

Original Research

NIHSS-Defined Stroke Severity in an Indonesian Emergency Department: A Descriptive Cross-Sectional Study

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ABSTRACT

Introduction: Standardized assessment of neurological deficits is important in acute stroke care, but local distributions of National Institutes of Health Stroke Scale (NIHSS) severity are incompletely reported.

Objective: To describe NIHSS-defined stroke severity and recorded neurological deficit profiles among stroke patients in an emergency department in Bojonegoro, East Java, Indonesia.

Method: This descriptive cross-sectional study enrolled 70 consecutive stroke patients in February–March 2026. Total NIHSS severity categories and individual item distributions were summarized using counts and percentages.

Result: Moderate NIHSS severity (5–15) was recorded in 31 patients (44.3%), severe (16–42) in 29 (41.4%), and mild (1–4) in 10 (14.3%). Ischemic stroke was recorded in 44 (62.9%). Minor facial palsy occurred in 43 (61.4%) and mild-to-moderate sensory loss in 41 (58.6%).

Conclusion: Most patients in this single-department sample were classified as moderate or severe under the study thresholds. Findings describe a local case profile and do not establish stroke prognosis, diagnostic performance, or treatment effectiveness.

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INTRODUCTION

Stroke is a major contributor to mortality and long-term disability. Global Burden of Disease estimates distinguish incident cases, prevalent disease, stroke-related deaths, and disability-adjusted life-years, all of which are important for interpreting the public-health burden (1,21,24). Ischemic and hemorrhagic strokes can cause acute focal neurological deficits; rapid clinical assessment is necessary in emergency settings, together with brain imaging, last-known-well history, and appropriate physiological evaluation (2,20). The National Institutes of Health Stroke Scale (NIHSS) provides a standardized description of neurological impairment, but an NIHSS score alone is not a diagnosis of stroke subtype, tissue-injury volume, or long-term outcome (4,17).

The NIHSS records consciousness, gaze, visual fields, facial movement, limb strength, ataxia, sensation, language, dysarthria, and inattention. The total score ranges from 0 to 42; higher values generally indicate more severe measurable deficits. Nevertheless, neurological domains are unevenly weighted and posterior-circulation symptoms can be underrepresented (4,14). Agreement between assessors cannot be assumed: a clinical study reported discrepancies in scores assigned by emergency nurses and neurologists, supporting standardized assessor preparation and transparent reporting of the assessment procedure (3). Categories such as mild, moderate, and severe also vary across studies; thresholds should therefore be explicitly described rather than treated as universal (15).

Prior work has assessed the clinical use of NIHSS in emergency nursing (7,23), examined scoring consistency (3), investigated the relation between NIHSS and lesion characteristics (17), and evaluated stroke severity in other hospital populations (12). Research on record-based score extraction (5), clinical detection of deterioration [9], nursing assessment (11), adjusted analysis of NIHSS change (13), prediction algorithms (16), and prognostic associations (19) answers different questions: instrument performance or clinical associations cannot be inferred from a descriptive frequency table, and findings from inpatient or selected acute-stroke cohorts may not transfer directly to a mixed ischemic–hemorrhagic emergency population. International acute-stroke guidance places NIHSS within a broader clinical and imaging workflow rather than as an independent determinant of treatment (2,20).

In the participating Bojonegoro hospital, preliminary service observations suggested that complete NIHSS component documentation was inconsistent. The scientific and service-level evidence gap is therefore the absence of a clearly reported baseline distribution of NIHSS-defined severity and individual neurological signs at this emergency department, rather than a lack of an instrument or a claim of unprecedented methodology. Existing local descriptive reports do not establish whether their patient populations, stroke-subtype mix, or measurement timing resemble this setting. Such context matters when interpreting proportions of moderate or severe presentations (7,12,15).

This study contributes a single-center descriptive profile of NIHSS severity categories and recorded neurological deficits among ED stroke patients. It may inform a subsequent quality-improvement audit of assessment completeness and service planning, but it neither validates the NIHSS nor evaluates whether its use improves patient management. The research objective was

to describe NIHSS-defined stroke severity and individual item distributions among consecutively sampled patients at an emergency department in Bojonegoro, Indonesia.

Based on these considerations, this study was conducted to describe stroke severity as assessed using the NIHSS in stroke patients in the Emergency Department (IGD) of a Hospital in Bojonegoro.

METHOD

This was a descriptive cross-sectional observational study conducted during February–March 2026 in an emergency department of a private hospital in Bojonegoro, East Java, Indonesia. Clinical information was collected at the participating service without random allocation or a follow-up intervention. Reporting was developed with reference to the STROBE framework for observational studies (25).

Population and Sample/Informants

The study population comprised patients with a physician-documented ischemic or hemorrhagic stroke who attended the emergency department during the study period. Seventy patients were recruited consecutively. The latest author revision specifies adults aged 18 years or older, an available neurological examination and medical record, and consent from patients or family representatives when patients could not consent personally; it also reports excluding patients transferred before NIHSS assessment or with an incomplete assessment. These eligibility and proxy-consent procedures require confirmation against the approved protocol. No statistical sample-size calculation was supplied, so the 70 cases should not be presented as a precision-based sample or a complete census of all arrivals. The age bands in Table 1 describe observed participants rather than eligibility restrictions.

Research Location

The research was performed at one private-hospital emergency department in Bojonegoro, East Java. The hospital's acute-stroke pathway, imaging availability, referral criteria, and annual stroke caseload were not documented in the supplied research materials. These unreported service characteristics limit interpretation of case selection and comparison with comprehensive stroke centers. The hospital name remains masked in this review-stage manuscript.

Instrumentation or Tools

Stroke-related neurological deficits were recorded using the NIHSS, an established scale with 11 major domains and multiple component scores, producing a total from 0 to 42 (3,4). The study grouped scores as mild (1–4), moderate (5–15), and severe (16–42). These are study-specific reporting categories; cut-offs differ across published studies and the classification does not explicitly tabulate score 0 (15). An item-level dataset, including whether items were untestable, would be needed to independently audit scoring. The instrument does not directly measure lesion size or determine stroke subtype (4,17).

Data Collection Procedures

Following institutional research permission, the team reviewed medical records for demographic characteristics, physician-recorded stroke subtype, and documented medical history, and performed an NIHSS examination for enrolled patients. Recruitment was consecutive until 70 observations were obtained during February–March 2026. However, the materials provided do not specify the time from symptom onset or emergency arrival to assessment, imaging-

confirmation procedures, assessor training or certification, use of sedation or reperfusion therapy before scoring, or inter-rater checks. These cannot be retrospectively asserted without supporting records and must be confirmed by the authors for reproducibility (3,8).

Data Analysis

Data were checked, coded, and summarized descriptively. Categorical variables were reported as counts and percentages; the manuscript also retained a reported NIHSS arithmetic mean of 13.32. Individual total scores were not supplied, so the median, interquartile range, standard deviation, range, stroke-subtype cross-tabulations, and confidence intervals could not be reconstructed reliably. No inferential tests or multivariable analyses were performed, and the study cannot estimate associations, risk, causality, or predictive performance.

Ethical Approval

The authors reported ethics approval from the Health Research Ethics Committee of the Faculty of Health Sciences, Muhammadiyah University of Lamongan (034/EC/KEPK-S1/02/2026). The supplied revision describes informed consent before data collection and confidentiality safeguards. For patients with aphasia or impaired consciousness, the identity and legal authority of any proxy decision-maker, as well as safeguards against selection bias, require author verification against the ethics protocol. No individual identifiable information is reported.

RESULTS

Among 70 patients, 31 (44.3%) were categorized as having moderate stroke severity, 29 (41.4%) as severe, and 10 (14.3%) as mild according to the study-defined NIHSS thresholds. These findings describe the severity distribution within the participating emergency department and should not be generalized to the broader stroke population.

Table 1. General Characteristics

General Characteristics	Category	Frequency	Percentage(%)
Age	41-50 years	9	12.9%
	51-60 years	14	20.0%
	61-70 years	35	50.0%
	71-80 years	12	17.1%
	Total	70	100.0%
Type Sex	Man	29	41.4%
	Woman	41	58.6%
	Total	70	100.0%
Education	No Formal Education	15	21.4%
	Elementary School	23	32.9%
	Junior High School	11	15.7%
	Senior High School	15	21.4%
	Bachelor's Derece	6	8.6%
	Total	70	100.0%
Work	Private	29	41.4%
	Businessman	4	5.7%
	Housewife	12	17.1%
	Doesn't work	25	35.7%
	Total	70	100.0%

Table 1. General Characteristics

General Characteristics	Category	Frequency	Percentage(%)
Age	41-50 years	9	12.9%
	51-60 years	14	20.0%
	61-70 years	35	50.0%
	71-80 years	12	17.1%
	Total	70	100.0%
Types of Stroke	Ischemic	44	62.9%
	Hemorrhagic	26	37.1%
	Total	70	100.0%
Income	Below the locally specified minimum wage (IDR 2,500,000)	38	54.3%
	Minimum Wage 2,600,000	5	7.1%
	No income	27	38.6%
	Total	70	100.0%
Medical history (coding to be verified)	Hypertension	29	41.4%
	Diabetes	13	18.6%
	Cholesterol	15	21.4%
	Others (asthma, vertigo)	13	18.6%
	Total	70	100.0%

Source: Primary Data

Table 1 describes 70 ED stroke patients; the largest age group was 61–70 years (35/70, 50.0%), and 41 (58.6%) were women. Elementary-school education was the largest educational category (23/70, 32.9%), not a majority. Ischemic stroke was documented in 44 (62.9%). Hypertension was the most frequently recorded medical-history category (29/70, 41.4%). Because the medical-history categories sum to 70, their coding as a single primary condition versus potentially coexisting conditions requires verification; they must not be interpreted as prevalence of all comorbidities. Income labels also require confirmation of their cut-offs and year.

Table 2. Stroke Severity Based on NIHSS

Severity Level	Frequency	Percentage (%)
Mild (1–4)	10	14.3 %
Moderate (5–15)	31	44.3 %
Severe (16–42)	29	41.4 %
Total	70	100.0 %
Average NIHSS score	13.32	

Table 2 shows that 31 of the 70 patients (44.3%) were categorized as moderate, 29 (41.4%) as severe, and 10 (14.3%) as mild using the prespecified study thresholds. The combined moderate-to-severe proportion was 60/70 (85.7%). The reported mean NIHSS score was 13.32, but dispersion and raw-score distributions were unavailable. The 0-score category was not separately reported, and interpretation of the thresholds should be limited to this study.

Table 3. Distribution of NIHSS Indicators

No.	NIHSS Indicator	Category	Frequency	Percentage %
1.	Level of consciousness (NIHSS 1a)	Alert (0)		
		Not alert; arousable by minor stimulation (1)	39	55.7%
		Not alert; requires repeated or strong stimulation (2)	11	15.7%
			9	12.9%
			11	15.7%
2.	Best gaze	Unresponsive (3)		
		Normal (0)	33	47.1%
		Partial gaze palsy (1)	16	22.9%
3.	Visual fields	Forced deviation (2)	21	30.0%
		No visual loss (0)	26	37.1%
		Partial hemianopia (1)	18	25.7%
4.	Facial palsy	Complete hemianopia (2)	26	37.1%
		Normal (0)	23	32.9%
		Minor paralysis (1)	43	61.4%
5.	Right arm motor	Partial paralysis (2)	4	5.7%
		No drift (0)		
		Drift (1)	10	14.3%
		Some effort against gravity (2)	21	30.0%
		No effort against gravity (3)	10	14.3%
			12	17.1%
6.	Left arm motor		17	24.3%
		No movement (4)		
		No drift (0)		
		Drift (1)	8	11.4%
		Some effort against gravity (2)	26	37.1%
			8	11.4%
7.	Right leg motor	No effort against gravity (3)	11	15.7%
			17	24.3%
		No movement (4)		
		No drift (0)		
		Drift (1)	9	12.9%
		Some effort against gravity (2)	25	35.7%
8.	Left leg motor		7	10.0%
		No effort against gravity (3)	11	15.7%
			18	25.7%
		No movement (4)		
		No drift (0)		
		Drift (1)	11	15.7%
9.	Limb ataxia	Some effort against gravity (2)	24	34.3%
			7	10.0%
		No effort against gravity (3)	10	14.3%
			18	25.7%
10.	Sensory	No movement (4)		
		Absent (0)	20	28.6%
		Present in one limb (1)	28	40.0%
		Present in two limbs (2; verify source coding)	22	31.4%
11.		Normal (0)	16	22.9%
		Mild-to-moderate loss (1)	41	58.6%
		Severe-to-total loss (2)	13	18.6%

No.	NIHSS Indicator	Category	Frequency	Percentage %
9.	Best language	No aphasia (0)	22	31.4%
		Mild-to-moderate aphasia (1)	27	38.6%
		Severe aphasia (2)	10	14.3%
		Mute/global aphasia (3)	11	15.7%
10.	Dysarthria	Normal (0)	21	30.0%
		Mild-to-moderate (1)	23	32.9%
		Severe (2)	26	37.1%
11.	Extinction/inattention	No abnormality (0)	20	28.6%
		Inattention in one modality (1)	28	40.0%
		Profound inattention (2)	22	31.4%

The item-level distribution was heterogeneous rather than uniformly mild or moderate. Minor facial palsy was recorded in 43 patients (61.4%), mild-to-moderate sensory loss in 41 (58.6%), severe dysarthria in 26 (37.1%), and no movement of the right arm in 17 (24.3%) and right leg in 18 (25.7%). Eleven patients (15.7%) had the highest category of the consciousness item as coded in the table. These figures should be interpreted as recorded NIHSS component categories, subject to confirmation that the original dataset used validated descriptors and correctly handled untestable items.

DISCUSSION

The major result was a high proportion of moderate (44.3%) and severe (41.4%) NIHSS categories among 70 patients who presented to this ED. Together, 85.7% fell within scores 5–42 under the study thresholds. This is a service-specific case profile, not the prevalence or population incidence of severe stroke in Bojonegoro. The distribution may reflect differences in ED case-mix, transfer practices, timing of assessment, inclusion of both stroke subtypes, and local referral pathways; these explanations remain hypotheses because they were not measured. For comparison, published work emphasizes that NIHSS severity thresholds and selection criteria vary substantially across studies (15).

Women accounted for 58.6% of this consecutive sample, while half the participants were aged 61–70 years. These are distributions among presenting patients, not evidence of greater sex-specific or age-specific stroke incidence. Population-level interpretation requires denominators that were not available here. Epidemiological studies document variation in age, sex, and vascular risk profiles across populations (1,18,21), but the present dataset cannot test menopause, hormone exposure, or other explanatory pathways.

The largest reported educational category was elementary school (32.9%); 41.4% were classified as private-sector workers. Neither education nor occupation was analyzed in relation to NIHSS score or compared with non-stroke controls. Consequently, stress, health literacy, occupation-specific exposures, and delayed access to care should not be advanced as explanations for the findings. These variables may be useful hypotheses for an appropriately designed future study of emergency access and stroke severity (6,21).

The sample included 44 ischemic strokes (62.9%) and 26 hemorrhagic strokes (37.1%). Global stroke-subtype proportions are not a suitable direct benchmark for a single ED because community incidence data and hospital admissions represent different source populations

(21,24). Pooling both subtypes may conceal important variation in severity and neurological signs. A descriptive cross-tabulation of NIHSS categories by imaging-confirmed subtype, if author source data are available, would strengthen interpretation without requiring causal analysis.

Hypertension was the most frequently documented medical-history category (29/70; 41.4%). Since the categories in Table 1 sum to exactly 70, it is unclear whether coexisting conditions were restricted to a single response or whether more complete comorbidity data were available. It would therefore be misleading to describe hypertension as the dominant causal risk factor in this sample. Population-level evidence and a separate hospital-based study discuss vascular exposures in relation to stroke (10,21,22), but such associations were not assessed in this descriptive study.

A mean NIHSS score of 13.32 was reported, yet a mean alone cannot characterize a potentially skewed or ordinal severity distribution. The clinically meaningful finding in this dataset is the proportion classified as moderate and severe, while uncertainty remains regarding score dispersion, categories with NIHSS 0, and how severity cut-offs were selected. A median and interquartile range, observed range, and subgroup profiles should be calculated from the original individual scores before publication. Because NIHSS reflects functional neurological impairment, neither a moderate nor severe category demonstrates infarct volume or a particular brain location without imaging analysis (4,17).

Standardized ED neurological documentation can potentially support communication between emergency clinicians, neurologists, and receiving services. However, decisions about reperfusion, airway care, and destination of care also depend on time since last known well, vascular and brain imaging, clinical contraindications, and other examination findings (2,20). The present descriptive series did not measure clinician decisions, treatment delays, outcomes, or improvement from implementing NIHSS; therefore, no enhancement in management or prognosis can be attributed to this study.

The most commonly recorded facial-palsy response was minor paralysis (43/70, 61.4%). This finding identifies a frequently observed item score, rather than the anatomical location of a lesion. In the same dataset, 17 patients (24.3%) had no movement recorded for the right arm and 17 (24.3%) for the left arm, suggesting substantial motor limitations in a subset of ED presentations. These item-level observations should be interpreted together with total scores and documented stroke subtypes rather than used for unmeasured lesion localization (4,17).

Mild-to-moderate sensory loss was recorded in 41 participants (58.6%), indicating that sensory deficits were prominent in this sample. Language, dysarthria, and neglect categories also varied, highlighting the importance of documenting deficits beyond limb strength. The NIHSS does not weight all manifestations equally, particularly some posterior-circulation deficits, so a low total score would not necessarily exclude a clinically important syndrome [4].

The recorded limb-ataxia responses included 28 patients (40.0%) in the one-limb category and 22 (31.4%) in score category 2. Standard NIHSS describes score 2 as ataxia in two limbs, not “more than two extremities”; the underlying coding must be checked before the table is considered validated. This is a terminology and data-interpretation issue, not evidence of a specific cerebellar lesion. Standardized training and explicit handling of items that cannot be assessed are especially relevant in severely affected ED patients (3,4).

The item-level results also included 28 patients (40.0%) coded with single-modality inattention and 22 (31.4%) with a more marked score-2 abnormality. These proportions must be interpreted cautiously because inter-rater agreement, examiner training, and assessment conditions were not reported. A study comparing emergency nurses and neurologists documented clinically relevant NIHSS scoring disagreement, particularly with higher overall scores and language deficits [3]. This supports the need for measurement quality assurance before local patterns are used in clinical-service comparisons.

Language impairment occurred across the reported categories: 27 patients (38.6%) had mild-to-moderate aphasia, 10 (14.3%) severe aphasia, and 11 (15.7%) the highest recorded language impairment score. Because severely affected patients may have impaired capacity to consent or cooperate with testing, the method used for proxy consent, examiner observation, and handling of untestable tasks could materially affect selection and measurement. No independent cognitive, communication, or long-term functional outcome instrument was used.

Overall, the mixed pattern of item scores reinforces that neurologic deficits were heterogeneous. In particular, the data do not justify an overarching description of “mostly mild-to-moderate neurological conditions” when non-moving limbs, severe dysarthria, and consciousness impairments were documented. As a baseline quality-improvement dataset, these findings may motivate standardized NIHSS recording, examiner training, and more complete capture of assessment timing, but they do not demonstrate that any quality-improvement intervention is effective (3,8).

Comparison with Previous Studies

The present findings should be compared with caution. Maghfirah and colleagues (12) described ischemic stroke severity in an inpatient neurology setting, whereas this study recruited both ischemic and hemorrhagic presentations in an ED. Differences in selection, disease subtype, and time of measurement may explain different NIHSS distributions without indicating that one setting has a higher stroke incidence. Research on ED scoring (3) addresses inter-assessor reproducibility, rather than the frequency of severity categories. Roesner and colleagues (15) found substantial variability in definitions of “severe stroke” used by clinical studies; hence the 16–42 grouping reported here cannot be assumed equivalent across cohorts. Weigel and colleagues (17) evaluated relationships between lesion features and neurological scores using imaging-based data, whereas no such analysis was undertaken here. These distinctions establish the limited but defensible contribution of a locally defined descriptive baseline rather than a novel or validated mechanism.

Limitations and Cautions

Limitations are substantial. This was one private-hospital sample recruited non-randomly by consecutive enrollment, with no reported precision-based sample-size calculation. The assessment interval after symptom onset or arrival, imaging verification, assessor training, repeatability, treatment before scoring, incomplete records, and the handling of untestable NIHSS items were not documented. The reported average lacked measures of dispersion, and individual data needed for subtype-specific NIHSS comparisons were not available. The consent procedure for patients with severe impairment also requires protocol-level confirmation. The medical-history variables may have been forced into mutually exclusive categories, and the NIHSS item labels and severity thresholds require checking against original source forms. These limitations

increase the potential for selection and measurement bias and preclude generalization to the community or claims about treatment, prognosis, or the instrument's performance (3,4,15,25).

Recommendations for Future Research

Further work should prospectively standardize NIHSS timing and assessor training, document stroke subtype using imaging and clinical records, and record individual total scores so that median (IQR), score range, and severity-by-subtype tables can be presented. A multicenter design with follow-up could evaluate associations between access, assessment timing, stroke severity, management, and patient outcomes. A local quality-improvement audit could separately assess NIHSS documentation completeness and inter-rater reliability; such evaluation should not be confused with the descriptive objective of the present paper (2,3,20).

CONCLUSION

Among the 70 stroke patients assessed in this Bojonegoro emergency department, 31 (44.3%) were in the moderate NIHSS category, 29 (41.4%) in the severe category, and 10 (14.3%) in the mild category under the study-specific thresholds. Minor facial palsy and mild-to-moderate sensory impairment were commonly recorded; more marked deficits were also present across other NIHSS components. These data offer a limited single-center baseline profile of neurological impairment. They do not establish tissue-lesion size, population-level stroke risk, diagnostic accuracy, treatment effects, or prognosis.

Interpretation is constrained by single-center consecutive sampling, incomplete reporting of assessment timing and examiner procedures, unverified item-level coding, and lack of raw-score dispersion. Future studies should confirm standardized NIHSS assessment and provide subgroup descriptions and longitudinal clinical outcomes.

AUTHOR'S CONTRIBUTION STATEMENT

Roifatul Fatma Amilia contributed to the manuscript preparation and is reported as the lead investigator; Isni Lailatul Maghfiroh and Aprelia Afidatul Hanafi are listed as coauthors. Individual CRediT roles (conceptualization, methodology, investigation, formal analysis, data curation, supervision, and writing contributions) have not been provided for each author and must be confirmed and approved by all three authors before final submission. No unverified allocation of scholarly contributions is asserted here.

CONFLICTS OF INTEREST

The authors declare no financial or non-financial conflicts of interest, as stated in the submitted manuscript. This declaration should be confirmed by each author prior to final publication.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors reported using generative AI tools for language and grammar editing. The authors remain responsible for verifying factual accuracy, reference integrity, clinical interpretation, and every substantive revision. This updated declaration should be approved by all authors before submission.

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DATA AVAILABILITY

De-identified participant-level NIHSS data were not included in the supplied manuscripts. Availability for reasonable scholarly requests is subject to author, institutional, and ethics approval; this statement must be checked against the consent and data-governance conditions.

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REFERENCES

1. ADDIN Mendeley Bibliography CSL_BIBLIOGRAPHY Feigin VL, Brainin M, Norrving B, Martins S, Sacco RL, Hacke W, et al. World Stroke Organization (WSO): Global Stroke Fact Sheet 2022. *Int J Stroke*. 2022;17(1):18–29. doi:10.1177/17474930211065917.
2. Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, et al. Guidelines for the early management of patients with acute ischemic stroke: 2019 update. *Stroke*. 2019;50(12):e344–e418. doi:10.1161/STR.0000000000000211.
3. Comer AR, Templeton E, Glidden M, Bartlett S, D'Cruz L, Nemati D, et al. National Institutes of Health Stroke Scale (NIHSS) scoring inconsistencies between neurologists and emergency room nurses. *Front Neurol*. 2023;13:1093392. doi:10.3389/fneur.2022.1093392.
4. Makharia A, Agarwal A, Garg D, Vishnu VY, Srivastava MVP. The pitfalls of NIHSS: Time for a new clinical acute stroke severity scoring system in the emergency? *Ann Indian Acad Neurol*. 2024;27(1):15–18. doi:10.4103/aian.aian_842_23.
5. Fernandes M, Westover MB, Singhal AB, Zafar SF. Automated extraction of stroke severity from unstructured electronic health records using natural language processing. *J Am Heart Assoc*. 2024;13(21):e036386. doi:10.1161/JAHA.124.036386.
6. Firdaus J, Solikin, Firdaus MW. The relationship between prehospital delay and severity in stroke patients at Banjarmasin Hospital. *J Nurs Invention*. 2023;3(2):108–116. doi:10.33859/jni.v3i2.274.
7. Fitriana EE, Haryanto H. The effectiveness of the National Institutes of Health Stroke Scale (NIHSS) in determining nursing diagnoses in stroke patients: A scoping review. *J Nurs Sci Update*. 2024;12(1):26–34. doi:10.21776/ub.jik.2024.012.01.04.
8. Funk B, Khazai B, Shim B, Van Vorst J, du Preez L, Anendaga CM, et al. Availability and applicability of the National Institute of Health Stroke Scale at time of imaging interpretation for code stroke in the community hospital setting. *J Belg Soc Radiol*. 2025;109(1):22. doi:10.5334/jbsr.3932.
9. Han JH, Han C, Park S, Kim YJ, Kim BJ. Effect of nurse's detection of neurological deterioration on the prognosis of patients with acute cerebral infarction. *Heliyon*. 2024;10(12):e32175. doi:10.1016/j.heliyon.2024.e32175.
10. Handayani IY, Isnawati IA, Hamim HN. Factors influencing stroke severity in the Melati Ward of Dr. Haryoto Lumajang Regional Hospital. *Mandira Cendikia Health Sciences Journal*. 2023;2(10):543–554.
11. Imran Y, Zahra AA. The use of NIHSS as an assessment of acute stroke severity. *J Soc*

- Med. 2024;3(2):31–34. doi:10.47353/jsocmed.v3i2.128.
12. Maghfirah CZ, Ikhsan M, Fonna TR. Gambaran derajat keparahan stroke iskemik berdasarkan skor National Institute of Health Stroke Scale (NIHSS) di ruang rawat inap saraf RSUD Cut Meutia Aceh Utara. *Manusia dan Kesehatan*. 2025;8(2):483–495.
13. Mistry EA, Yeatts SD, Khatri P, Mistry AM, Detry M, Viele K, et al. National Institutes of Health Stroke Scale as an outcome in stroke research: Value of ANCOVA over analyzing change from baseline. *Stroke*. 2022;53(4):e150–e155. doi:10.1161/STROKEAHA.121.034859.
14. Qureshi MM, Strbian D, Herweh C, Möhlenbruch MA, Rätty S, Olivé-Gadea M, et al. Endovascular versus medical therapy in posterior cerebral artery stroke: Role of baseline NIHSS score and occlusion site. *Stroke*. 2024;55(7):1787–1797. doi:10.1161/STROKEAHA.124.047383.
15. Roesner K, Brodowski H, Strutz N. Measuring severe stroke: A scoping review of RCTs. *Front Neurol*. 2025;16:1631275. doi:10.3389/fneur.2025.1631275.
16. Rout M, Vaughan A, Sidorov EV, Sanghera DK. Improving stroke outcome prediction using molecular and machine learning approaches in large vessel occlusion. *J Clin Med*. 2024;13(19):5917. doi:10.3390/jcm13195917.
17. Weigel K, Gaser C, Brodoehl S, Wagner F, Jochmann E, Güllmar D, et al. Acute stroke severity assessment: The impact of lesion size and functional connectivity. *Brain Sci*. 2025;15(7):735. doi:10.3390/brainsci15070735.
18. Yoon CW, Bushnell CD. Stroke in women: A review focused on epidemiology, risk factors, and outcomes. *J Stroke*. 2023;25(1):2–15. doi:10.5853/jos.2022.03468.
19. Zhang L, Ma J, Wang M, Zhang L. The association between National Institutes of Health Stroke Scale score and clinical outcome in patients with large core infarctions undergoing endovascular treatment. *Neurol Ther*. 2024;13(3):563–581. doi:10.1007/s40120-024-00588-8.
20. Berge E, Whiteley W, Audebert H, De Marchis GM, Fonseca AC, Padiglioni C, et al. European Stroke Organisation (ESO) guidelines on intravenous thrombolysis for acute ischaemic stroke. *Eur Stroke J*. 2021;6(1):I–LXII. doi:10.1177/2396987321989865.
21. GBD 2021 Stroke Risk Factor Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990–2021: A systematic analysis for the Global Burden of Disease Study 2021. *Lancet Neurol*. 2024;23(10):973–1003. doi:10.1016/S1474-4422(24)00369-7.
22. Bushnell C, Kernan WN, Sharrief AZ, Chaturvedi S, Cole JW, Cornwell WK 3rd, et al. 2024 guideline for the primary prevention of stroke: A guideline from the American Heart Association/American Stroke Association. *Stroke*. 2024;55(12):e344–e424. doi:10.1161/STR.0000000000000475.
23. Rahman S, Apriannor A, Auliyah GR. Effectiveness of the Siriraj Stroke Score and National Institute of Health Stroke Scale assessment methods in determining actual nursing diagnoses for stroke patients in the emergency room. *Dinamika Kesehatan*. 2021;12(2):529–547. doi:10.33859/dksm.v12i2.741.
24. GBD 2019 Stroke Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet Neurol*. 2021;20(10):795–820. doi:10.1016/S1474-4422(21)00252-0.
25. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *PLoS Med*. 2007;4(10):e296. doi:10.1371/journal.pmed.0040296.