Original Article

Factors Associated with Prehospital Delay in Patients with Acute Stroke in South India

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Abstract

Background: Early hospital presentation is critical in the management of acute ischemic stroke. The effectiveness of stroke treatment is highly dependent on the amount of time lapsed between onset of symptoms and treatment. This study was aimed to identify the factors associated with prehospital delay in patients with acute stroke. **Material and Methods:** A cross-sectional descriptive study was conducted in Sri Ramachandra University Hospital, India. A total of 210 patients hospitalized in the stroke unit were included. Patients' data were obtained by interviewing the patient and/or accompanying family member and by reviewing their medical records using a standard questionnaire. Associations were determined between prehospital delay (≥4.5 h) and variables of interest by using univariate and multivariate logistic regression analyses. **Results:** The prehospital delay was observed in 154 patients (73.3%) and the median prehospital delay was 11.30 h. The following are the factors significantly ($P < 0.05$) attributed for the delay in presenting to the hospital: contextual factors like using public transport (bus), taxi, time of onset of symptoms, 7 pm–3 am; family history of stroke, perceived cognitive and behavioral factors like, wishing or praying for the symptoms to subside on its own, hesitation to travel due to long distance, delay in arranging transport, and arranging money for admission and wasting time by shopping for general practitioners, nursing homes, and hospitals. The presence of stroke symptom, headache, significantly decreased the prehospital delay. **Conclusions:** Prehospital delay is high in South India and influenced by clinical, contextual, and cognitive/behavioral factors.

Keywords: Acute stroke, factors, prehospital delay, thrombolysis

Introduction

Stroke is ranked as the second leading cause of death worldwide and ischemic stroke constituted 62.4% of all incident strokes.[1] Annually, 15 million people worldwide suffer a stroke. Of these, 5 million die and another 5 million are left permanently disabled, placing a burden on family and community. The public health burden of stroke tends to rise in future due to demographic transitions of populations, particularly in developing countries.[2,3]

Stroke is a foremost cause of disability, with an increasing incidence in developing countries. Ischemic stroke caused by arterial occlusion is responsible for the majority of strokes. Management focuses on rapid reperfusion with intravenous thrombolysis and endovascular thrombectomy, which both reduce disability but are time-critical. Intravenous thrombolysis reduces disability when administered within 4.5 h of the onset of stroke. Thrombolysis also benefits selected patients with evidence from perfusion imaging of salvageable brain tissue for up to 9 h and in patients who awake with stroke symptoms.[4]

Early intervention is a critical determinant of successful management of acute stroke. Thrombolytic drugs can restore blood flow before major brain damage and improve recovery after stroke and used within 4.5 h of stroke in Europe and India and within 3 h in the USA.[5,6] The ministry of health and family welfare, Government of India (2019), urged to evaluate all the acute ischemic stroke patients that would be benefited by thrombolytics within 4.5 h of the onset of stroke symptoms.[6]

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The identification of factors related to either early or delayed hospital arrival may reveal potential targets of intervention to reduce prehospital delay (PHD) and improve access to time-critical thrombolysis and clot retrieval therapy. Major factors affecting prehospital time were related to emergency medical pathways, stroke symptomatology, patient and bystander behavior, patient health characteristics, and stroke treatment awareness.[7]

A study conducted in Switzerland (2020) recommends, continuous efforts are mandatory to raise public awareness on the importance of fast hospital referral in patients with suspected stroke by directly informing emergency medical service (EMS), avoiding contact of a general practitioner (GP), and maintaining high effort for fast transportation also in patients with milder symptoms.[8]

A study (2001) conducted in North India (New Delhi[9] and Ludhiana[10]) report 25% and 29% patients, respectively, arrived within 3 h. Similarly, a study conducted (2015) in Kerala[10] (South India) among 264 stroke patients reports 25% patients presented within 4 h of stroke onset. These three studies[9-11] have found the factors like less distance from hospital, history of coronary artery disease, higher educational status, awareness of the stroke symptoms, presence of hemiplegia and aphasia, living in city, reaching EMS directly, presence of family history, and older age were associated with early arrival to the hospital.

The majority of studies have been undertaken in Western populations. Factors associated with prolonged PHDs may differ between Indian and Western populations due to variations in ethnicity, culture, health literacy, rural population, socioeconomic features, transportation facilities, and health-care system. Among the previously published studies, two were from North India and one was from South India (Kerala) and none in Tamil Nadu state.

The findings of this study may help in identifying new factors and confirm the already explored factors. Hence, this study was undertaken to investigate the factors influencing the delayed presentation to hospital among patients with acute stroke in South India.

Methods and Materials

This cross-sectional descriptive study was conducted from the year 2017–2019 in the Sri Ramachandra university teaching hospital in Chennai, South India and is a referral center for all kinds of diseases and conditions in South India. It is a multispecialty tertiary-care hospital with more than 1600 beds and it is one of the largest private health-care facilities in South Asia. The neurology department is an active proponent of thrombolysis for acute stroke care and thrombolysis is done for all eligible patients admitted within 4.5 h of the onset of stroke symptoms. Approximately 400 new stroke patients per year (7–8 patients/week) are admitted in the neurology department. The stroke ICU and neurology ward are equipped with 8 and 22 beds, respectively. Chennai is a metropolitan city with both public and private teaching and non-teaching hospitals spread throughout with latest facilities for the management of stroke once the patients arrive at the hospital.

The Institutional Ethical Clearance was obtained. The study setting included neurology intensive care unit and neurology units. The sample size in our study was 210 patients with acute stroke assuming a prevalence of 0.75 [10] , absolute precision 8% and 5% alpha.

The inclusion criteria were patients above the age of 19 years with neurologic symptoms who were hospitalized in the study hospital and diagnosed with nontraumatic ischemic stroke and/or hemorrhagic stroke by diffusion magnetic resonance imaging (MRI) or computerized tomography scan.

Exclusion criteria were diagnoses of tumors, poisoning, or trauma, in-hospital stroke, or lesion-negative transient ischemic attack and patients who had been treated by thrombolysis before visiting the study hospital; stroke due to intracranial aneurysm and arteriovenous malformations; patients presenting seven days after stroke symptoms; and patients with unknown duration of symptom onset.

Patients were informed of the purpose of the study and the informed consent was obtained from all patients and/or family member before enrolment in the study. A structured questionnaire was completed for every stroke patient by interviewing the patient and/or accompanying family member and reviewing their medical records. The interview lasted from 30 to 40 min per patient. When patients encountered speech difficulties or disorientation, their caretakers or family members were interviewed. The questionnaire was developed from the literature review and similar previous studies.

Variables

Prehospital time was defined as the time from symptom onset to the earliest documented time to the emergency department or outpatient department of the hospital.

PHD was defined as anytime greater than 4 h and 30 min from time of symptoms onset to presentation to the study hospital.

Factors include socio-demographic, medical history (type of stroke, first time or recurrent stroke, and 13 stroke risk factors with yes/no options), stroke manifestations (13 stroke symptoms questions with yes/no options), contextual factors (time, day, and place of onset of stroke, presence of bystanders during onset of stroke, time of arrival to hospital, mode of travel, distance and time of transportation from home to hospital, presentation to hospital, and other hospitals visited), and 20 perceived cognitive and behavioral factors that contribute to the late arrival at the hospital (with yes/no options).

Statistical analysis

All the categorical variables were summarized using frequency and percentage. Quantitative variables were summarized

using median and interquartile range (IQR) as data violate the normality assumptions. Arrival time to study hospital after stroke was the dependent variable dichotomized as either early (≤4 h and 30 min) or late (>4 h and 30 min).[6]

Univariate analysis and Chi-square test/Fisher's exact tests were performed to identify the factors associated with PHD in acute stroke. Variables with a *P* value of ≤0.2 in the univariate analysis of PHD were entered into a multiple robust Poisson regression model to identify the independent predictors of PHD.

Spearman's correlation coefficient was performed to explore the relationship of cognitive and behavioral factors with the PHD.

$P < 0.05$ was considered as statistically significant and the analysis was performed using SPSS 16 software.

Results

Patient characteristics

There were 210 patients included in our study, 151 (71.9%) patients had ischemic stroke and 59 (28.1%) patients had hemorrhagic stroke. One-hundred and eighty-two (86.7%) patients had stroke for the first time. Sixty (28.6%) patients were in the age group between 51 and 60, and 91 (43.3%) patients were above 60 years and 154 (73.3%) patients were male.

The frequency, percentages of demographic variables and clinical factors, stroke symptoms, stroke risk factors, contextual and cognitive/behavioral factors, and its association with PHD in the univariate analysis are given in Tables 1–5.

The common stroke symptoms presented by the patients were hemiparesis (69.5%), slurred speech (61.4%), dizziness (38.6%), facial deviation (26.2%), vomiting (21%), consciousness disturbances (18.6%), headache (18.6%), and hemiplegia (18.6%) [Table 3].

The stroke common risk factors found were hypertension (77.6%), diabetes mellitus (65.7%), hyperlipidemia (61.4%), stress (54.3%), alcohol intake (25.7%), smoking (24.8%), and family history of stroke (15.2%). The median stroke risk factor was 4 (IQR 3–5) [Table 4].

Prehospital delay and its associated factors

The median PHD, that is, from stroke symptom onset to arrival at the study hospital, was 11.30 h (IQR 4.30–29.36). Out of 210 patients studied, 56 (26.7%) patients presented within 4 h and 30 min to the hospital, whereas 154 (73.3%) patients arrived after 4 h and 30 min.

In the multiple robust Poisson regression analysis [Table 6], the following factors were significantly associated with a PHD of ≥4 h and 30 min (≥270 min): contextual factors, mode of transport to reach hospital, public transport by bus ($P < 0.05$, prevalence ratio [PR] 1.668; 95% confidence interval [CI] 1.07–2.61), taxi ($P < 0.01$; PR 1.268; 95% CI 1.06–1.51), time of onset of symptoms, 7 pm–3 am ($P < 0.01$; PR 1.307; 95% CI 1.07–1.59); stroke risk factors, having family history of stroke ($P < 0.01$; PR 1.286; 95% CI 1.07–1.54); cognitive and behavioral factors: praying/wishing that symptom would go away ($P < 0.01$; PR 1.351; 95% CI 1.10–1.66), hospital being far away ($P < 0.01$; PR 1.504; 95% CI 1.14–1.99), delay in arranging transport ($P < 0.01$; PR 0.502; 95% CI 0.31–0.82), problem in arranging money for admission ($P < 0.05$; PR 1.266; 95% CI 1.05–1.52), wasted time in visiting GPs and hospitals/nursing homes ($P < 0.05$, PR 1.541; 95% CI 1.11–2.15). Stroke clinical manifestation and headache ($P < 0.05$; PR 0.806; 95% CI 0.68–0.96) were significantly associated with early arrival.

The Spearman's rank correlation test also revealed; there was a significant positive correlation between PHD and total cognitive and behavioral factors ($r = 0.233$; $P < 0.001$).

Discussion

The results of our study report that there is considerable PHD among patients with acute stroke in South India, and comparable PHD times were reported by the previous studies done in India,[9-12] Nepal[13] South Korea,[14] China,[15] and the Unites States.[3]

However, much lesser prehospital and median delay times were reported from Switzerland, Spain, UK (London), Australia (Sydney), Turkey, and Greece.[16-21]

Factors associated with prehospital delay

Demographic factors

In our study, none of the demographic variables were associated with the PHD. However, PHD was significant in other studies pertaining to age, education, and ethnicity.[1,7,11,13,14,19,22-24]

Stroke symptoms

In the current study, the stroke symptom, headache, was independently associated ($P < 0.014$) with PHD in the multiple regression analysis. Thirty-nine out of 210 patients (18.6%) had headache. The possible reason may be that they might have perceived headache less seriously and must have managed with self-medication and home remedies. However, in other studies done in India and world report, stroke symptoms like hemiplegia, weakness, facial deviation, speech disturbances, consciousness disturbance, aphasia, headache, nausea/vomiting, facial deviation, or perceiving stroke symptoms as severe were associated with earlier hospital visitation.[10,11,13,15,25,26]

Stoke risk factors

The history of previous stroke was associated with PHD in univariate analysis. Yet, family history of stroke was independently associated ($P < 0.007$) with PHD in the multiple regression. The possible reason may be, the patients and family members might have not learnt any lesson from the stroke incident in the family due to illiteracy and ignorance. In other studies, risk factors like atrial fibrillation and coronary heart disease were associated with the early arrival.[11,20,27]

Contextual factors

The onset of symptoms at night and reaching the hospital by bus and taxi were independent predictors of late arrival to the

Table 1: Demographic factors contributing to prehospital delay in univariate analysis (*n*=210)

Variables	*n* (%)	Prehospital delay PHD (%)		*P*†
Age (in years)				
20-30	5 (2.4)	1 (20.0)	4 (80.0)	0.953
31-40	12 (5.7)	2 (16.7)	10 (83.3)	
41-50	42 (20)	12 (28.6)	30 (71.4)	
51-60	60 (28.6)	17 (28.3)	43 (71.7)	
61-70	53 (25.2)	13 (24.5)	40 (75.5)	
>70	38 (18.1)	11 (28.9)	27 (71.1)	
Sex				
Male	154 (73.3)	40 (74.0)	114 (26.0)	0.707
Female	56 (26.7)	16 (28.6)	40 (71.4)	
Marital status				
Married	206 (98.1)	54 (26.2)	152 (73.8)	0.242
Widow/Widower	1 (0.5)	1 (100.0)	0 (0.0)	
Unmarried	3 (1.4)	1 (33.3)	2 (66.7)	
Education				
No education	26 (12.4)	4 (15.4)	22 (84.6)	0.369
Primary	48 (22.9)	16 (33.3)	32 (66.7)	
Secondary	72 (34.3)	20 (27.8)	52 (72.2)	
Hr. secondary	15 (7.1)	2 (13.3)	13 (86.7)	
Graduate and postgraduate	49 (23.3)	14 (28.6)	35 (71.4)	
Occupation				
Unskilled	24 (11.4)	5 (20.8)	19 (79.2)	0.383
Agricultural farmers	20 (9.5)	6 (30.0)	14 (70.0)	
Skilled	43 (20.5)	7 (16.3)	36 (83.7)	
Professional	22 (10.5)	6 (27.3)	16 (72.7)	
Business	32 (15.2)	8 (25.0)	24 (75.0)	
Unemployed (retired and homemaker)	69 (32.9)	24 (34.8)	45 (65.2)	
Living Status				
Nuclear	121 (57.6)	30 (24.8)	91 (75.2)	0.597
Joint	83 (39.5)	25 (30.1)	58 (69.9)	
Living alone	6 (2.9)	1 (16.7)	5 (83.3)	
Medical insurance				
Yes	97 (46.2)	24 (24.7)	73 (75.3)	0.559
No	113 (53.8)	32 (28.3)	81 (71.7)	
Place of residence				
Rural	84 (40)	16 (19.0)	68 (81.0)	0.104
Urban	52 (24.8)	18 (34.6)	34 (65.4)	
Suburban	74 (35.2)	22 (29.7)	52 (70.3)	
Type of stroke				
Ischemic	151 (71.9)	43 (28.5)	108 (71.5)	0.343
Hemorrhagic	59 (28.1)	13 (22.0)	46 (78.0)	
History of stroke				
First time	182 (86.7)	44 (24.2)	138 (75.8)	0.037*
Recurrent	28 (13.3)	12 (42.9)	16 (57.1)	

*P<0.05; †Chi-square/Fisher's exact test, P

hospital. In our study, 38 (18.1%) patients had stroke onset at night between 7 pm and 3 am. The stroke onset at night limits the accessibility in getting resources like getting help and transportation. A study done in Spain reports, onset of stroke during the daytime and the weekend and occurrence of stroke outside the home were associated with reduced PHD.[17]

In the present study, traveling by bus and taxi (2.9% and 40.5%, respectively) significantly increased the delay in reaching the hospital. The possible reason may be, people prefer other modes of transport due poor accessibility and affordability of EMS. A systemic analysis review reports that stroke in the evening or night and use of private transport to hospital and symptoms not taken seriously were responsible for PHD.[6] Many studies report that using EMS was associated with less PHD.[14,15,16,19,20]

In our study, the other contextual factors like distance and transportation time from home to hospital, arrival time to the study hospital, and presentation to the hospital were associated

Table 2: Contextual factors contributing to prehospital delay in univariate analysis (*n*=210)

Contextual factors	*n* (%)	Prehospital delay		*P*†
		No	Yes	
Location when stroke onset				
Home	175 (83.3)	44 (25.1)	131 (74.9)	0.264
Outside	35 (16.7)	12 (34.3)	23 (65.7)	
Presence of bystander on onset				
Yes	181 (86.2)	47 (26.0)	134 (74.0)	0.567
No	29 (13.8)	9 (31.0)	20 (69.0)	
Onset day				
Monday	39 (18.6)	11 (28.2)	28 (71.8)	0.827
Tuesday	26 (12.4)	5 (19.2)	21 (80.8)	
Wednesday	30 (14.3)	6 (20.0)	24 (80.0)	
Thursday	28 (13.3)	7 (25.0)	21 (75.0)	
Friday	29 (13.8)	8 (27.6)	21 (72.4)	
Saturday	25 (11.9)	9 (36.0)	16 (64.0)	
Sunday	33 (15.7)	10 (30.3)	23 (69.7)	
Stroke onset				
While awake	164 (78.1)	46 (28.0)	118 (72.0)	0.392
While sleeping	46 (21.9)	10 (21.7)	36 (78.3)	
Stroke onset time				
3 am-11 am	110 (52.4)	30 (27.3)	80 (72.7)	0.191
11 am-7 pm	62 (29.5)	20 (32.3)	42 (67.7)	
7 pm-3 am	38 (18.1)	6 (15.8)	32 (84.2)	
Hospital arrival time				
3 am-11 am	52 (24.8)	20 (38.5)	32 (61.5)	0.048*
11 am-7 pm	88 (41.9)	23 (26.1)	65 (73.9)	
7 pm-3 am	70 (33.3)	13 (18.6)	57 (81.4)	
Distance to study hospital				0.000***
≤80 km	135 (64.2)	52 (38.5)	83 (61.5)	
81-120 km	22 (10.5)	3 (13.6)	19 (86.4)	
>120 km	53 (25.2)	1 (1.9)	52 (98.1)	
Transportation time				
Up to 3 h	159 (75.7)	55 (34.6)	104 (65.4)	0.000***
3.1-6 h	44 (20.9)	1 (2.3)	43 (97.7)	
>6 h	7 (3.3)	0 (0.0)	7 (100)	
Presentation to study hospital				
EMS by self	132 (62.9)	45 (34.1)	87 (65.9)	0.003**
OPD by self	18 (8.6)	5 (27.8)	13 (72.2)	
Referral by other hospital	60 (28.6)	6 (10.2)	54 (89.8)	
Other hospital visited				
General practitioner (GP)	20 (9.5)	3 (15.0)	17 (85.0)	0.000***
Local hospital/nursing homes	113 (53.8)	16 (14.2)	97 (85.8)	
GP and local hospital	9 (4.3)	0 (0.0)	9 (100)	
Directly to study hospital	68 (32.4)	37 (54.4)	31 (45.6)	

*P<0.05; **P<0.01; ***P<0.001; †Chi-square/Fisher's exact test: *P;* PHD*:* Pre Hospital Delay*;* EMS: Emergency medical services; OPD: Outpatient department

with the PHD in the univariate analysis. One-hundred and thirty-five (64.2%) patients' houses were located far away from the study hospital (>80 km) and 51 patients (24.2%) spent their time more than 3 h in traveling and 70 (33.3%) patients arrived hospital at night. One-hundred and thirty-two (62.9%) patients presented by themselves to EMS of the study hospital either directly or after visiting the local doctors or nursing homes and 60 (28.6%) patients came to the study hospital after referral. Previous studies reported that a distance of 20 km or less from the hospital[10,13,18] was associated with early arrival and certain PHD was associated with distances of 50 km or more.[23]

In the current study, visiting different types of health facilities before admitting in the study hospital were also associated with PHD in the univariate analysis. Immediately after the stroke onset, only 68 (32.4%) patients visited directly to the study hospital and others wasted their golden time in visiting GPs, nursing homes, and other hospitals where neurology specialists, CT/MRI scan, and thrombolysis facilities are limited.

One major determinant of delay is the referral pattern in India. It was noted that substantial proportion of patients (51%) contacted their local or community doctor first rather than going directly to emergency department.[11]

In agreement, in the present study, the perceived cognitive and behavioral factor, "Wasted time by visiting many general practitioners/nursing homes/hospitals," was an independent predictor of PHD. One-hundred and thirty-four (63.8%) patients perceived that they wasted time by visiting many hospitals/nursing homes and GPs. Seventy-four (35.2%) patients expressed that they wasted time by visiting their family doctor or GPs immediately after the onset of symptom. Similar findings are reported in other studies.[9,28-31] Almost one in three patients with a diffusion-weighted MRI–confirmed ischemic stroke first called the family physician. Face-to-face visits to the family doctor quadrupled the odds of PHD.[11,16]

Table 3: Association between stroke symptoms and prehospital delay in univariate analysis (*n*=210)

	n (%)	*P*†
Symptoms		
Hemiparesis	146 (69.5)	0.299
Slurred speech	129 (61.4)	0.248
Dizziness	81 (38.6)	0.608
Deviation of the face	55 (26.2)	0.636
Vomiting	44 (21.0)	0.210
Consciousness disturbances	39 (18.6)	0.574
Hemiplegia	39 (18.6)	0.172
Head ache	39 (18.6)	0.077
Aphasia	25 (11.9)	0.872
Visual disturbances	11 (5.2)	0.167
Fall	10 (4.8)	1.000
Seizure	8 (3.8)	0.442
Weakness of affected side hand alone	5 (2.4)	1.000

†Chi-square/Fisher's exact test; *P*

Table 4: Association between stroke risk factors and prehospital delay in univariate analysis (*n*=210)

Stroke risk factors	*n* %	Prehospital delay PHD%	*P*
		Yes (*n* and %)	
1. Hypertension	163 (77.6)	117 (71.8)	0.343
2. Previous stroke	28 (13.3)	16 (57.1)	0.037*
3. Transient ischemic attack	2 (1.0)	1 (50.0)	0.463
4. Diabetes mellitus	138 (65.7)	103 (74.6)	0.554
5. Hyperlipidemia	129 (61.4)	96 (74.4)	0.654
6. Smoking	52 (24.8)	38 (73.1)	0.962
7. Alcohol intake	54 (25.7)	43 (79.6)	0.225
8. Atrial fibrillation	3 (1.4)	2 (66.7)	1.000
9. Coronary heart disease	5 (2.4)	4 (80.0)	1.000
10. Family history of stroke	32 (15.2)	27 (84.4)	0.125
11. Valvular heart disease	9 (4.3)	7 (77.8)	1.000
12. Congestive heart failure	5 (2.4)	4 (80.0)	1.000
13. Stress	114 (54.3)	89 (78.1)	0.091

*$P<0.05$; †Chi-square/Fisher's exact test; *P*

Perceived cognitive and behavioral factors

In the current study, the perceived cognitive and behavioral factors like wishing or praying that symptom would subside on its own, hesitation to travel to hospital due to long distance, delay in arranging transport and money for admission, and wasted time by shopping for GPs/nursing homes/hospitals were independent predictors for delayed arrival to the hospital. Twenty-six (12.4%) patients perceived that arranging money for hospital admission delayed the hospital arrival. Fourteen (6.7%) patients were reluctant to travel as the hospital was far away and 15 (7.1%) patients had problem in arranging transport. A study done in Dhaka reports that 30% of the patients had financial constraints that led to PHD.[31]

In the current study, 14 patients (6.6%) stated that they did not have any help to reach hospital immediately as their close relatives were at work elsewhere. Immediately after stroke onset, eight patients (3.8%) were treating the hemiparesis with home remedies, like applying and massaging with herbal or Ayurveda oil and iodex/tiger balm, and few of them (2.4%) visited native treatment centers run by traditional healers. Five patients (2.4%) were trying to treat by self-medication and/or by local pharmacist's prescription.

The study finding also showed that there was a significant positive correlation between PHD and cognitive/behavioral factors indicating the higher the unfavorable perceived cognitive and behavioral factors, higher is the PHD. Most of the cognitive/behavioral factors are related to low awareness of the patients and their relatives on stroke management. Many studies conducted all over the world report lack of awareness about identification of stroke symptoms and its management by the patient and their relatives influence the PHD.[7,9,12,16,17,23,32]

The limitations of this study: Our study was conducted in a large private tertiary-care hospital in a Metropolitan city in South India, thus excluding patients dependent on public health care. Further studies are needed in the public sector to establish overall population characteristics. However, our study findings are similar and consistent with the studies done all over the world on factors influencing PHD in acute stroke. This study analyzed most of the factors influencing PHD including the factors unique to the developing countries pertaining to culture, socioeconomic status, and health-care delivery system. It is a single-centered study with a small sample size. Multicenter studies are required to reflect the experience of patients with stroke in other cities and rural areas of our country. Next, patients' memory may be hampered by stroke-related cognitive impairment and consciousness disturbances.

In conclusion, this study demonstrated significant PHD after an acute stroke in South Indian population and identified several factors associated with PHD in the area of clinical, contextual, and cognitive/behavioral domains. Modifiable factors like

Table 5: Cognitive and behavioral factors contributing to prehospital delay (*n*=210)

Cognitive and behavioral factors	*n* (%)	Prehospital delay	*P*†
		Yes (*n* and %)	
1. Taking medicines by self and waited for the symptoms to subside	5 (2.4)	4 (80.0)	1.000
2. Not able to call for help	14 (6.6)	9 (64.3)	0.531
3. Waited for the symptoms to subside on its own	39 (18.6)	32 (82.1)	0.172
4. Prayed for symptoms to go away on its own	31 (14.8)	27 (87.1)	0.061
5. Visited local doctor immediately after the onset of symptoms	74 (34.9)	62 (83.8)	0.012*
6. Applied home remedies	8 (3.8)	5 (62.5)	0.442
7. Delay because the incident happened at night	20 (10.5)	16 (80.0)	0.478
8. Delay in decision-making regarding treatment	51 (24.1)	39 (76.5)	0.560
9. Delay in decision-making to select hospital	43 (20.3)	32 (74.4)	0.857
10. Delay in arranging transport	15 (7.1)	8 (53.3)	0.125
11. Ambulance/Vehicle arrived late	4 (1.9)	3 (75.0)	1.000
12. Hesitation to travel to hospital due to long distance	14 (6.6)	13 (92.9)	0.119
13. Problem in arranging money for treatment	26 (12.4)	23 (88.5)	0.062
14. Low perceived threat of stroke symptoms by the relatives	69 (32.9)	54 (78.3)	0.259
15. Low perceived threat of stroke symptoms by the patient	73 (34.7)	59 (80.8)	0.073
16. Patient was not knowing, the symptoms were stroke related	87 (41.4)	69 (79.3)	0.100
17. Patient's relative was not knowing, the symptoms were stroke related	87 (41.4)	65 (74.7)	0.704
18. Thought to be caused by some other cause	20 (9.5)	16 (80.0)	0.478
19. No knowledge of patient about thrombolysis	175 (83.3)	130 (74.3)	0.485
20. Wasted time by visiting many general practitioners/nursing homes/ hospitals	134 (63.8)	118 (88.1)	0.000***

*P<0.05; ***P<0.001; †Chi-square/Fisher's exact test; PHD: Pre Hospital Delay

lack of awareness on identification of stroke symptoms and importance of time in stroke management, lack of awareness in identifying the hospital for stroke management, poor referral system, inaccessibility of government tertiary-care hospitals with acute stroke care management facilities, nonaffordability of stroke treatment cost in the private hospitals, and poor EMS influence the PHD in acute stroke.

Primary prevention strategies by educating the public on early identification and reduction of stroke risk factors and approaches to improve the community awareness through electronic media on early identification of symptoms of stroke, management, and consequences of PHD, educating the local physicians on prompt diagnosis and early referral to stroke centers and hospitals with thrombolysis facilities, increasing the availability of ambulance services appear as assuring methods to hasten the presentation to hospital in India.

Ethics approval

The study was approved by the Institute Ethics Committee, Sri Ramachandra University, Chennai, India (Reference number: IEC-NI/17/JAN/57/04 dated 22/02/2017).

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Table 6: Factors associated with Prehospital delay in multiple Poisson regression (≥4 h and 30 min) (*n*=210)

Factors	*n* (%)	PR(95% CI)	
Contextual factors			
Transportation used			
Train	2 (1.0)	1.282	0.95-1.72
Bus*	6 (2.9)	1.668	1.07-2.61
Relatives vehicle	9 (4.3)	0.922	0.48-1.78
Own vehicle	35 (16.7)	1.053	0.79-1.40
Auto	10 (4.8)	0.926	0.59-1.45
Taxi**	85 (40.5)	1.268	1.06-1.51
Ambulance	63 (30)	1	
Time of onset of symptoms			
7 pm-3 am**	38 (18.1)	1.307	1.07-1.59
11 am-7 pm	62 (29.5)	0.992	0.82-1.20
3 am-11 am	110 (52.4)	1	
Stroke clinical manifestations			
Headache			
No*	171 (81.4)	0.806	0.68-0.96
Yes	39 (18.6)	1	
Stroke risk factors			
Family history of stroke			
Yes**	32 (15.2)	1.286	1.07-1.54
No	178 (178)	1	
Perceived cognitive and behavioral factors			
Wished/Prayed for symptoms to go away			
Yes**	31 (14.8)	1.351	1.10-1.66
No	179 (85.2)	1	
Hospital far away			
Yes**	14 (6.6)	1.504	1.14-1.99
No	196 (92.5)	1	
Delay in arranging transport			
Yes**	15 (7.1)	0.502	0.31-0.82
No	195 (95)	1	
Had problem in arranging money for admission			
Yes*	26 (12.4)	1.266	1.05-1.52
No	184 (87.6)	1	
Wasted time by visiting general practitioners, hospitals/nursing homes			
Yes*	134 (63.8)	1.541	1.11-2.15
No	76 (36.2)	1	

*P<0.05; **P<0.01; OPD: outpatient department; PR: prevalence ratio; CI: confidence interval; EMS: emergency medical services

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