

Beyond Symptom Recognition: Stroke Knowledge and Understanding of Its Neuroanatomical Mechanism Among University Students

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ABSTRACT	Original Research Article
Background: Stroke is a leading cause of death and disability worldwide, and prompt recognition of its warning signs depends on adequate public and student knowledge of its risk factors, symptoms, and underlying neuroanatomical mechanism. Data on how well health-science students understand not only the clinical presentation but also the pathophysiological basis of stroke remain limited. Methods: A cross-sectional survey of 83 university students (74.7% male, 96.4% from health-related disciplines) was conducted using a structured, self-administered online questionnaire covering demographics, general stroke awareness, warning signs, risk factors, and an open-ended item on the neuroanatomical mechanism of stroke. A 30-item knowledge scale (General Awareness, Warning Signs, Risk Factors) was scored against a factual answer key, and total scores were categorized as Poor (<60%), Moderate (60–79%), or Good (≥80%). The open-ended neuroanatomy response was independently coded for conceptual accuracy. Group comparisons used independent t-tests, one-way ANOVA, and chi-square tests ($\alpha = 0.05$). Results: Mean total knowledge score was 63.4% (SD = 20.3 percentage points; 19.02/30 items; Cronbach's $\alpha = 0.87$). Only 26.5% of respondents were classified as having Good knowledge, 41.0% Moderate, and 32.5% Poor. General awareness (69.4%) exceeded warning-sign (61.7%) and risk-factor (62.6%) recognition. Common misconceptions included believing stroke affects only the elderly (38.6%) and equating stroke with heart attack (24.1%); more than half of respondents misclassified non-stroke distractor items (skin itching, gradual weight gain, arm-radiating chest pain) as stroke warning signs. Only 12.0% of respondents could correctly explain the neuroanatomical mechanism of stroke (interrupted blood/oxygen supply leading to neuronal death), and this conceptual understanding was not associated with the factual knowledge score ($F = 0.24$, $p = 0.867$). No demographic or academic variable was significantly associated with total knowledge (all $p > 0.05$), though a non-significant downward trend was observed with increasing level of study ($p = 0.076$). Conclusion: Despite a health-science-dominated sample, overall stroke knowledge was only moderate, and understanding of the underlying neuroanatomical mechanism was markedly deficient relative to factual recognition knowledge. Curricula should place greater emphasis on the pathophysiological basis of stroke, not solely on symptom and risk-factor checklists. Keywords: stroke; awareness; neuroanatomy; knowledge; health-science students; cross-sectional study.	Article History Received: 09-07-2026 Accepted: 01-09-2026 Published: 10-09-2026 Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.



1. INTRODUCTION

Stroke remains one of the leading causes of death and long-term disability worldwide, and early recognition of its warning signs is critical to timely treatment and improved outcomes. In sub-Saharan Africa, including Nigeria, the burden of stroke is rising alongside increasing prevalence of hypertension, diabetes, and other modifiable risk factors, yet public and

student awareness of stroke symptoms and risk factors has repeatedly been found to be suboptimal.

Community- and hospital-based surveys in Nigeria have consistently reported gaps in stroke knowledge. Among suburban Nigerians at high risk for stroke, awareness of warning signs was found to be poor even among patients with hypertension or diabetes, two major modifiable risk factors [1]. A large survey of

students and staff at a Nigerian university similarly found that weakness was the most commonly recognized warning sign, but recognition rates were consistently lower among students than staff [2]. More recently, a multi-university study in Northeast Nigeria reported that university students overall had low stroke knowledge, with adequate knowledge more likely among female students and those with a family history of stroke, but not associated with academic discipline or prior stroke lectures [3]. Comparable patterns have been reported outside Nigeria: a study of Palestinian undergraduate health students found that knowledge varied significantly by gender, academic year, and field of study, and was, counterintuitively, lower among health-science students than pre-clinical medical students [4], while a large multinational study of university students across five Middle Eastern and North African countries likewise linked sociodemographic factors to stroke knowledge and behavioral response scores [5]. At a regional level, the SIREN (Stroke Investigative Research and Educational Network) initiative has similarly called for renewed public and institutional action on stroke knowledge, attitudes, and practice gaps across Ghana and Nigeria [6].

Most existing instruments, however, focus on factual recognition of symptoms and risk factors and rarely probe whether respondents understand the underlying neuroanatomical or pathophysiological mechanism of stroke - that is, whether they understand why a blocked or ruptured cerebral blood vessel produces the clinical picture they can otherwise recognize. This conceptual dimension of knowledge may be particularly relevant for health-science students, who are expected not merely to recognize stroke but to understand and eventually explain its pathophysiology to patients and the public. The present study therefore had two aims: (i) to assess general stroke awareness, warning-sign recognition, and risk-factor knowledge among university students using a structured 30-item instrument, and (ii) to independently assess and compare respondents' understanding of the neuroanatomical mechanism of stroke via an open-ended item, in order to determine whether factual/recognition knowledge and conceptual/mechanistic understanding move together or represent distinct dimensions of stroke literacy in this population.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a descriptive cross-sectional survey administered online via a structured Fillout questionnaire titled "Assessment of Stroke Awareness and Knowledge of Neuroanatomical Relationships." Data collection took place in August 2026.

2.2 Study Population and Sampling

Eighty-three (83) university students who completed the questionnaire in full were included in the analysis. Respondents were predominantly from health-

related disciplines (96.4%), including Human Anatomy, Basic Medical Sciences, Pharmacology/Pharmacy, Physiology, Nursing, and Public/Environmental Health, spanning 100 to 500 Level (undergraduate) of study, with a minority (3.6%) from non-health disciplines.

2.3 Instrument

The questionnaire comprised: (i) demographic items (sex, age band, field and level of study, department, family history of stroke); (ii) seven General Awareness statements (e.g., "stroke is a medical emergency," "stroke only affects elderly people"); (iii) ten Warning Signs/Symptoms items, of which seven were established stroke warning signs and three were distractor items not indicative of stroke (persistent itching, gradual weight gain, chest pain radiating to the left arm — a classic myocardial infarction symptom); (iv) fifteen Risk Factor items, of which twelve were established stroke risk factors and three were distractor/protective-factor items (regular exercise, common cold, fruit/vegetable consumption); and (v) one open-ended item asking respondents to explain, in their own words, what they believe happens in the brain during a stroke. All closed items used a Yes/No/Not Sure response format.

2.4 Scoring and Data Cleaning

Free-text department entries (69 unique raw strings) were standardized into eight categories using keyword-based classification. All 83 respondents answered every closed-ended item (no missing data); the open-ended neuroanatomy item had 14 blank responses, retained and coded as "No response." For each closed item, a response was scored 1 if it matched the factually correct answer and 0 otherwise (including "Not Sure"), yielding domain sub-scores (General Awareness /5; Warning Signs /10; Risk Factors /15) and a Total Knowledge score (/30), expressed as a percentage. Two exposure/familiarity items ("I have heard the term stroke before"; "I personally know someone who has had a stroke") were analyzed descriptively but excluded from the knowledge score. Total knowledge percentage was categorized as Poor (<60%), Moderate (60–79%), or Good (≥80%), a cut-off convention commonly applied in health-knowledge survey literature. The open-ended neuroanatomy response was coded by keyword/content analysis for presence of core physiological concepts (interrupted blood/oxygen supply; clot, blockage, rupture, or bleeding; resulting brain-cell damage or death) into four categories: Correct/Adequate, Partial, Incorrect/Vague, and No response.

2.5 Statistical Analysis

Data were analyzed in Python (pandas, SciPy). Descriptive statistics (means, standard deviations, frequencies) summarized demographic and knowledge variables. Internal consistency of the 30-item knowledge scale was assessed with Cronbach's alpha. Independent-samples t-tests compared two-group variables (sex); one-way ANOVA compared three-or-more-group variables

(age group, level of study, department, family history, and neuroanatomical-understanding category) against total knowledge percentage; and chi-square tests of association examined categorical associations between demographic variables and knowledge category. Pearson correlation coefficients assessed relationships among the three knowledge sub-domains. Statistical significance was set at $p < 0.05$.

2.6 Ethical Considerations

Ethical approval for the study was obtained from the Faculty of Basic Medical Sciences' Research and Ethics Committee (FBMSREC), Sa'adu Zungur University, Bauchi State, Nigeria, with approval reference number BASUG/FBMS/REC/VOL.11/0287. The approval covered the research project titled "Assessment of Stroke Awareness and Knowledge of Neuroanatomical Risk Factors among Undergraduate Students" and the research instruments submitted for review.

3. RESULTS

3.1 Sample Characteristics

Of the 83 respondents, 62 (74.7%) were male and 21 (25.3%) female. Most (61.4%) were aged 21–25 years, 21.7% were 16–20 years, and 16.9% were 26–30 years. Respondents were concentrated in 300 Level (39.8%) and 400 Level (39.8%), with smaller proportions in 200 Level (14.5%), 100 Level (3.6%), and 500 Level and above (2.4%). Regarding family history, 38.6% reported a family history of stroke, 53.0% did not, and 8.4% were unsure. Most respondents (93.9%) had previously heard the term "stroke," and 60.2% personally knew someone who had suffered a stroke — indicating substantial exposure to the condition prior to the survey. The most frequently cited sources of stroke information were lectures/school (70%), health workers (35%), social media (20%), family/friends (17%), and television/radio (7%); 2% reported never having received any information on stroke.

3.2 Overall Knowledge Scores

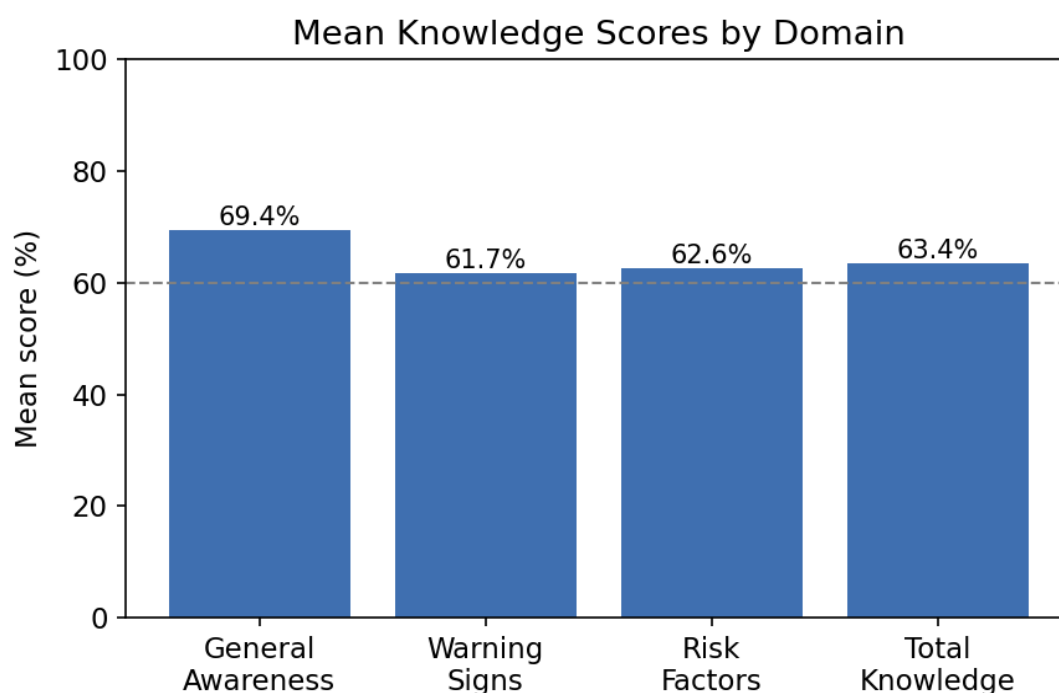


Figure 1: Mean knowledge score (%) by domain, with the 60% threshold marked.

Table 1. Domain and overall knowledge score summary (N = 83).

Domain	Max score	Mean (SD)	Mean %
General Awareness	5	3.47 (1.12)	69.4%
Warning Signs & Symptoms	10	6.17 (2.30)	61.7%
Risk Factors	15	9.39 (3.63)	62.6%
Total Knowledge	30	19.02 (6.07)	63.4%

The 30-item knowledge scale showed good internal consistency (Cronbach's $\alpha = 0.87$). Overall, 22 respondents (26.5%) were classified as having good knowledge, 34 (41.0%) Moderate, and 27 (32.5%) Poor (Figure 2).

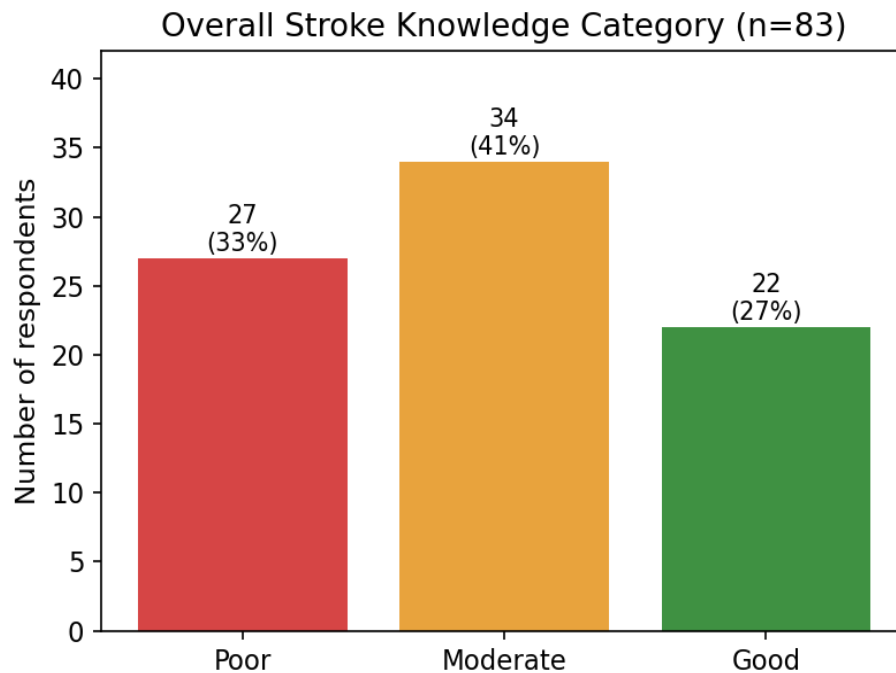


Figure 2: Overall knowledge classification (Good $\geq 80\%$, Moderate 60–79%, Poor $< 60\%$).

3.3 Misconceptions and Item-Level Patterns

General awareness of stroke as a serious, preventable emergency was comparatively strong, but specific misconceptions persisted: 38.6% of respondents incorrectly believed stroke only affects elderly people, and 24.1% incorrectly believed stroke and heart attack are the same condition. Among the warning-sign distractor items, 55.4% incorrectly endorsed persistent skin itching, 53.0% incorrectly endorsed gradual weight gain, and 51.8% incorrectly endorsed chest pain radiating to the left arm as stroke warning signs (Figure

3). By contrast, the classic sign of sudden one-sided numbness/weakness was well recognized (83.1% correct). Among risk factors, hypertension was the most consistently recognized true risk factor (85.5% correct), whereas oral contraceptive use (37.3% correct) and sickle cell disease (39.8% correct) were the least recognized. Protective behaviors were sometimes mistaken for risk factors: 31.3% incorrectly flagged fruit/vegetable consumption, and 26.5% incorrectly flagged regular exercise, as stroke risk factors.

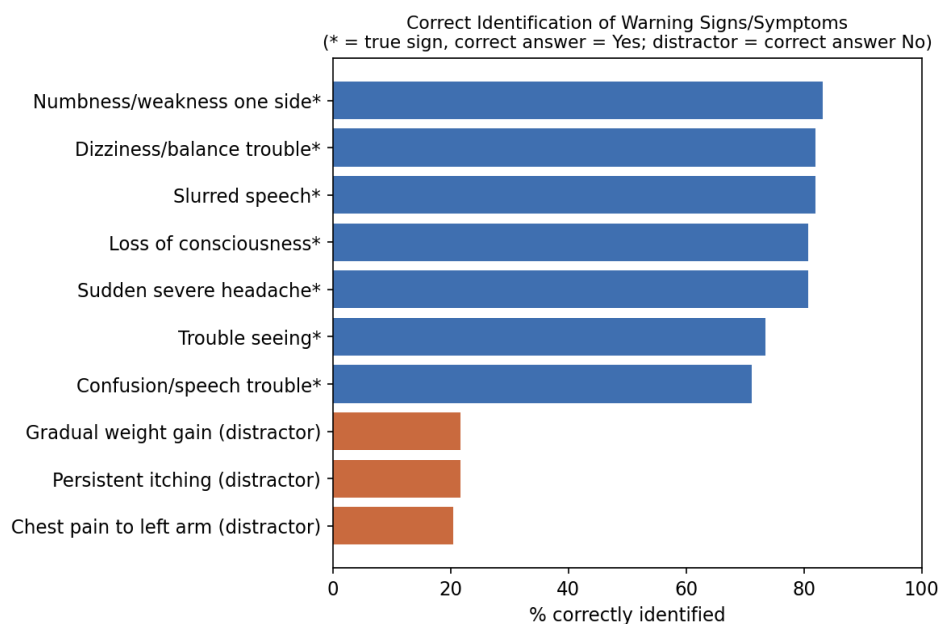


Figure 3: Percentage of respondents correctly identifying each warning-sign item (true signs vs. distractors).

3.4 Neuroanatomical Understanding

On the open-ended item asking respondents to explain what happens in the brain during a stroke, only 10 respondents (12.0%) gave a response reflecting correct understanding of the core mechanism (interrupted blood/oxygen supply leading to brain-cell damage or death), 17 (20.5%) showed partial understanding (mentioning only one core concept), 42 (50.6%) gave a vague or incorrect explanation, and 14

(16.9%) left the item blank or stated they did not know (Table 2, Figure 4). A one-way ANOVA found no significant association between neuroanatomical-understanding category and total factual knowledge score, $F(3,79) = 0.24$, $p = 0.867$, indicating that respondents' ability to recognize symptoms and risk factors on the closed-ended items did not predict their ability to explain the underlying brain mechanism.

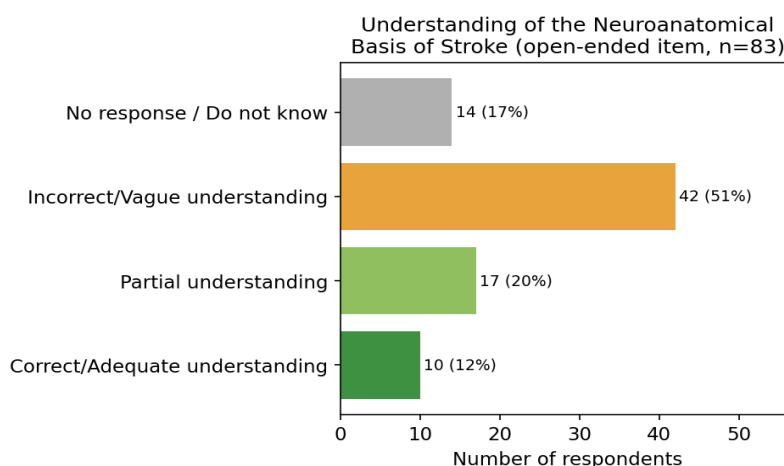


Figure 4: Distribution of coded responses to the open-ended neuroanatomy question (N = 83).

Table 2: Coded distribution of neuroanatomical-understanding responses.

Category	n	%
Correct/Adequate understanding	10	12.0%
Partial understanding	17	20.5%
Incorrect/Vague understanding	42	50.6%
No response / Do not know	14	16.9%

3.5 Subgroup Comparisons

Total knowledge percentage did not differ significantly by sex (Welch's t-test: Female mean = 66.8%, Male mean = 62.3%, $t = -0.90$, $p = 0.376$), age

group (one-way ANOVA, $F = 0.02$, $p = 0.977$), department ($F = 1.61$, $p = 0.169$; Nursing and Physiology students scored numerically highest at 76–78%, and Anatomy students lowest at 58%), or family history of stroke ($F = 0.81$, $p = 0.449$). Level of study showed a non-significant downward trend with academic seniority ($F = 2.21$, $p = 0.076$): mean scores were highest among 100/200 Level students (73–76%) and lowest among 300/400 Level students (59–62%) (Figure 5). Chi-square tests likewise found no significant association between sex and knowledge category ($\chi^2 = 4.86$, $df = 2$, $p = 0.088$) or between family history and knowledge category ($\chi^2 = 5.72$, $df = 4$, $p = 0.221$).

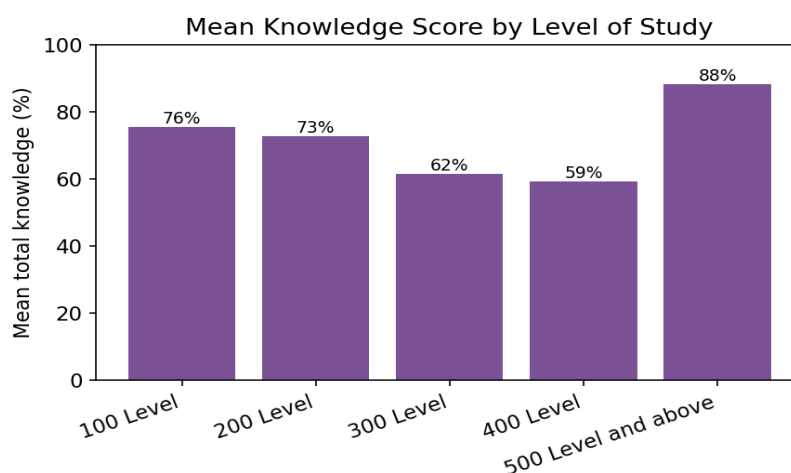


Figure 5: Mean total knowledge percentage by academic level of study.

The three knowledge sub-domains were positively and moderately-to-strongly correlated with one another (Pearson $r = 0.35-0.59$) and, by construction, strongly correlated with the total score ($r = 0.86-0.95$), supporting the internal coherence of the composite knowledge measure.

4. DISCUSSION

4.1 Overall knowledge levels in context

This study assessed both factual/recognition knowledge of stroke and conceptual understanding of its underlying neuroanatomical mechanism among a sample dominated by health-science undergraduates. Despite this favourable academic background, overall knowledge was only moderate (63.4%), with just over a quarter of respondents reaching the "Good" knowledge threshold. This finding sits within a well-documented regional pattern: Nigerian university-based surveys have repeatedly found that students in health-related disciplines do not consistently demonstrate adequate stroke knowledge, even when stroke content nominally features in their curricula [1,2]. It also echoes hospital- and community-based Nigerian data showing that even individuals at objectively elevated stroke risk hypertensive and diabetic patients, for instance often display poor awareness of warning signs and risk factors [3,4]. A comparable moderate-to-poor knowledge distribution has recently been reported among health-science students in Saudi Arabia, where scores were poor in 54.2% of respondents, satisfactory in 40.5%, and good in only 5.3% [5], and among university students across five Middle Eastern and North African countries, where knowledge remained inconsistent despite high self-reported familiarity with the term "stroke" [6]. Taken together with a recent analysis of three decades of temporal trends in public stroke knowledge showing that improvements in awareness have plateaued in many settings despite sustained public health messaging [7], our findings suggest that the moderate knowledge level observed here is not an anomaly but part of a broader, persistent pattern across both high- and low-resource settings.

The persistence of specific misconceptions in our sample that stroke affects only the elderly (38.6% of respondents) and that stroke and heart attack are the same condition (24.1%) mirrors similarly reported gaps in other student and community samples in the region [1,3,8] and underscores an important distinction: repeated exposure to the term "stroke" does not, by itself, translate into accurate factual knowledge. In our sample, 93.9% had heard of stroke and 60.2% personally knew a stroke survivor, figures broadly comparable to those reported among Nigerian undergraduates elsewhere (96.9% having heard of stroke) [8], yet this near-universal familiarity coexisted with substantial factual gaps. This dissociation between awareness of a condition's existence and accurate understanding of its nature has been observed consistently across the Nigerian stroke literature, including among hospital non-

clinical staff and community members with otherwise high general literacy [4,9], suggesting that simple exposure or name recognition is an unreliable proxy for health literacy and should not be relied upon as a stand-alone indicator in future surveillance.

4.2 The factual–conceptual knowledge gap

A more novel finding of this study is the marked discrepancy between factual/recognition knowledge and conceptual understanding of the underlying neuroanatomical mechanism of stroke. While the majority of respondents could recognize classic warning signs such as one-sided weakness (83.1% correct) and hypertension as a risk factor (85.5% correct), only 12.0% could correctly articulate why these signs occur that is, that interrupted blood or oxygen supply to brain tissue leads to neuronal injury or death. Moreover, this conceptual understanding was statistically unrelated to the factual knowledge score, suggesting that these two forms of knowledge are acquired somewhat independently.

This dissociation is plausible given how stroke education has typically been designed and evaluated in the literature to date. Most existing health-education materials and prior quantitative studies including the widely used symptom/risk-factor checklists that underpin instruments such as the Stroke Knowledge Test and Stroke Action Test [6] emphasize recognition-based knowledge of symptoms and risk factors rather than the underlying pathophysiology. Recognition-focused instruction is pedagogically easier to deliver (via mnemonics such as FAST) and easier to measure, which may explain why it dominates both public health messaging and the research instruments used to evaluate it. However, for a population of predominantly health-science students who will eventually be expected to explain disease mechanisms to patients not merely recite a checklist this gap is clinically and pedagogically significant. To our knowledge, this specific dissociation between recognition-level and mechanistic knowledge has received little prior quantitative attention in the regional stroke-knowledge literature, which has instead focused predominantly on aggregate knowledge scores and their socio-demographic correlates [1,2,8,9]. This gap represents a genuine addition to the literature: it suggests that future health-science curricula and public health interventions may need to explicitly and separately target mechanistic understanding, rather than assuming that it develops automatically alongside symptom recognition.

4.3 Socio-demographic correlates

Unlike some previous studies, which have reported significant associations between stroke knowledge and sex, academic year, or field of study [2,6], we did not find statistically significant differences across sex, age group, department, or family history in this sample. This is not, in itself, an unusual finding; several Nigerian and regional studies have similarly

failed to demonstrate consistent socio-demographic predictors of stroke knowledge, suggesting that such associations may be highly context- and sample-dependent rather than generalizable [1,4].

A borderline, non-significant decline in knowledge with increasing level of study ($p = 0.076$) is nonetheless worth noting, as it runs counter to the expectation that more senior students, who have had greater cumulative curriculum exposure, would score higher. This unexpected pattern may reflect the modest and unevenly distributed sample sizes across levels (only three respondents in 100 Level and two in 500 Level and above) rather than a genuine decline in knowledge with seniority, and should be interpreted cautiously pending replication in a larger, more evenly distributed sample. It is also possible that this reflects a genuine curricular gap if mechanistic and risk-factor content is concentrated in early pre-clinical coursework and not revisited or reinforced in later clinical years, knowledge acquired early could plausibly decay by senior levels without deliberate reinforcement, a phenomenon documented in other areas of medical education. This possibility cannot be distinguished from a sampling artefact with the present data and warrants targeted follow-up.

4.4 Distractor analysis and possible acquiescence bias

Distractor items proved particularly informative. Over half of respondents incorrectly endorsed non-specific symptoms (itching, weight gain) and a myocardial-infarction symptom (chest pain radiating to the left arm) as stroke warning signs, suggesting either genuine confusion between cardiovascular conditions or a tendency toward acquiescence bias that is, defaulting to "Yes" when uncertain rather than confidently rejecting an incorrect item. The conflation of stroke and cardiac symptomatology is not unique to this sample: cross-national data have shown that the public commonly conflates stroke and heart attack symptoms, with accurate discrimination between the two remaining a persistent public health messaging challenge even in settings with mature stroke-education campaigns [10]. Similarly, close to a third of respondents mistakenly identified protective behaviours (fruit/vegetable consumption, regular exercise) as stroke risk factors, indicating that some students may be recalling health-related buzzwords without a clear conceptual framework distinguishing risk from protective factors. This finding reinforces the broader argument made above: that recognition-based familiarity with health terminology - whether applied to symptoms, risk factors, or protective behaviours - can create a false impression of competence that formal knowledge scoring alone may not adequately capture, and that testing instruments and educational interventions alike should be designed to explicitly probe this distinction rather than assume it is intuitive.

5. Limitations

1. The modest sample size ($N = 83$), drawn from a single institutional context and dominated by health-related disciplines (96.4%), limits statistical power for subgroup comparisons and generalizability to the broader student population.
2. The cross-sectional, self-administered online design cannot establish causality and may be subject to self-selection or social-desirability bias.

6. CONCLUSION

Among this predominantly health-science student sample, overall stroke knowledge was moderate, and a substantial minority held clinically important misconceptions regarding stroke's age distribution and its distinction from heart attack. Most strikingly, conceptual understanding of the neuroanatomical mechanism of stroke was markedly weaker than symptom/risk-factor recognition and was not predicted by it. These findings suggest that stroke-education efforts in similar academic settings should move beyond checklist-style teaching of symptoms and risk factors to explicitly address the underlying pathophysiological mechanism vascular occlusion or rupture leading to cerebral ischemia and neuronal injury which may in turn help correct persistent misconceptions and strengthen durable, generalizable stroke literacy.

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