THE FACTORS ASSOCIATED WITH LATE ARRIVAL AMONG STROKE PATIENTS: A SISTEMATIC REVIEW

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ABSTRACT

Delayed arrival of stroke patients at the hospital is a major factor causing delays in stroke management, every 60-minute delay in the arrival of stroke patients at the hospital has the potential to increase short-term mortality significantly. This study aims to identify factors associated with delayed arrival of patients at the hospital. This research used the systematic review method with keywords "related factors OR related factor OR associated factor" AND "late arrival OR delayed arrival" AND "stroke or acute stroke or ischemic stroke" by including all full-text primary studies written in English and published between 2013 to 2024 from four databases, EBSCO-host, PubMed, and Scopus, EBSCO (Cinahl), Science Direct, and two e-resources, Google Scholar and Sage Journals. Twenty-nine articles were obtained from 7280 articles that discussed the causes of stroke patients' delayed arrival. There were six causes of delayed arrival: Socio-Demographic Factors, Knowledge and Awareness Factors, Family and Social Support Factors, Transportation and Distance Factors, Health System Factors, and Patient Perception of Stroke Condition Factors. Overall, this systematic review identifies factors contributing to delays, including socio-demographic aspects, knowledge, family support, transportation, patient perception, and health system readiness. Addressing these factors through education, infrastructure improvements, and enhancing healthcare service readiness can help accelerate patient arrival at the hospital and improve stroke treatment outcomes.

Keywords: Delayed arrival, Pre- Hospital, Stroke

INTRODUCTION

The Global Burden Disease (GBD) (2019) and the American Stroke Association, (2019) state that stroke is still an alarming global burden as it is still the second leading cause of death and a third leading cause of disability worldwide. Data obtained from the World Stroke Organization (WSO) (2022) illustrate a significant increase in the prevalence of stroke, with 12,225 new cases recorded each year (Feigin et al., 2022;Virani et al., 2021).

Stroke is a series of clinical symptoms that develop rapidly, causing impaired brain function either as a whole or in certain areas, lasting for at least 24 hours, potentially fatal, and can cause death due to disruption of blood vessels (Feigin et al., 2021). Current recommendations for the treatment of both ischemic and hemorrhagic

acute stroke are intravenous thrombolysis and mechanical thrombectomy (Chugh, 2019), both of which should be performed within 60 minutes to 3 hours post symptom onset. The sooner treatment is initiated the greater the chance of successful treatment and improved clinical outcomes for patients and results in excellent outcomes with significantly lower disability and mortality rates (Advani et al., 2017; Seremwe et al., 2017; Ebinger & Richter, 2016). However, the main challenge in this regard is the high rate of delayed patient arrival at the hospital (Pulvers & Watson, 2017).

Many factors contribute to this delay, including awareness of stroke signs and symptoms, perception of the importance of early treatment, religious and cultural beliefs, education level, geographical access, as well as technical factors such as availability of diagnostic and therapeutic facilities. (Sobral et al., 2019; Pulvers & Watson, 2017; Alkhotani et al., 2022; Al Khathaami et al., 2018; Yoon et al., 2022), data on the behavior of acute stroke patients and the health system in Indonesia in seeking treatment is still limited. This study aims to examine the factors associated with the delayed arrival of stroke patients and By collecting and analyzing data from various studies, a Systematic Review can help identify trends or common patterns related to factors that influence the delayed arrival of stroke patients.

LITERATURE REVIEW

Earlier arrival of stroke patients to the hospital provides an opportunity for patients to receive fast and appropriate medical treatment, which is related to the success of therapy and improvement of patient clinical outcomes, while clinical outcomes will worsen in stroke patients who do not receive fast and appropriate medical treatment. The following are influencing factors, namely (Trisniawati, 2022):

a. The relationship between gender and the arrival time of stroke patients (especially ischemic stroke) to the hospital's Emergency Department did not differ significantly by age category or stroke severity. Differences in arrival time in stroke patients according to patient gender are likely due to the lack of researchers' ability to control existing variables and the use of different patient selection criteria in each study.
b. The distance of the patient's residence closer to the hospital is one of the factors associated with earlier patient arrival at the hospital, but patient knowledge of stroke symptoms and signs is an important factor that influences the arrival time of stroke patients at the hospital.
c. Stroke patients with higher education tend to have shorter delays in hospital arrival.8 Education level is an important independent factor in patients with adequate knowledge of stroke.14 Adequate knowledge of stroke symptoms and signs is an independent factor associated with earlier arrival of stroke patients at the hospital.
d. The use of ambulances as a means of transportation can reduce the delay in arrival of stroke patients at the hospital,6 but patient knowledge of stroke symptoms and signs is important when patients are going to make a decision to get ambulance services (Barahama, 2019).

RESEARCH METHODS

The systematic review was conducted and reported using the Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines (Page et al., 2021). The search strategy aimed to find primary published studies as well as reviews, text papers, and opinion pieces on factors affecting the delayed arrival of stroke patients., research questions, and the eligibility criteria of research articles under PICO (Population, Intervention, Comparison, Outcome) approach, including: Stroke patients The factors or conditions studied related to delayed arrival. Factors associated with delayed arrival.

The inclusion criteria in this review are full-text articles that were accessible in English in the last 10 years and articles with case-control studies, cross-sectional studies, and cohort studies. Inaccessible and not in English full-text articles, and secondary research papers were excluded. The search strategy for supporting literature in this scooping review uses a database EBSCO-host, PubMed, Scopus, Science Direct, Sage Journals, and Google Scholar databases. The keywords used were "related factors OR related factor OR associated factor" AND "late arrival OR delayed arrival" AND "stroke or acute stroke or ischemic stroke".

All articles were independently reviewed based on a PRISMA flow diagram (Page et al., 2021). A screening process was started through the title and abstract and continued with a full-text screening of selected studies to exclude studies that met the exclusion criteria if any. All selected studies were finally validated to ensure eligibility for the next step.

Independent authors selected studies that met eligibility criteria. The authors checked for duplication in the initial selection process using the Mendeley reference manager. Then, the author checked the title, abstract, and full text for relevance to the research topic and established inclusion and exclusion criteria. All articles that met the criteria were examined and further evaluated for quality using the Joanna Briggs Institute (JBI) critical assessment checklist (Joanna Briggs Institute (JBI)., 2022). The critical assessment for case-control study, cross-sectional study, and cohort study. Each question consists of four response choices: Yes, No, Not Applicable, and Unclear. The answer "Yes" was given a score of 1, and other answers were given a score of 0. After the assessment, the authors eliminated all studies with a JBI score of less than 75%, and the final determination of included articles was carried out by two other researchers considered experts in nursing (A.A and A.P). Any differences between the evaluators were discussed to obtain a firm agreement. All authors had no differences of opinion regarding the appropriateness of this research.

In this review, data extraction from the studies is analyzed using tables that describe in detail all the results related to the topic discussed. The information presented in the extraction table relates to the characteristics of the research, including the author, year and country, study design, sample size, mean age, criteria for patient delay, type of stroke, and influencing factors. Therefore, data analysis was carried out thematically using an exploratory descriptive approach. The data analysis process begins with identifying and presenting the obtained data in table form based on the articles reviewed. After obtaining the data, all authors analyzed and explained each finding based on factors affecting the

delayed arrival of stroke patients to the hospital. Finally, the authors double-checked the included studies to ensure and minimize errors in the data extraction process.

RESEARCH RESULTS

The initial search resulted in 7280 articles, of which 3681 were duplicate articles, 1881 After filtering out articles that did not address delayed arrival in stroke patients, 1059 articles were screened based on the inclusion criteria of open access 463 articles, non-English articles 20 and not original articles 5. Of these, 153 were screened from the full text, finally, As a result, 29 studies were included in this systematic review.

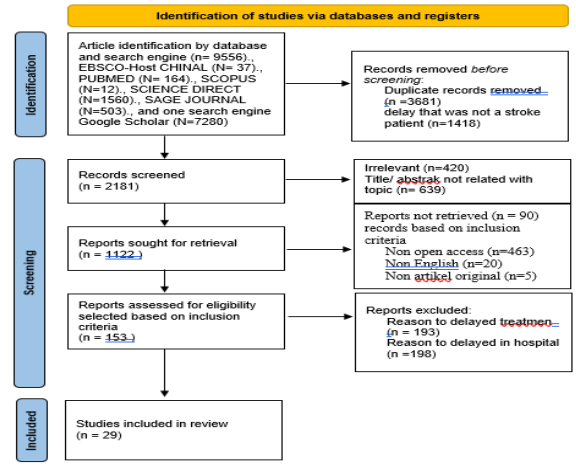

Figure 1. PRISMA flow diagram

Figure 1. Research Results

Table 1. Extraction

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
(Gupta et al., 2023) India	Prospective study	36/64	N/I	48 h	Acute stroke a. 87 patients with ischemic stroke b. 11 patients a hemorrhagic stroke, c. 2 patients	Based on the abstract and conclusion: from multiple linear regression results: Living in a nuclear family, distance from the tertiary care center, and mode of transport Judging from the results:	6/8 75 %

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
					with a transient ischemic attack.	Place of residence (p<.001)*, living arrangement (p=.004)*, distance from the tertiary care center (p<.001)*, initial appraisal of symptoms by patient (p<.001)*, type of stroke (p<.001)*, and mode of transport (p<.001)*	
(Edakkattil et al., 2024) India	Cross-sectional study	188/282	62.94 ± 12.11	4.5 h	Acute stroke	a. Awareness of stroke (OR: 5.16, 95% CI: 3.040–8.757) (p< .001)**, b. Vehicle availability (OR: 3.745, 95% CI: 1.864–7.522) (p < .001)**, c. upper-middle-class socioeconomic status (OR: 0.135, 95% CI: 0.018–1.035) (p = .054)**, d. Distance from first medical contact to the emergency department (km) (OR: 1.071, 95% CI: 1.028–1.116) (p < .001)**	7/8 87.5%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
(Lim et al., 2023) Malaysia	Cross-sectional study	37/65	59 ± 12.7	2 h	Acute stroke	Factors Associated with Prehospital Delay: Positive predictors: a. No history of stroke (adj. OR: 4.15, 95% CI: 1.21-14.25) (p=.024)***, unaware of thrombolysis service (adj. OR: b. 17.12, 95% CI: 1.28 - 229.17) (p=.032)*** Negative predictor: c. Indian ethnicity (adj. OR: 0.09; 95% CI: 0.02-0.52) (p=.007)*** d. Factors Associated with Decision Delay: e. National Institutes of Health Stroke Scale (NIHSS) score (adj. OR: 0.86, 95% CI: 0.78-0.95) (p=.002)***	7/8 87.5%
(Zhou et al., 2017) China	Cross-sectional study	686/1149	N/I	3 h	Acute stroke (Acute ischemic stroke)	a. Patient had a history of stroke (OR: 1.319, 95% CI: 1.018–1.710) (p=.028)***, b. Onset location was at home (OR: 1.573, 95% CI:	7/8 87.5%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						1.162–2.129) (p=.002)***, and c. patients rather than someone else noticed the symptom onset first (OR: 1.711, 95% CI: 1.300–2.252) (p<.001)***.	
(Yanagida et al., 2015) Japan	Cross-sectional study	222/437	N/I	6.6 h	acute stroke	NIHSS score overall (r: -0.38, 95% CI: -0.46 to -0.30) (p<0.001)**** Syntoms: a. confusion/ decreased level of consciousness (p=0.027)****, b. dysarthria (p<0.001)****, c. facial weakness (p=0.013)****, d. weakness of the upper limb (p<0.001)****, e. weakness of the lower limb (p<0.001)****, and **f.** sensory disturbance (p=0.017)****	6/8 75 %
(Ghadimi et al., 2021) Iran	Cross-sectional study	90/114	68.99 ±13.91	4.5 h	Acute stroke (Acute ischemic stroke)	a. Consultation after the onset of symptoms (OR: 0.001, B: 4.536) (p=.001)***	8/8 100%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						b. Transportation by EMS (OR: 0.12, B: 2.369) (p= .001)*** c. Patient's perception of early symptoms (OR: 7.46, B: -1.565) (p= .003)***	
(Kakame et al., 2023) Uganda	Cross-sectional study	69/74	59 ± 16	3 h	Acute stroke d. 79 patients ischemic stroke e. 59 patients a hemorrhagic stroke, 5 patients a transient ischemic attack.	Staying outside Kampala district (> 25 km from hospital) (PR: 1.28, 95% CI: 1.22–1.34) (p<.001)***** d. using hired or government ambulance for transport to tertiary facility (PR: 1.17, 95% CI: 1.13–1.20) (p<.001)*****	8/8 100%
(Terecoasă et al., 2022) Romania	Cross-sectional study	210/206	72 (IQR: 65–80)	4.5 h	Acute stroke (Acute ischemic stroke)	Factors associated with hospital arrival after 4.5 h from stroke onset: a. Atrial fibrillation (previously diagnosed) (OR: 0.5, 95% CI: 0.3–0.7) (p=.001)*** b. Transport to hospital by own means (OR: 2.2, 95% CI: 1.4–3.6) (p=.0003)***	6/8 75 %

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						c. NIHSS ≥ 16 (OR: 0.6, 95% CI: 0.3–0.9) (p=0.04)*** d. Hemianopsia (OR: 0.6, 95% CI: 0.4–0.9) (p=0.03)*** e. Facial palsy (OR: 0.6, 95% CI: 0.4–0.9) (P=.04)*** f. Sensory disturbance (OR: 0.4, 95% CI: 0.3–0.6) (p=.0001)*** Factors associated with hospital arrival after 24 h from stroke onset: g. Living alone (OR: 1.7, 95% CI: 1.8–2.6) (p=.001)*** h. Living in rural area (OR: 1.4, 95% CI: 1.01–2.1) (p=.04)*** i. Atrial fibrillation (OR: 0.6, 95% CI: 0.4–0.9) (p=0.03)*** j. Transport to hospital by ambulance (OR: 0.4, 95% CI: 0.3–0.6) (p<.0001)*** k. NIHSS ≥ 16 (OR: 0.5, 95% CI: 0.3–0.9) (p=0.03)***	

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						l. Speech disturbance (OR: 0.4, 95% CI: 0.3–0.7) (p=.002)***	
(Lee et al., 2021) South Korea	Retrospective Study	58,867/ 85,147	68.3 ± 12.3	4.5 h	Acute stroke a. 79 patients ischemic stroke b. 5 patients a transient ischemic attack.	a. Age > 65years old (aOR: 1.23; 95% CI: 1.19–1.27) (p<.001)***, b. female sex (aOR: 1.09, 95% CI: 1.05–1.13) (p<.001)***, c. hypertension (aOR: 1.12, 95% CI: 1.08–1.16) (p<.001)***, d. diabetes mellitus (aOR: 1.38, 95% CI: 1.33–1.43) (p<.001)***, e. smoking (aOR: 1.15, 95% CI: 1.11–1.20) (p<.001)***, f. disability prior to incident stroke (aOR: 1.44, 95% CI: 1.37–1.52) (p<.001)***, **g.** mild stroke severity (NIHSS score<5) (aOR: 1.55, 95% CI: 1.50–1.61) (p<.001)***	8/8 100%
(Damon et al., 2022) Senegal	Cross-sectional study	26/30	48.2 ± 13.2	3 h	Acute stroke (Acute ischemic stroke)	**a.** Married (OR: 7.2, 95% CI: 1.5 - 35.8) (p= .008)**, **b.** being a female (OR: 5.5, 95% CI: 1.5 - 19.8)	6/8 75 %

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						(p= .006)**, and **c.** having stroke during week days (OR: 4.3, 95% CI: 1.3-13.9) (p= .013)**.	
(Zhu et al., 2020) China	Prospective study	238/392	N/I	3 h	Acute stroke (Acute ischemic stroke)	**a.** direct visiting to the hospital after onset (OR: 0.443, 95% CI: 0.246-0.795) (p= .006)***, and **b.** rushing to emergency after onset (OR: 0.001, 95% CI: 0.000-0.009) (p<.001)***, were independent predictor of early arrival of AIS	7/8 87.5%
(Kazadi Kabanda et al., 2024) DRC (the Democratic Republic of the Congo)	Prospective cohort study	82/98	57.9 ± 13.1	4.5 h	Acute stroke	a. Unmarried status (aOR: 2.29, 95% CI: 1.17–4.88) (p = .007)***, b. low education level (aOR: 2.29, 95% CI: 1.12–5.10) (p = .014)***, c. absence of impaired consciousness (aOR: 3.12, 95% CI: 1.52-4.43) (p = .005)***, d. absence of a history of hypertention	10/11 90.91 %

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						(aOR: 1.85, 95% CI: 1.18-3.78) (p = .041)***, e. absence of a history of diabetes (aOR: 1.93, 95% CI: 1.15–4.58) (p = .013)***, f. heavy alcohol consumption (aOR: 1.83, 95% CI: 1.12-2.83) (p = .045)***, g. absence of a severe to very severe stroke (aOR: 4.93, 95% CI: 0.82-1.01) (p = .002)***, and **h.** presence of ischemic stroke (aOR: 2.93, 95% CI:1.54–4.59) (p = .001)***	
(Arulprakash & Umaiorubahan, 2018) India	Cross-sectional study	58/142	58.08 (range 22-90)	4.5 h	Acute stroke (Acute ischemic stroke)	a. seriousness of symptoms (ß: 0.414, p = .001)*, b. residence (ß: 0.197, p = .001)*, point of admission (ß: 0.132, p = .033)* and c. wake-up stroke (ß: 0.169, p = .005)*	6/8 75 %
(Yanagida et al., 2014)	Retrospective	222/247	75 (67-81)	12 h	Acute stroke	**Delay > 4 h:** a. Recognition of symptoms by the patients	8/11 72.72

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
Japan	Study					themselves (OR: 0.50, 95% CI: 0.27-0.92) (p= .025)***, b. visiting a local doctor prior to admission (OR: 0.27, 95% CI: 0.10-0.66) (p= .004)***, c. living alone (OR: 0.40, 95% CI: 0.21-0.76) (p= .005)***, and d. living with a spouse (OR: 0.51, 95% CI: 0.29-0.89) (p= .017)*** **Delay > 12 h:** a. Recognition of symptoms by the patients themselves (OR: 0.48, 95% CI: 0.27-0.87) (p= .015)***, b. visiting a local doctor prior to admission (OR: 0.28, 95% CI: 0.14-0.56) (p < .001)***, c. living alone (OR: 0.40, 95% CI: 0.21-0.72) (p= .003)***, and d. living with a spouse (OR: 0.39, 95% CI: 0.23-0.66) (p < .001)***	%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
(Bahnasy et al., 2019) Egypt	Cross-sectional study	1783/1899	59.6 ± 8.9	3.5 h	Acute stroke (Acute ischemic stroke)	e. Residence (p < .0001)****** f. Scene to hospital distance (p < .0001)****** g. Stroke awareness (p < .0001)****** h. Stroke onset (p < .0004)******	7/8 87.5%
(Sobral et al., 2019). Portugal	A case-control study	146/222	73 years (±11, 61)	6 h	acute ischemic stroke	a. Age (p: <0.001)****** b. social insertion income (p: <0.001)****** c. education literate (p: <0.001)****** d. Availability of thelephone contact (p: <0.001)****** e. Hospital arrival by prehospital emergency services (p: <0.001)****** f. period of the day (p: <0.001)****** g. Vascular territory (p:0,004)******	6/8 75 %
(Faiz et al., 2014) Norway	Cross-sectional study	245/195	69.9 years (SD 12.9)	2 h	acute stroke or transient ischemic attack	a. Moderate (National Institutes of Health Stroke Scale [NIHSS] score 8-16; odds ratio [OR] 4.16 [95% confidence interval 1.86-9.30])**** or	7/8 87,5%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						severe symptoms (NIHSS score ≥ 17; OR 10.38 [2.70-39.90])**** or living together (OR 1.84 [1.02-3.43])**** were associated with decision delay of 1 hour or less. b. Moderate (OR 6.31 [2.79-14.29])**** or severe symptoms (OR 8.44 [2.64-26.98])**** were associated with calling the EMS as the first medical contact	
(Seremwe et al., 2017) Zimbabwe	A descriptive cross-sectional study	66/37	61.5+17.5 years	3 h	Acute Stroke	a. Not having money to pay for hospital bills was a predictor of late hospital presentation (OR =6.64; 95% CI, (2.05-21.53); p=0.002)****** b. Residence (p: 0,016)******	8/8 100%
(Alkhotani et al., 2022)	cross-sectional observati	46/52	60.4 ± 10.3 years	4,5 h	acute ischemic stroke	a. low educational level (p=0,01)******, unemployment	7/8 87,5%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
Saudi Arabia	onal study					status (p=0.033)******, and b. knowledge of stroke (p=0,013)	
(Kapoor et al., 2020) Canada	retrospective study	232.549/230.761	N/i	7 h	acute stroke	a. older patients arrived significantly faster than younger patients (6.8 vs. 8.3 h; Z = 7.19, p < 0.0001)., b. Older women arrived to hospital faster than older men (6.6 vs. 6.9 h; Z = -4.52, p < 0.0001)., c. whereas younger women arrive significantly later than younger men (9.2 vs. 7.5 h; Z = 2.90, p = 0.004)	6/8 75 %
(Kharbach et al., 2021) Morocco	observational, prospective, cross-sectional study	107/90	68.77 ± 12.28 years	6 h	Ischemic stroke	**Delay >4,5 h** a. Patient educational level OR 38.58; $CI_{95\%}$: 3.40–437.27; P = .003)***, b. Waiting for symptoms to disappear (patient behavior) (OR 11.24; $CI_{95\%}$: 1.57–	8/8 100%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						80.45; P = .016)***, c. Deciding to go directly to the hospital (patient behavior) (OR 0.069; $CI_{95\%}$: 0.01–0.57; P = .013)***, d. The bystander's knowledge that stroke is a disease requiring urgen care with a limited therapeutic window (OR 0.005; CI95%: 0.00–0.36; P = .015)***, e. Direct admission without reference (OR 0.005; CI95%: 0.00–0.07; P ≤ 0.001)*** **Delay >6 h** a. Patient educational level (OR 24.62; CI95%: 4.37–138.69; P .001)***, b. Vertigo and disturbance of balance or coordination (OR 0.14; CI95%:	

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						0.030.73; P = .020)***, c. The bystander's knowledge that stroke is a disease requiring urgent care with limited therapeutic window (OR 0.03; CI95%: 0.00–0.22; P = .001)***, d. Calling an ambulance (bystander behavior (OR 0.16; CI95%: 0.03–0.80; P = .026)***, e. Distance between 50 and 100 km (OR 10.16; CI95%: 1.16–89.33; P = .036)***, and f. Direct admission without reference (OR 0.03; CI95%: 0.00–0.14; P = .001)***	
(Al Khathaami et al., 2018)	A cross-sectional survey	71/156	60.4 ± 15.6 years	4,5 h	acute ischemic stroke	**a.** being alone during the onset of stroke (OR = 10.4; 95% CI: 1.3–82.0)***, **b.** not knowing the emergency services number	6/8 75 %

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						(OR = 2.0; 95% CI: 1.1–3.3), **c.** not being transported in an ambulance (OR = 3.3; 95% CI: 2.0-10.0)***, **d.** not knowing that they were experiencing a stroke (OR = 4.2; 95%CI: 2.0-8.7)***, **e.** residing outside of the city of Riyadh (OR = 30.0; 95% CI: 9.0-99.0)*** and **f.** experiencing blurred vision (OR = 2.3; 95% CI: 1.1–4.9)***	
(Hagiwara et al., 2014) Japan	retrospective study	90/163	70.7 ± 13.2 years	3 h	Acute Stroke	**a.** Night-time onset (OR= 3.882; 95% CI 1.890-7.975; P=.000)***., **b.** Route of admission (OR=.206; 95% CI .102-.416; P=.000)***., **c.** Stroke subtype (OR=.393; 95% CI .188-.823; P=.000)***	8/8 100%
(Ashraf et al., 2015) India	Cross-sectional study	94/170	61,5 ± 12,4	4 h	Acute stroke (Acute ischemic stroke)	a. Distance 15 km or less from hospital (OR: 2.7, 95% CI: 1.08-6.67) (p= .03)*** b. Directly reaching the	7/8 87.5%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						stroke department (OR: 9.72, 95% CI: 3.82-24.7) (p < .001)*** c. history of coronary artery disease (OR: 3.84, 95% CI: 1.77 – 8.3) (= .001)***, **d.** higher educational status (OR: 5.14, 95% CI: 1.95-13) (P= .001)***, and presence of hemiplegia (OR: 5.55, 95% CI: 1.89 – 16.6) (P= 0.001).	
(Sim et al., 2016) Korea	A cross-sectional, descriptive study	91/138	-	5,8-7,9 h	ischemic stroke	**a.** Symptom perceived by patient: serious (OR: 1.60;95% CI: 1.16-2.20)***, **b.** reason for delay: unclear symptoms (OR:0.64, 5% CI:0.45-0.91, p=.000)***., **c.** symptom perception by patient: not serious (OR: 1.69, 95% CI: 1.14-4.96, p=.000)***, **d.** Symptom experienced: hemiparesis (OR: 2.80, 95% CI: 1.58-4.96)	6/8 75 %

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
(Zhu et al., 2020) China	prospective	238/392	-	3 h	ischemic stroke	**a.** Transportation (OR: 0.152, 95%CI:0.44-0.518, P=.001)***, **b.** Day of onset (OR: 1.417, 95%CI:1.012-1.982, P=.042)***, **c.** Dizziness (OR: 1.718, 95%CI:1.088-2.710, P=.019)***, **d.** Atrial fibrillation (OR: 0.555, 95%CI:0.372-0.828, P=.004)***, **e.** Response of symptoms (OR: 0.002, 95%CI:0.000-0.013, P=.000)***, **f.** Baseline score at admission (P=.000)***	7/8 87,5%
(Le et al., 2020) Korea	retrospective review	930/944	68.3 ± 13.1 years	4 h	Intracranial hemorrhage, subarachnoid hemorrhage, ischemic stroke	**a.** Female gender (OR = 0.70; 95%CI 0.55–0.89)***, **b.** Medicaid status (OR = 0.22; 0.07–0.64)***, **c.** rural residence (OR = 0.66; 0.44–0.99)***, and **d.** substance abuse (OR = 0.41; 0.23–0.74)***	7/8 87,5

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
(Jiang et al., 2024) Hongkong	retrospective analysis	319/852	-	12 h	Acute Ischemic Stroke	**a.** male gender (OR=1.65, 95% CI:1.14−2.48, P= .009)***, **b.** self-acknowledged diabetes (OR = 2.50, 95% CI:1.21–5.17, P=.013)***, **c.** small vessel (OR = 2.07, 95% CI:1.27-3.36, P=.003)***, and **d.** wake stroke (OR = 7.04, 95% CI:3.69-13.44, P=<.001)***. **e.** Educational background (high school and above) stroke (OR = 0.65, 95% CI 0.44–0.97, P=.034)***, **f.** Educational background (bachelor degree or above) stroke (OR = 0.32, 95% CI 0.20-0.51, P=<.000)***, **g.** GCS score with 3–8 points (OR = 0.52, 95% CI:0.09–0.69, P=<.000)***, **h.** understanding stroke-related knowledge (OR = 0.26, 95%	7/8 87,5%

Author, years &country	Study design	Sample size (F/M)	Mean age	Criteria for patient delay (hours)	Tipe of stroke	Influencing factors	Score JBI
						CI:0.09–0.44, P=.013)***, i. conscious disturbance (OR = 0.25, 95% CI:0.10–0.62, P=<.001)***, and limb weakness (OR=0.21, 95% CI:0.21–0.49, P= .025)***	
(Yang et al., 2014) China	A prospective study	778	-	4 h	acute ischemic stroke	j. Education (P=.0008)***, k. level of income (P=.007)***, l. place of residence (sub urban areas, P=.004***., m. urban areas, P=.000)***, n. Response after symptom onset (Wait until the symptom subsides P=.000***, o. Ignore P=.001)***, p. Means of transport to the hospital (P=.000)***	6/8 75 %

Characteristics of the included studies and quality assessment results.

Twenty-nine articles were identified according to the established criteria and this study aimed to identify factors that cause delays in the arrival of stroke patients at the hospital. Based on the origin of the articles, there were eighteen articles from Asia, five articles from Africa, four articles from Europe, and two articles from America with a total of 625. 346 participants, the average delay in hospital arrival ranged from 3-6 hours after symptom onset with five articles addressing delays of more

than 6 hours, 7-48 hours after symptom onset, Eleven articles were prospective studies, nine articles were cross-sectional studies, eight retrospective studies, one case-control study and one sequential series, including 386,700 men and 238,646 women, including 386,700 men and 238,646 women.

Systematic result

Influencing factors

The results of the analysis of thirty articles that have the potential to influence and become factors associated with delays in the arrival of stroke patients to the hospital, namely the distance of the scene with health facilities > 10km, ownership of health insurance, lack of awareness about stroke, education level, stroke severity as measured by NIHSS score ≤ 4 points, living in rural areas, having impaired consciousness, history of atrial fibrillation, average age ≥ 65 years, living alone when experiencing stroke symptoms, history of stroke, obesity, history of coronary heart disease, symptoms appear at night, referral between hospitals, coming to health facilities that are not suitable.

DISCUSSION

Delayed arrival of stroke patients to the hospital is a critical issue as it reduces the likelihood of patients receiving effective thrombolytic therapy, which should be administered within a certain timeframe from the onset of symptoms (Yang et al., 2014). This systematic review found that the factors of such delays include socio-demographic aspects, knowledge, family support, transportation, patient perception, and health system readiness. Identification of these factors is critical in developing interventions to accelerate the time to arrival of stroke patients to the hospital.

Socio-demographic factors affecting delayed arrival of stroke patients to health facilities include various aspects. Poor knowledge of stroke symptoms and low education levels often lead patients to be unaware of their condition or underestimate the urgency of their symptoms (Jiang et al., 2016; Alkhotani et al., 2022; Kharbach et al., 2021; Kazadi Kabanda et al., 2024). Awareness and response to symptoms also play an important role; some individuals may ignore early signs or misinterpret stroke symptoms as non-serious health problems (Arulprakash & Umaiorubahan, 2018; Edakkattil et al., 2024). In addition, advanced age and other health conditions, such as (Kazadi kabanda et al., 2024), diabetes or heart disease, can complicate the recognition of stroke symptoms, causing confusion and delays in seeking help (Sobral et al., 2019; Kapoor et al., 2020; Kazadi Kabanda et al., 2024; Lee et al., 2024). Gender also influences, with women tending to be slower to seek care than men (Ashraf et al., 2015; Damon et al., 2022; Lee et al., 2024). Finally, reliance on a family member or caregiver to make medical decisions can add to the response time, especially if that person does not immediately recognize the urgency of the situation (Rachmawati et al., 2017;Sim et al., 2016).

Family support and the patient's social environment also have a major influence on the response to stroke symptoms (Sobral et al., 2019;Sim et al., 2016). Patients who live alone or who do not have immediate family support

tend to be slower in taking action to go to the hospital (Al Khathaami et al., 2018; Yanagida et al., 2014; Kakame et al., 2023). On the other hand, families who are unaware of how to respond to stroke symptoms or who prefer alternative treatments also contribute to the delay (Ashraf et al., 2015;Arulprakash & Umaiorubahan, 2018). This factor points to the importance of education not only for patients but also for families and communities, so that they can recognize and respond to symptoms of stroke more quickly (Mustika Sari et al., 2019)

Distance to health facilities and availability of transportation are also significant barriers, especially in rural or remote areas. Patients living far from hospitals often face challenges in reaching medical facilities quickly (Ashraf et al., 2015; Seremwe et al., 2017; Zhou et al., 2017; Gupta et al., 2023). Limited access to public transportation, especially in areas with minimal infrastructure, exacerbates these delays (Golden & Odoi, 2015). In some studies, fast and reliable ambulance services have been shown to greatly help reduce patient arrival times, but these services are not yet available in all regions, especially in developing countries or remote areas (Faiz et al., 2014;Al Khathaami et al., 2018;Terecoasă et al., 2022). In addition, patients' perception of the severity of the stroke condition also affects their arrival time. Some patients and families do not consider stroke symptoms as a life-threatening condition or do not immediately realize that stroke requires urgent medical treatment (Ashraf et al., 2015;Arulprakash & Umaiorubahan, 2018). This perception is often influenced by the lack of health education in the community and the existence of misguided traditional beliefs (Mariati et al., 2023). In some cultures, alternative medicine is still often prioritized before seeking medical care, leading to significant delays in the arrival of stroke patients at the hospital (Putro, 2018).

Health system readiness is also a very important factor (Yarmaliza & Zakiyuddin, 2019). In some areas, the lack of resources and training of medical personnel regarding early detection and treatment of stroke results in patients not being immediately referred to the right facility (Salsabila et al., 2024). Health workers in primary care are often the initial link for stroke patients, so education for health workers about the symptoms and urgency of stroke is very important (Del Brutto et al., 2019) (Hidayat & Agustina, 2020)

Overall, addressing delays in the arrival of stroke patients to the hospital requires a holistic approach that involves community education, improving access and transportation infrastructure, and optimizing health system readiness. Public education on stroke symptoms and the importance of immediate treatment, as well as strengthening family support in responding to emergencies, can reduce patient waiting times. Improving the healthcare system, such as the availability of affordable ambulances and trained medical personnel, is also an important step. With a comprehensive approach, it is hoped that delays in the arrival of stroke patients to the hospital can be minimized so that more patients can receive timely treatment and reduce the risk of serious complications due to stroke.

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