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Predictors and correlates of pre-hospital delay among acute stroke patients in Thiruvanthapuram district, Kerala.

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Abstract

Introduction

Stroke is a major public health challenge globally, leading to high mortality rates and long-term disability. Its impact extends beyond physiological health, placing a significant socio-economic burden on patients, families, and healthcare systems. Timely intervention is critical in mitigating the adverse outcomes associated with stroke, especially through the timely administration of reperfusion therapies. However, delays in reaching a healthcare facility after the onset of stroke symptoms often prevent patients from accessing these life-saving treatments. Understanding the prevalence and factors associated with these pre-hospital delays is vital for enhancing stroke care and outcomes. This study aimed to assess the prevalence of pre-hospital delays and its correlates among stroke patients in Thiruvananthapuram district, Kerala as well as to explore the situational factors faced by the patients while reaching healthcare facilities.

Materials and methods

A hospital-based cross-sectional survey was conducted among 170 Stroke patients with confirmed acute stroke who presented to the emergency units of four hospitals in Thiruvananthapuram district. Patients who arrived within four and half hours of symptom onset were categorized as "early arrivals," while those who arrived after four and half hours were classified as "delayed/late arrivals." Data collection was carried out using Open Data Kit software and analyzed with SPSS version 22. Univariate and multivariate analyses were performed to identify associations. Additionally, freewheeling interviews were coded to corroborate the quantitative findings.

Results

The median time from symptom onset to hospital arrival was 6.75 hours (IQR: 2.27-17.48 hours), with 40% of stroke patients experienced pre-hospital delays. Bivariate analysis showed significant associations between delay and factors such as age, housing type, income source, occupation, socioeconomic status, presence of dependents, choice of healthcare facility, number of facilities approached, and mRS score. Multiple regression analysis identified housing type and the number of facilities approached as significant predictors of prehospital delay. Freewheeling interviews revealed that regardless of sociodemographic characteristics, hesitation, reluctance, and self-assessment and judgment were the primary causes of delay.

Conclusion

The study found a high prevalence of prehospital delay (40%) among acute stroke patients in Thiruvananthapuram district, the capital city of Kerala. The study findings highlight the need for health promotion strategies that enhance public awareness of the early signs of stroke, prioritize the direct transfer of patients to hospitals equipped with CT scan and thrombolysis facilities, and standardize referral processes with uniform protocols to reduce prehospital delays and improve patient outcomes.

Categories: Public Health
Keywords: early arrival, functional outcomes, therapeutic window period, acute stroke care, pre-hospital delay

Introduction

Stroke is the second leading cause of mortality and third leading cause of disability globally, and its impact is particularly profound in low-middle-income countries (LMICs) [1]. The consequences of stroke extend beyond individual health outcomes and impose a significant socioecnomic burden on patients and their families. Stroke causes long-term disability characterized by physical, cognitive, and emotional challenges, leading to reduced quality of life, decreased productivity, and higher healthcare costs [2, 3]. In India, the burden of stroke is escalating; it is the fourth leading cause of death and fifth leading cause of disability [4]. Even in Kerala, one of the developed states with better health indices, the incidence of stroke remains

substantial [5]. The state has experienced a rise in stroke cases, with an average annual incidence rate of 145 per 100,000 people [6]. As highlighted by Jeffrey Save's concept of "time is brain," stroke management is time-sensitive and underlines the critical importance of the early administration of medical interventions to minimize brain damage and enhance survival rates and functional outcomes [7]. The appropriate therapeutic window period is less than four and a half hours, and treatment within 90 minutes yields the best results [8]. The World Stroke Organization (WSO), American Heart Association (AHA), and Ministry of Health and Family Welfare, Government of India, issued recommendations emphasizing the significance of timely diagnosis and intervention [9]. However, in developing countries like India, due to severe delays in hospital presentation, only a small percentage of patients with acute stroke are eligible for thrombolysis, leading to underutilization of this treatment. These delays are attributed to multiple challenges, including systemic issues and pre-hospital delays [10].

Pre-hospital delay is defined as the time delay between the onset of symptoms and the start of treatment, significantly impacting treatment outcomes. Therefore, reducing pre-hospital delay is very crucial for better outcomes [11]. Very few studies in India, especially in South India, have evaluated the prevalence of pre-hospital delay and its correlates [12, 13]. This study mainly aimed to assess the pre-hospital delay and its correlates among acute stroke patients in Thiruvananthapuram district, Kerala. I hope this study might help in developing strategies to reduce pre-hospital delays and improve the quality of healthcare service delivery to stroke patients in Kerala. This study is particularly relevant in the context of the upscaling of the state's ambitious project "Stroke Identification, Rehabilitation Awareness, and Stabilization" *('SIRAS'-Malayalam meaning "head"* which aims to provide timely care through primary stroke care units at no cost [14].

Materials And Methods

A cross-sectional survey was conducted from July 2023 to April 2024 among acute stroke patients admitted in four selected hospitals, who gave consent in Thiruvananthapuram district, Kerala. The sample size was estimated using OpenEpi Version 3.0, based on the reported prevalence of pre-hospital delays of approximately 73.3% from an Indian study [11], with 10% absolute precision and a design effect of 2. The calculated sample size was 151 at a 95% confidence interval. Assuming a 10% non-response rate, the final sample size was rounded to 170. Initially, a list of patients admitted during the study period was collected from each selected hospital and obtained gatekeeper consent. Deceased patients and those who did not respond after three consecutive phone calls were removed from the list, and the patients who gave consent for the study were visited by the Principal and Co-investigators at the patient's residence based on their convenience. The eligible participants were those aged 18 years or older diagnosed with ischemic or hemorrhagic stroke by Computed tomography or magnetic resonance imaging techniques. Exclusion criteria included pregnant women, individuals with cognitive impairments and unable to respond to questionnaires due to aphasia.

Before starting the interview, informed consent was obtained from all participants (stroke patients). In very few cases (n=12), stroke patients were unable to recall the events before the hospital admission. In these instances, the caregiver who was present during the patient's admission was contacted to confirm the events that occurred in between symptom onset and hospital admission.

The cross-sectional survey was carried out among the patients who could respond and recollect the memory during admission and confirmed it with the caregiver. In very few cases (n=12), the stroke patients were not able to respond and memorize the events, in that cases, the caregiver who was present during the admission time was contacted and collected the stroke-related admission events. The survey was done using a questionnaire developed by the research team. The questionnaire consisted of four sections: sociodemographic characteristics (age, gender, education, marital status, occupation details, income and its source and socioeconomic status), household details (household size and house type), clinical details (comorbidities, type of Stroke, time of symptom onset and arrival for care) and functional outcomes (Modified Rankin Scale and Health Quality Scale). During the survey, the comorbidities of the patients were self reported and confirmed with the discharge summary and the list of medicines consumed by the patient during the data collection period. After the cross-sectional survey, freewheeling interviews (n=15) were conducted with the patients/caregivers of the patients who were present during the admission time. The participants were selected purposively, based on the initial quantitative survey. The interviews were transcribed, translated and then coded to substantiate the cross-sectional survey findings. During the freewheeling interviews, the information on symptom identification and decision-making on shifting of the patients was captured.

Ethical considerations

This study was carried out as part of a larger study titled "Estimation of Catastrophic health expenditure and its coping strategies among Stroke Survivors in Thiruvananthapuram district, Kerala. The study was approved by the Institutional Ethics Committee of SHSRC- Kerala (EC/NEW/IND/2022/2909). According to the National Ethical Guidelines of the Indian Council of Medical Research, the study came under the category of less than minimal risk. Privacy and confidentiality were maintained throughout the study.

Operational definition

Pre-hospital delay was defined as the time interval from symptom onset to the time of arrival at the hospital where essential stroke care services were received exceeded 4.5 hours. This definition was developed in accordance with the American Heart Association's guidelines, which recommend administering recombinant tissue plasminogen activator (rtPA) within 3 to 4.5 hours of stroke onset for eligible patients (Class I Recommendation, Level of Evidence B), and based on the study by Hany et al. [15,16].

Data analysis

The data was entered using Open Data Kit and exported to SPSS version 24 (IBM Corp., Armonk, NY, USA) for analysis. Univariate analysis was carried out for descriptive purposes, then the variables were coded and recoded for bivariate analysis. Bivariate analysis was conducted using chi-square and Mann-Whitney U tests. For the multivariate analysis, logistic regression was conducted using the variables found to be significantly associated with pre-hospital delay in the bivariate analysis. A p-value of less than 0.05 was considered statistically significant in both bivariate and multivariate analyses. The free-wheeling interviews were transcribed, translated, and coded to substantiate the quantitative findings.

Results

Profile of study participants

The sociodemographic and household details are given in table *1*. The median age of the study participants was 66 years (IQR - 59.7 - 74.25) and were predominantly males (n=113, 66.5%), completed at least high school education (n=162, 94.8%) and lived in rural areas (n=127, 74.7%). According to the classification of the Antyodaya Anna Yojana (AAY) scheme, the Government of India, majority belonged to APL (Above Poverty Line) (n=106, 62.3%). About 72% had monthly income (n=123), with the primary source being an employee pension (28.5%), followed by salary (26.4%), old age pension (16.2%) (not regular) and gift /assistance (1.2%). The median monthly income reported was Rs. 5000 INR (IQR: 0 - 20,000 INR). The median household size was four (IQR: 3-5) The household and treatment expenses were primarily managed by family members, specifically children, who held decision-making power (n=89, 53%) in the family.

The details of comorbidities and stroke related information are given in table *1*. Substance addiction was noted among a few participants (5.8%), as most had quit alcohol and smoking after Stroke. Many of the patients (n=112, 65.8%) visited multiple facilities and reached public healthcare facilities (57.9%)for final Stroke care with or without reference due to unaffordability. The median (IQR) time taken to reach the stroke care facility was reported to be 6.75 hours (2.27-17.48) and the median (IQR) distance in km from home to the final Stroke care facility was found to be 18.05 km (8.175-35.792). The median (IQR) hospitalization duration was five days (4-9).

The median mRs score during admission was 4 (moderately severe disability) (IQR - 3-5); discharge was 3 (moderate disability) (IQR - 2-5) and the current score was 2 (slight disability) (2-3). The median EQ-5D-5L utility score was 0.78597 (IQR: 0.50068-0.9323), indicating a reasonably good health state. More than 60% of the participants (n=113, 66.5%) were independent and 57 (33.5%) were dependent in performing Activities of Daily Living (ADL) but more than 70% (n=126, 74.1%) reported psychosocial issues after stroke. Additionally, the median EQ-Health Analog Scale (HAS) score was 60 (IQR: 40-75) which means individuals perceive their health as better but not at the optimal level (table *1*).

Variable	Categories	Frequency N (%)
Age in years	18-40	6 (3.5%)
	41-60	48 (28.2%)
	>60	116 (68.2 %)
Gender	Male	113 (66.5%)
	Female	57 (33.5%)
Type of Residence	Rural	127 (74.7%)
	Urban	43 (25.3%)
Marital status	Unmarried	6 (3.5%)
	Married and living with spouse	136 (80.0%)
	Widowed	27 (15.9%)
	Separated	1 (0.6%)

Education	No formal education	8 (4.7%)
	Up to high school	113 (66.5%)
	Higher Secondary	14 (8.2%)
	Diploma	6 (3.5%)
	Graduation or above	29 (17.1%)
Occupation	Employed	96 (56.5%)
	Unemployed	74 (43.5%)
Economic status	Most economically backward	9 (5.3%)
	Below poverty line	55 (32.4%)
	Above poverty line	106 (62.3%)
Patient's income	0-5000	86 (50.6%)
	5001-10000	16 (9.4%)
	10001-30000	52 (30.6%)
	Above 30000	16 (9.4%)
Household head	Patient	132 (77.6%)
	Children	24 (14.2%)
	Others	14 (8.2%)
Household size	1-4 members	102 (60%)
	5-6 members	56 (32.9%)
	More than 6 members	12 (7.1%)
Multiple comorbidities	Yes	109 (64.4%)
	No	60 (35.5%)
Type of comorbidties	Diabetes Mellitus	90 (52.9%)
	Hypertension	118 (69.4%)
	Dyslipidemia	71 (41.8%)
	Cardiac Disease	35 (20.6%)
	Respiratory Disease	19 (11.2%)
	Musculoskeletal Disorders	24 (14.1%)
	Others	20 (11.8%)
Number of facilities opted for Stroke care	Single	58 (33.9%)
	Multiple	112 (65.5%)
mRs during Admission	Good Outcome (1-2)	28 (16.5%)
	Bad outcome (3-5)	142 (83.5%)
mRs Present	Good outcome	105 (61.8%)
	Bad outcome	63 (37.1%)

TABLE 1: Profile of study participants

Pre-hospital delay and its correlates

Out of 170 patients, 68 arrived (40%) at the stroke care facility four and a half hours after the symptom

onset. Most of them (65.8%) visited multiple facilities, started from small private clinics/hospitals and then to the hospitals with acute or comprehensive stroke care facilities (ranging from two to four). Bivariate analysis revealed a statistically significant association between pre-hospital delay and factors such as age, income source, occupation, socioeconomic status, choice of facilities, and presence of dependents ($p<0.05$). Among those who arrived at the hospital late, significant participants were employed, belonged to the APL category, and had dependents ($p<0.05$). Although most of the patients who experienced late arrival were males, lived in rural areas, had poor education, and had multiple comorbidities, these factors were not statistically significant (table *2*).

Variables		Early arrival N (%)	Late arrival N (%)	Odds Ratio	P value
Gender	Male	67 (39.4%)	46 (27.1%)	0.916	0.791
	Female	35 (20.6%)	22 (12.9%)		
Type of residence	Rural	73 (42.9%)	54 (31.8%)	0.653	0.249
	Urban	29 (17.1%)	14 (8.2%)		
Type of house	Kaccha or semikachha	26 (15.3%)	31 (18.2%)	0.408	<0.05*
	Pucca	76 (44.7%)	37 (21.8%)		
Marital status	Married, living with spouse	77 (45.3%)	59 (34.7%)	0.470	0.072
	Never married and married, not living with spouse	25 (14.7%)	9 (5.3%)		
Education	Primary education to Higher secondary	83 (48.8%)	52 (30.6%)	1.344	0.439
	Diploma to PG or above	19 (11.2%)	16 (9.4%)		
Presence of income	No	28 (16.5%)	19 (11.2%)	0.976	0.944
	Yes	74 (43.5%)	49 (39.8%)		
Income source of patient	Pension	53 (31.2%)	23 (13.5%)	0.89	<0.05*
	Salary	19 (11.2%)	20 (11.8%)		
	Others	2 (1.2%)	6 (3.5%)		
	Not Applicable	28 (16.5%)	19 (11.2%)		
Occupation	Employed	51 (30%)	45 (26.5%)	0.511	<0.05*
	Unemployed	51 (30%)	23 (13.5%)		
Socioeconomic status	BPL	31 (18.2%)	33 (19.4%)	0.463	<0.05*
	APL	71 (41.8%)	35 (20.6%)		
Household head	Patient	42 (24.7%)	34 (20%)	0.700	0.257
	Others	60 (35.3%)	34 (20%)		
Decision maker Patient Others	Patient	52 (30.6%)	29 (17.1%)	0.873	0.527
	Joint including patient	5 (2.9%)	3 (1.8%)		
	Others	45 (44.1%)	36 (52.9%)		
Presence of multiple comorbidity	No	32 (18.8%)	28 (16.5%)	0.653	0.190
	Yes	70 (41.2%)	40 (23.5%)		
Type of facility opted for final stroke care	Private	50 (29.4%)	21 (12.4%)	2.152	<0.05*
	Public	52 (30.6%)	47 (27.6%)		
Stroke type	Ischemic	95 (55.9%)	61 (35.9%)	0.24	0.627
	Hemorrhagic	3 (1.8%)	4 (2.4%)		
	Others	4 (2.4%)	3 (1.8%)		

Health insurance	Yes	72 (42.6%)	40 (23.7%)	1.738	0.093
	No	29 (17.2%)	28 (16.6%)		
mRs during admission	Good outcome	22 (12.9%)	6 (3.5%)	2.842	<0.05*
	Bad outcome	80 (47.1%)	62 (36.5%)		
mRs present	Good outcome	67 (39.9%)	38 (22.6%)	1.548	0.144
	Bad outcome	33 (19.6%)	30 (17.9%)		

TABLE 2: Correlates of pre-hospital delays

*p value < 0.05

The freewheeling interviews revealed that irrespective of sociodemographic characteristics, hesitation/reluctance and self-judgment were the primary causes of delay. Many patients and their families believed certain symptoms as minor, (headache, diarrhea, nausea and palpitation) ignored those symptoms. The belief that regular intake of NCD medications would prevent a stroke, coupled with the perception of being healthy, further delayed their decision to seek medical attention. Their understanding of typical stroke symptoms including limb weakness, paralysis, or facial drooping, led them to underestimate the severity of their condition. This misjudgment resulted in delayed medical care and allowed the symptoms to worsen. In some instances, especially women and young men waited for more symptoms to manifest before seeking medical attention (figure *1*).

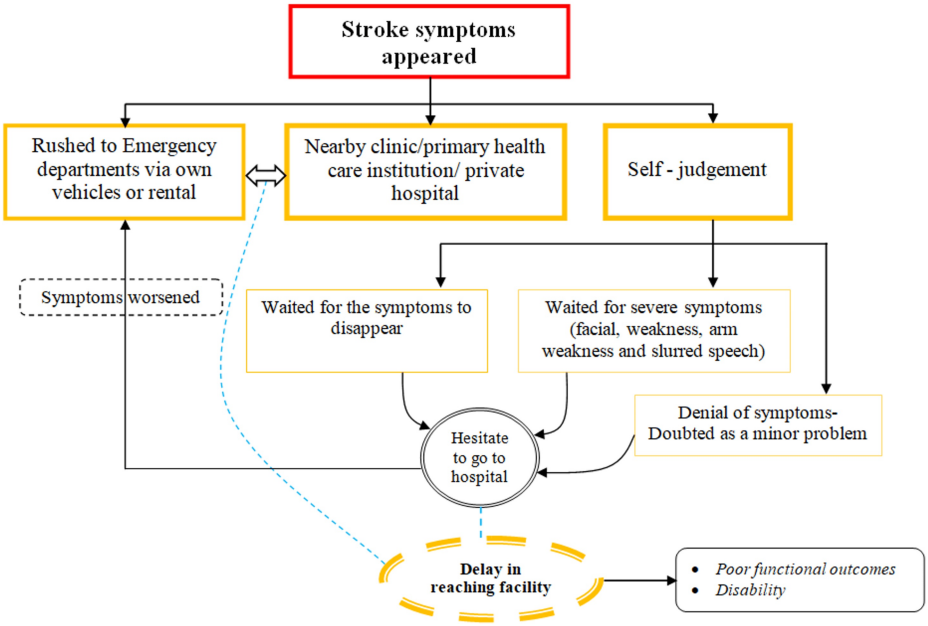

FIGURE 1: Framework evolved

"Around 10:00 am, I experienced slight pain and numbness in my right palm. I tried massaging it with balm, but it didn't help, so I went to XXX hospital for an orthopedic consultation. I received some medication and returned home. Around 1:00 pm, I started having balance issues, which I attributed to high blood pressure and the side effects of the medication. I ignored it and lay down for a while. Later, I went outside where my wife was washing clothes, and she insisted I go to the hospital, but I wasn't interested. Suddenly, I collapsed, and my upper limb felt heavy. I was immediately taken to a private hospital, where the doctors informed me that I had arrived too late" - 54-year-old man

"Morning. I was preparing tea for everyone at 6:30 am when I started feeling shivery and uncomfortable, but I didn't pay much attention because I was busy preparing lunch for my husband, who needed to go to the office, and my children, who had to go to school. I continued with my tasks, but later, I collapsed and lost consciousness. When I woke up, I was admitted to the hospital due to a stroke. I was puzzled about how this could have happened since my limbs weren't paralyzed; I could sit and eat. How did this happen?" - 47 year old female

The study found that participants who received stroke care from public healthcare facilities experienced delays twice as often as those who sought treatment at private hospitals, with a statistically significant association ($p<0.05$). This pattern was discernible in free-wheeling interviews also. Patients and their families often encountered confusion and uncertainty regarding symptoms which further complicates the decision on which hospital to choose for stroke care. A common pattern observed was that patients initially went to small local clinics, then moved on to private hospitals and were referred to public hospitals after their symptoms had worsened due to poor infrastructure or unaffordability reported by the patients/family members.

"Early morning around 6.00 am.....I felt so tired..... .vomited.. and at that time urine and motion also went..... After the onset of symptoms at 6 am, I went to a XXX clinic near my home ... by 8.00 am. My son and daughter-in-law were with me.....their presence facilitated a quick response, although initially, they were unsure where to go..... I told them to take me to that clinic as I regularly visit it for my health issues....then i got medicines and reached home.....after one hour...I vomited and felt so tired and lost my balance ...('vaadippoyi') ....then we went to XXX hospital (Private) 9.45 am.....then they referred to XXXX (public) 11 pm due to inadequate facility for Stroke care"- Stroke Survivor aged 55 years, male

Furthermore, a significant association was found between delay and mRs score at admission ($p=0.028$), with those who experienced delays tending to have worse outcomes. The current mRs status does not show a significant association with delays ($p=0.144$), although worse outcomes remain more prevalent among those who faced delays (table *2*). Stroke patients who experienced pre-hospital delays generally had worse quality of life outcomes compared to those who arrived at the hospital without delays. Delayed patients also had higher levels of dependence on self-care and daily living activities (ADL) (figure *2*).

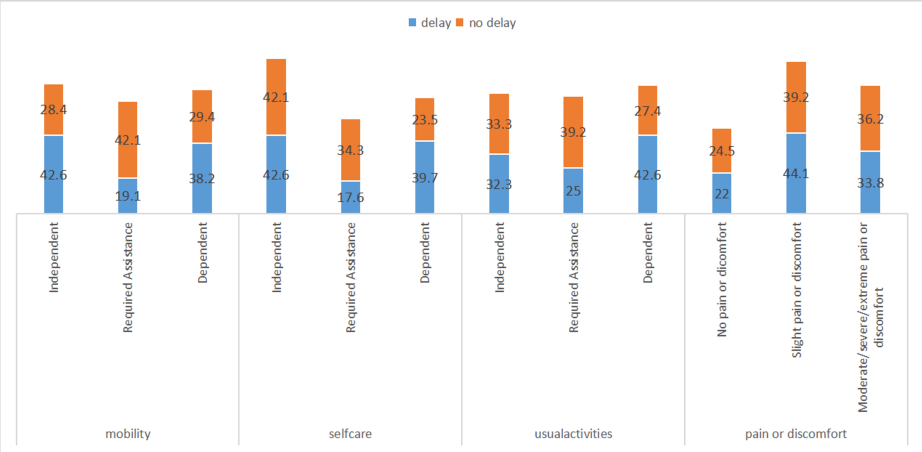

FIGURE 2: Delay and functional measures

Logistic regression analysis showed that socioeconomic status, as reflected by housing type, indecision in selecting a hospital for stroke care, and the number of facilities considered for hospitalization, significantly increases the likelihood of delays (p-value < 0.01). Patients who sought care at public hospitals had 1.018 times higher odds of experiencing delays compared to those who received care at private hospitals. Elderly patients exhibited a marginally lower propensity for delays. Unemployed and patients with dependents experienced more delays but were not significantly associated (table *3*).

Variable	Categories	Odds Ratio	P value
Duration of stroke	Less than or equal to six months (Ref.cat)		0.068
	More than six months	0.391	
Facility opted for stroke care	Private (Ref.cat)		0.972
	Public	1.018	
Occupation	Employed (Ref.cat)		0.239
	Unemployed	1.878	
Socioeconomic status	BPL (Ref.cat)		0.361
	APL	1.604	
Income source	Pension and old age pension (Ref.cat)		0.688
	Salary	1.276	0.713
	Not applicable	1.291	0.706
	Others	4.028	0.225
Type of house	Kachha or semikachha (Ref.cat)		0.038
	Pucca	2.958	
Age		0.986	0.575
Number of facilities opted for hospitalization		17.665	p<0.01*
Number of dependents		1.313	0.074

TABLE 3: Regression analysis

*p value < 0.01

Discussion

Stroke and its associated disabilities are recognized as a major global public health concern, significantly contributing to the overall disease burden [15-17]. Despite advances in stroke management, many acute stroke cases do not receive timely medical attention, even in high-income countries [18]. Thrombolytic treatment is most effective within a therapeutic window of less than four and a half hours (recommended by American Heart Association), with the best outcomes seen when administered within 90 minutes. However, due to significant pre-hospital delays, only a small number of acute stroke patients receive thrombolytic therapy [19, 20] In this study, we attempted to examine the pre-hospital delays and their associated factors among stroke patients admitted in both public and private hospitals in Thiruvananthapuram district, Kerala. The median time taken by the patients to reach the stroke care facility in our study was 6.75 hours, with an interquartile range (IQR) of 2.27 to 17.48 hours. This finding is particularly concerning, given that timely medical intervention is essential for optimizing stroke outcomes. The delays observed in our study align with similar findings from studies conducted in India, Nepal, China, United States, Greece, and United Kingdom [21-25]. These delays can be attributed to several factors, including a lack of public awareness about stroke symptoms, delays in recognizing the urgency of the situation, and inadequate emergency response systems. In many cases, patients or their families may hesitate to seek help due to uncertainty about the symptoms or logistical challenges, such as transportation difficulties and the time required to identify and reach an appropriate stroke care facility. This pattern was also evident in our study, as reflected in the free-wheeling interviews with patients and the median distance from home to the final stroke care facility, which was approximately 18 Km.

Consistent with previous studies, our findings indicate an inverse relationship between age and pre-hospital delay (PHD) in stroke patients, with older patients being less likely to experience delays and a significant association has been found [26-28]. Younger patients, particularly those under 55 years old, were more prone to hospital delays. Younger individuals may not immediately recognize the severity of stroke symptoms or may misinterpret them as less serious health issues or underestimate the urgency required for treatment, leading to delays in reaching a healthcare facility. These age-related differences in health-seeking behavior underscore the importance of tailored strategies to address the specific barriers faced by different age groups. According to previous studies, lower socioeconomic status is linked to longer delays in seeking

medical care. However, the present study found that individuals from higher socioeconomic classes experienced longer delays in reaching stroke care facilities [29-31]. Individuals belonging to higher socioeconomic status often had greater access to private healthcare facilities, which may be located farther from the patient's residence, thus increasing travel time and contributing to delays or such individuals may have more autonomy in decision-making, which could lead to delays as they explore various treatment options or seek multiple opinions before deciding to go to a hospital. In contrast, those from poor socioeconomic backgrounds may have more direct pathways to care, often relying on local healthcare providers or government-run facilities, which can result in quicker access to medical treatment [32]. In contrast to Alkhotani et al's findings, employed individuals experienced more delays in reaching stroke care facilities [33]. This could be because of the early symptoms, such as headache, diarrhea, or vomiting, were not recognized and were mistakenly attributed to stress at work, which could cause a delay in making a decision. The patient's perception of symptom severity and their knowledge regarding stroke symptoms and management options directly affected decision delay and led to pre-hospital delay. Previous studies also reported consistent relationships [34, 35]. Unwanted referrals often lead to unnecessary delays in reaching hospitals and receiving timely care. [33, 36]. These delays can be attributed to a lack of infrastructure to manage acute stroke cases, along with insufficient awareness of nearby available acute stroke care facilities among patients and their families. Additionally, trust in the public healthcare system and the heavy promotion of private healthcare options may prompt patients and their families to approach multiple facilities. A common trend observed in our study was that patients often sought initial treatment at healthcare facilities closest to their residences, particularly small private clinics or primary healthcare institutions. These facilities are typically chosen for managing symptoms like vomiting, headache, and diarrhea, which can be early signs of a stroke. However, as symptoms worsen over time, patients are compelled to seek more advanced care at secondary or tertiary healthcare facilities. This delay in accessing appropriate care is further exacerbated when patients are referred from private hospitals to public healthcare facilities due to financial constraints. In many cases, patients initially chose public hospitals, but due to inadequate infrastructure, significant delays in obtaining diagnostic reports including CT scan and lack of beds, the family members themselves decided to shift the patients to another hospital. These issues were prominently reflected in free-wheeling interviews conducted with the family members of stroke patients, underscoring the systemic challenges within the public healthcare system that contribute to delayed care. This situation not only highlights the need for improved infrastructure and resource allocation in public healthcare facilities but also raises critical questions about equitable access to timely care for all patients.

This finding underscores the urgent need to strengthen the State government's flagship program, the Stroke Identification, Rehabilitation, Awareness, and Stabilisation (SIRAS) initiative, which aims to ensure timely acute stroke care by establishing Primary Stroke Care Units in district and general hospitals across Kerala with free thrombolysis treatment using Alteplase / Tenteplase at free of cost [36]. Patients who experienced delays in reaching the hospital exhibited higher levels of dependence in performing activities of daily living (ADL) and poor quality of life [37-39]. This highlights the importance of rapid intervention and the need to address factors contributing to these delays including logistical challenges, lack of awareness, and potential systemic inefficiencies within healthcare delivery. These insights reinforce the critical need for enhancing emergency response systems, strengthening of public healthcare institutions through coherent policies, leadership and governance. Consistent with the previous study, patients who experienced delays in reaching the hospital were more likely to have worse mRs during admission and found a significant association [40]. Although no significant association was observed at discharge or in the current mRs scores, worse outcomes were still more prevalent among those who faced delays. This reinforces the importance of prompt interventions in acute stroke care facilities. Overall, these findings highlight the critical need for a multi-pronged approach to address the socioeconomic and systemic factors contributing to pre-hospital delays in stroke care. The study recommends further research to explore the sociocultural and systemic barriers contributing to pre-hospital and treatment delays among Stroke patients, such studies would be valuable for developing comprehensive strategies to enhance stroke care outcomes across various healthcare environments.

Study limitations

This study was conducted in a single district, which limits the generalizability of the findings to the broader population of India. Patients who passed away before reaching the hospital were excluded from the study. Since the focus was on prehospital factors, we did not capture delays or treatments that occurred after the patients arrived at healthcare facilities for stroke care. As a cross-sectional study, we were unable to establish causality between the identified factors and prehospital delays. There is also the potential for recall bias regarding the time of symptom onset reported by stroke patients or their attendants, though we mitigated this by selecting the most reliable informant. Information bias was another limitation, as comorbidities were self-reported by the patients. However, the author mitigated this by asking about each comorbidity in the local language and verifying the information using the discharge summary. Additionally, the medications the patients were currently taking were cross-checked for accuracy.

Conclusions

This study highlighted significant challenges in the timely access to stroke care in Thiruvananthapuram, with 40% of stroke patients experienced pre-hospital delays. The median delay of 6.75 hours is concerning,

especially given the critical importance of timely intervention in reducing mortality and disability associated with stroke. Factors such as age, socioeconomic status, occupation, and the presence of dependents were significantly associated with these delays, pointing to systemic barriers that must be addressed. Moreover, the study sheds light on the psychological and cultural factors contributing to pre-hospital delays, such as hesitation, self-judgment, and the underestimation of symptoms. To improve outcomes for stroke patients, it is crucial to tackle these barriers through targeted educational initiatives that enhance public awareness about stroke symptoms and the urgency of seeking immediate care. Simplifying referral processes and ensuring swift access to appropriate care facilities are also essential steps in reducing pre-hospital delays and improving patient outcomes. Ultimately, addressing these factors holistically will be key to reducing the burden of stroke and enhancing the quality of care.

Additional Information

Disclosures

Human subjects: Consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee of SHSRC– Kerala issued approval IEC/NEW/IND/2022/2909. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** This study was carried out as part of a larger study titled “Estimation of Catastrophic health expenditure and its coping strategies among Stroke Survivors in Thiruvananthapuram district, Kerala, which was funded by the Programme Implementation Plan, National Health Mission, Kerala. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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