar to those reported by Kothari

et al.,¹⁷ along with a lack of social media influence in creating awareness in society (Table 4).

Overall, the strength of our study is that it included only ischemic stroke patients, and IVT services using the recombinant tissue plasminogen activator (rtPA) agent were provided free of cost; hence, direct treatment cost was not a confounding factor in decision-making regarding the use of IVT. However, as a single-center study conducted in a tertiary care hospital in Chennai, the findings may not be generalizable to other regions. Prehospital

Table 3: Logistic regression analysis of factors associated with in-time arrival among study participants with AIS (N = 212)

S. no.	Variable	Unadjusted OR	p-value	Adjusted OR	p-value
1	Distance between location of acute stroke onset and the hospital				
	<15 km	2.5 (95% CI 1.3–4.7)	0.004*	4.4 (95% CI 1.8–10.5)	0.001*
	>15 km	Reference		Reference	
2	Socio-economic Status (BG Prasad Scale 2019)				
	Lower	Reference		Reference	
	Lower-middle class	0.2 (95% CI 0.0–1.5)	0.114	0.3 (95% CI 0.02–3.2)	0.310
	Middle class	0.5 (95% CI 0.0–3.8)	0.511	1.2 (95% CI 0.1–12.0)	0.904
	Upper middle class	0.5 (95% CI 0.0–4.1)	0.548	0.8 (95% CI 0.1–8.4)	0.827
	Upper class	0.4 (95% CI 0.1–4.6)	0.486	1.7 (95% CI 0.1–31.8)	0.737
3	Hypertension				
	No	2.1 (95% CI 1.1–3.8)	0.017*	2.2 (95% CI 1.0–5.0)	0.062
	Yes	Reference		Reference	
4	Diabetes mellitus				
	No	2.2 (95% CI 1.2–4.0)	0.015*	1.7 (95% CI 0.7–3.9)	0.217
	Yes	Reference		Reference	
5	Wake-up stroke				
	No	17.6 (95% CI 2.4–132.0)	0.005*	23.8 (95% CI 2.5–217.9)	0.006*
	Yes	Reference		Reference	
6	Mode of transport				
	Ambulance	4.8 (95% CI 2.4–9.6)	0.001*	5.5 (95% CI 2.0–14.9)	0.001*
	Own vehicle	2.3 (95% CI 0.6–8.6)	0.197	3.6 (95% CI 0.6–20.3)	0.153
	Other's vehicle	0.6 (95% CI 0.0–5.0)	0.625	0.6 (95% CI 0.1–6.8)	0.694
	Commercial	Reference		Reference	
7	NIHSS on admission				
	1 to 4	Reference		Reference	
	5–15	1.8 (95% CI 0.7–4.3)	0.217	1.3 (95% CI 0.4–4.2)	0.604
	16–20	8 (95% CI 1.8–35)	0.006*	6.9 (95% CI 1.0–46.7)	0.045*
	21–42	9.1 (95% CI 0.7–115.4)	0.087	5.9 (95% CI 0.3–111.2)	0.235
8	Hemiparesis				
	No	Reference		Reference	
	Yes	3.3 (95% CI 1.3–8.3)	0.010*	1.7 (95% CI 0.5–5.5)	0.391
9	Slurring of speech/speech disturbances				
	No	Reference		Reference	
	Yes	2.4 (95% CI 1.3–4.4)	0.005*	3. (95% CI 1.4–7.2)	0.006*

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S. no.	Variable	Unadjusted OR	p-value	Adjusted OR	p-value
10	Giddiness				
	No	4.64 (95% CI 1.1–20.5)	0.042*	3.0 (95% CI 0.5–18.7)	0.228
	Yes	Reference		Reference	

*Indicates statistical significance at $p < 0.05$ **Table 4:** Factors contributing to arrival duration among study participants as per their perception during interview

A	Factors contributing to in-time arrival ($n = 60$, 28%):	n (%)
1	Awareness about stroke symptoms from TV, radio, social media, newspaper, online, etc.	3 (5)
2	Past history of stroke	4 (6.7)
3	Awareness about therapeutic window period for stroke management (TV, radio, social media, newspaper, online, etc.)	0 (0)
4	Previous experience about symptoms of strokes from relatives, neighbors, acquaintances, etc.	8 (13.3)
5	Referred from local clinic/general physician	15 (25)
6	Unaware of stroke symptoms but sought help in the apprehension of some serious health issue)	30 (50)
B	Factors contributing to prehospital delay in arrival ($n = 152$, 72%):	n (%)
1	Unable to seek help (confused, unable to comprehend)	6 (3.9)
2	Stroke while asleep	37 (24.3)
3	Alone during onset of stroke	7 (4.6)
4	Did not realize the urgency to seek medical help	63 (41.4)
5	Failure to recognize the symptoms, and signs of stroke	44 (28.9)
6	Waiting for symptoms to subside on their own	51 (33.5)
7	Waiting after taking some medications to take effect	1 (0.6)
8	Sought help from general practitioner/clinic/another hospital	18 (11.8)
9	Lack of transportation	1 (0.6)
10	Delayed transportation	24 (15.8)
11	Lack of awareness regarding stroke and benefits of timely arrival to hospital for its treatment among patient/relative	74 (48.7)
12	Lack of awareness regarding stroke and benefits of timely referral to stroke care center for its treatment among first point of healthcare provider	12 (7.9)
13	Took alternative form of medicine for stroke management	3 (1.9)
14	Under substance intoxication (alcohol, drugs, etc.)	12 (7.9)

timings and reasons for delay relied on patient or caregiver recall, introducing potential recall and information bias.

Despite these limitations, the study provides important insights into gaps in prehospital and primary care pathways, consent processes, communication strategies, and wake-up stroke evaluation that contribute to missed opportunities for timely thrombolysis in India.

CONCLUSION

This study recommends generating awareness about stroke symptoms and their severity in the community and encouraging information, education, and communication (IEC) activities and stroke readiness campaigns in vulnerable populations. There is an unmet need to create awareness about the benefits of timely arrival and IVT in ischemic stroke cases. Appropriate technology to identify wake-up stroke,

referral services and their availability, and the use of telemedicine at various healthcare facilities in the community have scope for system strengthening to increase the utilization of IVT among AIS cases in India.

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