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Prevalence and associated factors of unilateral spatial neglect among patients with stroke at Mbarara Regional Referral Hospital, Uganda: a cross-sectional study

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Abstract

Background Unilateral spatial neglect (USN) is a common neurocognitive deficit following stroke and is associated with impaired rehabilitation and functional outcomes. Evidence on its burden and associated factors in low- and middle-income countries remains limited. This study determined the prevalence of USN and its associated factors among patients with stroke at Mbarara Regional Referral Hospital (MRRH), southwestern Uganda.

Methods We conducted a cross-sectional study from August 12 to December 15, 2024. Patients with a recent stroke event within the preceding 0–4 months receiving care at MRRH were enrolled using consecutive sampling. Patients who were unable to see, aged <18 years or had bilateral stroke were excluded. USN was assessed using the Sunnybrook Neglect Assessment Procedure (SNAP): scores >5 indicating USN. Sociodemographic, clinical, and lifestyle factors were collected via structured questionnaires. Multivariable modified Poisson regression was used to identify factors associated with USN, reporting adjusted prevalence ratios (aPR) with 95% confidence intervals (CI).

Results We enrolled 116 participants with a median age of 68 years (inter-quartile range [IQR]: 56–78). Most were female (65.5%). The prevalence of USN was 54.3% (n=63; 95% CI: 44–63). Among participants with USN, 60.4% were in the acute phase and 39.6% were in the subacute phase. Factors independently associated with a higher prevalence of USN included severe stroke (aPR=1.47), right-hemisphere lesions (aPR=1.58), and age ≥60 years (aPR=1.66), while right-handedness was associated with a lower prevalence of USN (aPR=0.94).

Conclusion This study revealed a high prevalence of USN among patients with stroke at a referral hospital in southwestern Uganda. Stroke severity, right-hemisphere lesions, advanced age, and right-handedness were associated with USN. Targeted rehabilitation and early screening for patients with stroke with risk factors, particularly those with severe strokes or advanced age, could optimize recovery and improve long-term outcomes.

Keywords Unilateral spatial neglect, stroke, prevalence, cerebrovascular disorders, Stroke rehabilitation, Uganda

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Introduction

Stroke is a major global health burden, contributing significantly to disability and mortality, particularly in low- and middle-income countries (LMICs) where healthcare resources are limited [1]. In sub-Saharan Africa, the incidence of stroke has risen due to increasing cardiovascular risk factors such as hypertension and diabetes, with Uganda reporting a stroke incidence of approximately 145 per 100,000 people annually [2]. Unilateral spatial neglect (USN), a neurocognitive deficit characterized by the failure to attend to stimuli on one side of the body or environment, affects 20–85% of stroke survivors, severely impacting rehabilitation, mobility, and quality of life [3]. USN not only prolongs hospital stays but also increases the risk of falls and dependency, posing significant challenges to functional recovery [4]. USN is often associated with right-hemisphere lesions, leading to neglect of the contralesional side, and is exacerbated by factors such as stroke severity, age, and lesion size [5].

In LMIC settings, where rehabilitation services are often inadequate, the burden of USN is likely amplified, yet data on its prevalence and associated factors remain scarce [6]. In Uganda, stroke is a leading cause of morbidity [2], with Mbarara Regional Referral Hospital (MRRH), a tertiary care center in southwestern Uganda, managing approximately 25 patients with stroke monthly. Despite this high burden, there is a lack of routine USN screening at MRRH, hindering targeted interventions. Routine USN screening using feasible tools such as Sunnybrook Neglect Assessment Procedure (SNAP) is crucial for identifying patients at risk of prolonged recovery, increased falls, and dependency, enabling early, tailored rehabilitation to improve functional outcomes and reduce healthcare costs. This study aimed to determine the prevalence of USN and its associated factors among patients with stroke at MRRH, providing evidence to inform clinical practice and improve stroke care in resource-constrained settings.

Methods

Study design and setting

This cross-sectional study was conducted from August 12 to December 15, 2024, at MRRH, a 500-bed tertiary hospital in Mbarara City, southwestern Uganda, located along the Mbarara-Kabale Highway (coordinates: 0.6164 S, 30.6589E). MRRH serves as a major referral center for southwestern Uganda, managing patients with stroke at emergency, medical, neurology, and physiotherapy units in the catchment area of Mbarara city, Isingiro, Bushenyi, Sheema, Ibanda, Kazo, Buhweju, Mitooma, Rubirizi, and Kiruhura districts. MRRH provides stroke care through its emergency unit, medical wards, neurology clinic, and physiotherapy department. Patients presenting with acute stroke are initially evaluated and

stabilized in the emergency care unit before admission to the medical ward for further management. Diagnostic services for stroke include clinical evaluation supported by neuroimaging, primarily computed tomography (CT) scanning which is mandatory for all patients with stroke. At the time of the study, advanced acute stroke interventions such as intravenous thrombolysis and endovascular thrombectomy were not routinely available. There is no dedicated stroke unit; however, stroke care is delivered through a multidisciplinary team approach involving physicians, medical officers, nurses, physiotherapists, and other allied health professionals. On average, approximately 25 stroke patients are admitted to MRRH per month, and patients typically receive rehabilitative care for a period of 3 to 6 months depending on clinical needs and functional recovery.

Study population, sample size, and sampling

We enrolled patients with stroke within 0–4 months of stroke onset, using consecutive sampling from both inpatient and outpatient services. Inpatients were recruited from the emergency care unit and medical wards, while outpatients were recruited from the neurology and physiotherapy outpatient clinics. Inclusion criteria included a CT scan-confirmed stroke diagnosis by a physician. Exclusion criteria were inability to see (due to limitations of the assessment tool), age < 18 years and having bilateral strokes.

Sample size was determined based on an expected USN prevalence of 50% (conservative estimate), using the Kish Leslie formula with a 95% confidence level ($Z = 1.96$) and a 5% margin of error, yielding a minimum sample of 106. Adjusting for a 10% non-response rate, the final sample size was 116 participants.

Data collection and study variables

Unilateral spatial neglect was assessed using the Sunnybrook Neglect Assessment Procedure (SNAP), a previously developed and validated standardized paper-and-pencil screening tool for detecting neglect in adult stroke populations [7]. The SNAP comprises line bisection, star cancellation, line crossing, and figure copying tasks. Total scores range from 0 to 100, with scores greater than 5 indicating the presence of unilateral spatial neglect, as defined in the original validation study [7]. The SNAP has demonstrated strong reliability, with high inter-rater agreement (92%) and excellent test–retest reliability ($r = 0.95$), supporting its consistency for repeated assessment of USN [7]. In validation studies comparing SNAP with the Visual Scanning Behavior (VSB) task, the tool demonstrated an overall sensitivity of 68% and specificity of 76% for detecting unilateral spatial neglect. Among SNAP subtests, the shape cancellation task showed the highest sensitivity (70%), while the drawing/

copying task demonstrated the highest specificity (99%) [7]. Administration of the SNAP takes approximately 10–15 min and requires minimal training, allowing its use by both clinicians and trained non-clinician research assistants in resource-limited settings. Stroke severity was measured with a standardized National Institutes of Health Stroke Scale (NIHSS), categorized as mild (0–4), moderate [5–15], or severe (16–42) [8]. Stroke phase was categorized using commonly accepted clinical definitions based on time since stroke onset. Acute stroke was defined as ≤ 7 days post-stroke and subacute stroke as > 7 days to < 6 months. Pre-stroke functional status was evaluated using the modified Rankin Scale (mRS) adopted and categorized as independent (0–2) or dependent [3–5, 9]. Sociodemographic factors (age, sex, education, occupation) and clinical factors included stroke type (ischemic or hemorrhagic), lesion location (right or left hemisphere), and handedness (right or left-handed). Comorbidities assessed included hypertension. Age was categorized as < 60 and ≥ 60 years to distinguish younger and older participants, based on prior literature demonstrating clinically meaningful differences in stroke characteristics, vascular risk profiles, and outcomes at this threshold [10, 11]. The data were collected via structured questionnaires administered by trained research assistants.

Research assistants were trained on SNAP administration, questionnaire delivery, and ethical considerations. The study tools were pretested on 12 patients with stroke at Mayanja Memorial Hospital to assess clarity, feasibility, and consistency of administration prior to the main data collection. Ability to sustain attention and follow instructions was assessed clinically during SNAP administration, and participants unable to complete the assessment due to cognitive, attentional, or language impairments were excluded. USN was defined as a SNAP score > 5 , based on established cutoffs for detecting neglect [3]. Patients were classified as having USN (SNAP score > 5) or not having USN (SNAP score ≤ 5).

Data management and analysis

Data were entered into Kobo Collect and exported to Stata version 17 (Stata Corp, College Station, TX, USA) for analysis. Descriptive statistics (frequencies, median, proportions, means, and standard deviations) summarized participant characteristics. The Shapiro–Wilk test was used to assess normality and guide the use of means or medians for continuous variables. Comparisons between participants with unilateral spatial neglect (USN+) and those without USN (USN–) were performed using the Chi-square test for categorical variables with adequate expected cell counts, while Fisher's exact test was used when expected cell counts were small (< 5). The prevalence of USN was calculated as the proportion of

participants with SNAP scores > 5 , and was reported with corresponding 95% confidence interval (CI).

Bivariate analyses using modified Poisson regression assessed associations between USN and independent variables. Multivariable modified Poisson regression with robust standard errors was used to identify factors associated with USN, reporting adjusted prevalence ratio (aPR) with 95% CI [12]. Variables with $p < 0.2$ in bivariate analysis, along with biologically plausible factors were included in the multivariable model. Modified Poisson regression was chosen instead of logistic regression because the outcome (USN) was common ($> 50\%$ prevalence), and logistic regression would overestimate effect sizes in this setting [9]. The statistical significance was set at $p < 0.05$.

Results

During the study period, 128 patients with stroke were assessed for eligibility. Of these, 120 met the inclusion criteria and were recruited. Four participants were unable to complete the assessment, resulting in a final analytical sample of 116 participants (Fig. 1).

Characteristics of study participants

We enrolled 116 patients with stroke, with a median age of 68 years (IQR: 56–78). The majority were female (65.5%), had low education (80.2%), were unemployed (67.5%), and were functionally independent pre-stroke (91.4%). Clinically, most participants experienced ischemic strokes (71.5%) predominantly of moderate severity (66.4%), with right-hemisphere lesions in 54.3%, and were in the acute phase (61.2%). The majority were right-handed (90.5%), and 16.4% had severe stroke (Table 1).

Prevalence of unilateral spatial neglect

Of the 116 participants, 63 had USN, yielding a prevalence of 54.3% (95% CI: 44–63).

USN was significantly more prevalent among participants aged ≥ 60 years (68.4%; 54/79) compared with those aged < 60 years (24.3%; 9/37) ($p < 0.001$). Prior functional dependence was more common among participants with USN (14.3%) compared to those without USN (1.9%; $p = 0.021$). Similarly, a higher proportion of participants with USN were not employed (78.8% vs. 54.7%; $p = 0.008$). Stroke severity and lesion location were also significantly associated with USN ($p = 0.001$ and $p = 0.004$, respectively). No significant differences were observed between USN and non-USN participants in terms of sex, education level, stroke type, handedness, stroke phase, or history of hypertension (Table 1).

Factors associated with unilateral spatial neglect

At multivariable analysis, severe stroke, right-hemisphere lesions, and age ≥ 60 years were independently

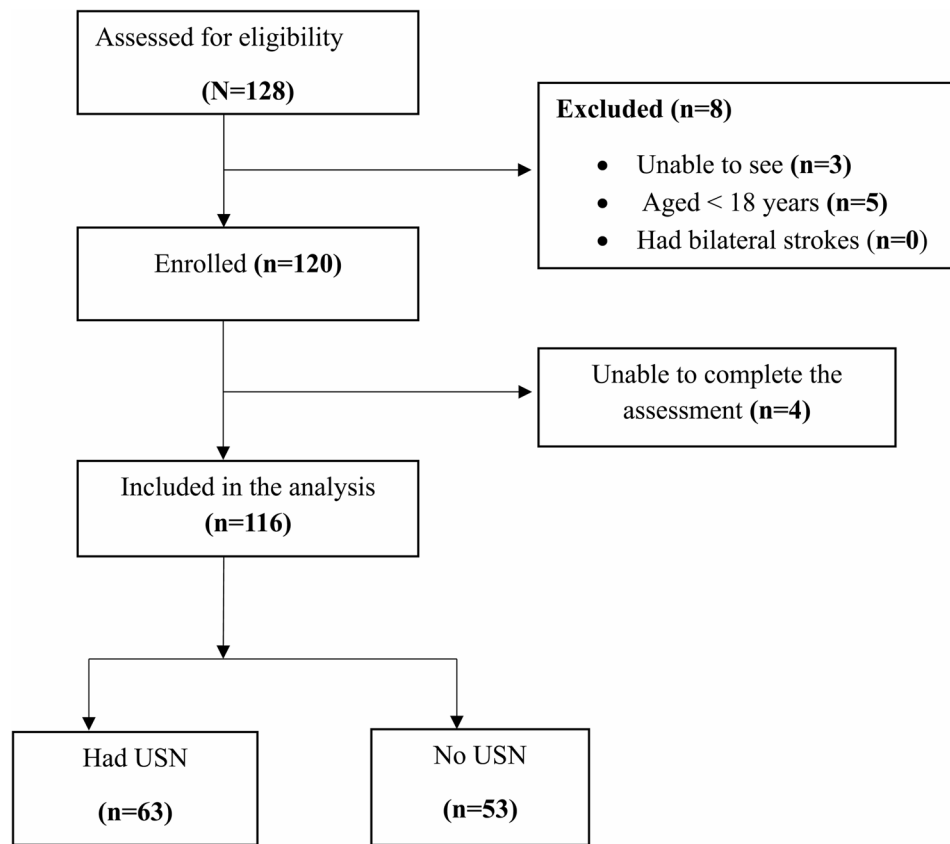


Fig. 1 Flow diagram of eligibility, exclusions, and final analytical sample of patients with stroke Mbarara Regional Referral Hospital, Uganda, August–December 2024; USN: unilateral spatial neglect

associated with an increased prevalence of USN, whereas right-handedness was independently associated with a reduced prevalence of USN (Table 2). Participants with severe stroke had a 1.47 times higher prevalence of USN (aPR=1.47, 95% CI: 1.12–1.92, $p=0.005$) compared to those with mild stroke. Those with right-hemisphere lesions had a 1.58 times higher prevalence (aPR=1.58, 95% CI: 1.14–2.19, $p=0.006$) compared to left-hemisphere lesions. Participants aged ≥ 60 years had a 1.66 times higher prevalence (aPR=1.66, 95% CI: 1.02–2.72, $p=0.042$) compared to those < 60 years. Right-handedness was associated with a 6% lower likelihood of experiencing USN (aPR=0.94, 95% CI: 0.94–0.99, $p<0.001$). Pre-stroke functional status showed a marginal association (aPR=1.19, 95% CI: 0.98–1.45, $p=0.070$). Other variables, including sex, stroke type, and hypertension history, were not significantly associated with USN ($p>0.05$) (Table 2).

Discussion

Approximately half of the patients with stroke surveyed at the regional referral hospital, southwestern Uganda were found to have USN. Significant associations were found between USN and stroke severity, right-hemisphere

lesions, and advanced age, all of which were associated with a higher prevalence of USN, while right-handedness was associated with a lower prevalence of USN.

The USN prevalence of 54.3% in the current study aligns with global estimates ranging from 20 to 85% but is higher than the commonly reported average of 30% [5]. Importantly, this prevalence is within the range reported in sub-Saharan Africa; for example, a Nigerian cohort of community-dwelling stroke survivors reported a USN prevalence of 37.5% [16]. Collectively, these findings suggest that the burden of USN in sub-Saharan Africa may be substantial and broadly comparable to that reported in high-income countries, despite differences in health system capacity and access to rehabilitation services [13]. Nevertheless, large-scale epidemiological studies quantifying the burden of USN across low- and middle-income countries remain limited, underscoring the need for further context-specific research. Additionally, the high prevalence of USN observed in this study may have been partly influenced by unrecognized post-stroke delirium, which is common in acute stroke and can exacerbate attentional deficits, indicating the importance of comprehensive neurocognitive assessment in early stroke care [14].

Table 1 Characteristics of study participants, by unilateral spatial neglect status (*N* = 116)

Variable	Overall (<i>N</i> = 116) <i>n</i> (%)	USN Yes (<i>n</i> = 63) <i>n</i> (%)	USN No (<i>n</i> = 53) <i>n</i> (%)	<i>P</i> - value
Age (Years)¶				
< 60	37 (31.9)	9 (14.3)	28 (52.8)	< 0.001
≥ 60	79 (68.1)	54 (85.7)	25 (47.2)	
Sex				0.776
Female	76 (65.5)	42 (66.7)	34 (64.8)	0.103
Male	40 (34.5)	21 (33.3)	19 (35.2)	
Education Level				0.008
None/Primary	93 (80.2)	54 (85.7)	39 (73.6)	
Secondary/Tertiary	23 (19.8)	9 (14.3)	14 (26.4)	0.656
Employment Status				
Employed	38 (32.5)	14 (22.2)	24 (45.3)	0.001†
Not Employed	79 (67.5)	49 (78.8)	29 (54.7)	
Stroke Type				0.004†
Ischemic	83 (71.5)	44 (69.4)	39 (73.6)	
Hemorrhagic	33 (28.5)	19 (30.6)	14 (26.4)	0.830
Stroke Severity (NIHSS)				
Mild (0–4)	20 (17.2)	7 (11.1)	13 (24.5)	0.064†
Moderate (5–15)	77 (66.4)	39 (61.9)	38 (71.7)	
Severe (16–42)	19 (16.4)	17 (27.0)	2 (3.8)	0.021†
Lesion Location				
Right Hemisphere	63 (54.3)	42 (66.7)	21 (39.6)	0.159
Left Hemisphere	53 (45.7)	21 (33.3)	32 (60.4)	
Stroke Phase				0.159
Acute (≤ 7 days)	71 (61.2)	38 (60.4)	33 (62.3)	
Subacute (> 7 days to < 6 months)	45 (38.7)	25 (39.6)	20 (37.7)	0.064†
Handedness				
Right	105 (90.5)	54 (87.7)	51 (96.2)	0.021†
Left	11 (9.5)	9 (14.3)	2 (3.8)	
Pre-Stroke functional status				0.159
Independent (0–2)	107 (91.4)	54 (85.7)	52 (98.1)	
Dependent (3–5)	10 (8.6)	9 (14.3)	1 (1.9)	0.159
Hypertension History				
No	64 (55.2)	31 (49.2)	33 (62.3)	0.159
Yes	52 (44.8)	32 (49.8)	20 (37.7)	

¶ Median age = 68 (IQR: 56–78) years; USN: Unilateral spatial neglect; mRS: modified Rankin Scale; NIHSS: National Institutes of Health Stroke Scale; †: Fisher's exact test

To address the high USN prevalence in low-resource settings such as MRRH, there is a need to implement low-cost screening tools, such as paper-based line bisection or star cancellation tasks, and training community health workers and caregivers in visual scanning exercises that can facilitate early detection and management, to improve functional outcomes. Our findings further highlight the need for targeted rehabilitation for patients with severe stroke, strengthened acute stroke care, and

timely initiation of secondary prevention and rehabilitation interventions.

Severe stroke was associated with a higher likelihood of USN, consistent with studies linking larger lesions to greater disruption of attention networks [15]. The underlying mechanism involves damage to the fronto-parietal networks essential for spatial attention, which are often more severely affected in larger strokes [17]. This association requires the need for prioritized screening and intensive rehabilitation for patients with severe stroke in similar low-resource settings, as their elevated risk of USN can lead to prolonged recovery, increased dependency, and higher healthcare costs [15]. It also highlights the importance of strengthening acute stroke care, preventing secondary complications, and ensuring timely initiation of rehabilitation.

Right-hemisphere lesions were associated with a higher likelihood of USN, supporting the right hemisphere's dominant role in spatial attention [5]. This hemispheric asymmetry is well-documented, with right-hemisphere strokes more frequently causing neglect due to the brain's lateralized attention systems [18]. While the prevalence of USN was higher in right-hemisphere strokes, 33.3% of patients with left-hemisphere strokes also exhibited neglect, indicating that USN is not exclusive to right-hemisphere lesions. Therefore, while patients with right-hemisphere strokes may be prioritized for screening and early intervention due to their elevated risk, it remains important to assess all patients, including those with left-hemisphere strokes, to avoid missing individuals who could benefit from rehabilitation.

Similarly older age (≥ 60 years) was associated with a 1.66 times higher prevalence, likely due to reduced brain plasticity and vascular aging, which impair compensatory mechanisms [19, 20]. However, 14.3% of patients younger than 60 years also had USN, indicating the need for routine screening across all age groups. Prioritization may focus on older patients due to higher risk, but younger patients should not be excluded from assessment and early intervention programs. Right-handedness was associated with a lower likelihood of experiencing USN, possibly due to left-hemisphere compensation, though its clinical significance may be limited [21]. Based on these findings, patients with left-handedness may warrant particular consideration for USN assessment. At MRRH, prioritization strategies for USN screening and intervention could focus on individuals with severe stroke, right-hemisphere lesions, and advanced age; however, universal screening remains important to ensure that younger patients and those with left-hemisphere strokes are not overlooked.

Overall, the high prevalence of USN in this setting indicates a gap in stroke care at MRRH, where routine screening for USN is not standard practice. Early detection and

Table 2 Factors associated with unilateral spatial neglect among patients with stroke at Mbarara Regional Referral Hospital, Uganda, August–December 2024

Variable	cPR	95% CI	p-value	aPR	95% CI	p-value
Age (Years)						
< 60	Ref	-	-	Ref	-	-
≥ 60	1.82	(1.05–3.16)	0.001	1.66	(1.02–2.72)	0.042
Sex						
Female	Ref	-	-	Ref	-	-
Male	0.95	(0.58–1.56)	0.779	0.97	(0.61–1.54)	0.892
Stroke Type						
Ischemic	Ref	-	-	Ref	-	-
Hemorrhagic	1.27	(0.76–2.12)	0.649	1.15	(0.70–1.89)	0.584
Stroke Severity (NIHSS)						
Mild	Ref	-	-	Ref	-	-
Moderate	1.31	(0.67–2.55)	0.425	1.25	(0.65–2.41)	0.503
Severe	2.12	(1.08–4.17)	0.029	1.47	(1.12–1.92)	0.005
Lesion Location						
Left Hemisphere	Ref	-	-	Ref	-	-
Right Hemisphere	1.89	(1.18–3.03)	0.008	1.58	(1.14–2.19)	0.006
Handedness						
Left	Ref	-	-	Ref	-	-
Right	0.62	(0.41–0.94)	0.049	0.94	(0.94–0.99)	< 0.001
Pre-Stroke functional status						
Independent (0–2)	Ref	-	-	Ref	-	-
Dependent (3–5)	1.65	(0.98–2.77)	0.059	1.19	(0.98–1.45)	0.070
Hypertension History						
No	Ref	-	-	Ref	-	-
Yes	1.45	(0.90–2.34)	0.126	1.42	(0.85–2.37)	0.176

cPR, crude prevalence ratio; aPR, adjusted prevalence ratio; USN, Unilateral spatial neglect; mRS, modified Rankin Scale; CI, Confidence interval; NIHSS, National Institutes of Health Stroke Scale

intervention, such as visual scanning training and prism adaptation, could mitigate USN's impact on functional recovery [15, 22]. In LMIC settings like Uganda, where rehabilitation resources are limited, integrating low-cost, community-based interventions such as training caregivers in neglect management could be a feasible strategy [23]. Additionally, targeting older patients and those with severe strokes through tailored rehabilitation programs could help address this burden [24].

Limitations

SNAP primarily assesses visuomotor neglect and personal neglect using paper and pencil tasks and may therefore fail to adequately detect personal and extra-personal forms of neglect, as well as neglect in non-visual sensory modalities. Although patients with known visual impairments were excluded, formal visual field testing was not performed, and subtle or undiagnosed visual field deficits may have influenced task performance, potentially resulting in false-positive classification of unilateral spatial neglect [25]. In addition, SNAP relies on basic cognitive and language abilities; therefore, patients with conditions such as alexia or Wernicke's aphasia, although not excluded, may have had difficulty completing the

assessment, potentially confounding results. A small number of participants ($n=4$) were excluded due to inability to complete the assessment, which may reflect challenges related to attention, comprehension, or cooperation. These factors may partly explain the high prevalence of USN observed in this study population.

The cross-sectional design limits the ability to assess USN recovery trajectories, and the single-center study setting may limit generalizability to other healthcare contexts outside southwestern Uganda. Furthermore, we did not collect data on cardiometabolic risk factors, including diabetes mellitus, dyslipidemia, or cigarette smoking. The absence of these variables may have introduced residual confounding, as cardiometabolic risk factors are known to influence stroke severity and recovery, which could indirectly affect the occurrence or detection of USN. Delirium was also not formally assessed, particularly in the acute phase, which may have affected attention and task performance, potentially influencing the prevalence of USN observed. Finally, this study was not designed to test pre-specified hypotheses regarding factors associated with USN; therefore, analyses of associated factors were exploratory, and the study may have been underpowered to detect modest associations. Future studies should

incorporate multimodal neglect assessments, such as the Catherine Bergego Scale or the Kessler Foundation Neglect Assessment Process (KF-NAP), standardized visual field testing, comprehensive cardiometabolic profiling, delirium screening, and longitudinal designs with pre-planned power calculations. to better characterize risk factors, recovery patterns, and functional outcomes of USN in low-resource settings.

Conclusion

This study revealed a high prevalence of USN among patients with stroke at a referral hospital in southwestern Uganda, affecting nearly half of the surveyed participants. Significant associations were found between USN and factors such as stroke severity, right-hemisphere lesions, advanced age, and right-handedness. Targeted rehabilitation and early screening for patients with stroke with risk factors, particularly those with severe strokes or advanced age, could optimize recovery and improve long-term outcomes in this low-resource setting.

Abbreviations

aPR	Adjusted Prevalence Ratio
CI	Confidence Interval
LMIC	Low- and Middle-Income Countries
mRS	Modified Rankin Scale
MRRH	Mbarara Regional Referral Hospital
NIHSS	National Institutes of Health Stroke Scale
SNAP	Sunnybrook Neglect Assessment Procedure
USN	Unilateral Spatial Neglect

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Authors' contributions

DA, RM, DN, CL, RN, ROO, DAC, AN, MS, JNN, MK, EK conceptualized and designed the study. DA and RM analyzed the data, DN and CL collected data, and DA, RM, DAC, and AN drafted the manuscript. All authors read and approved the final manuscript.

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Data availability

The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Mbarara University of Science and Technology Faculty Research Ethics Committee (FREC) and Mbarara University of Science and Technology Research Ethics Committee (MUST-2024-1568). Approval was also granted by the director of Mbarara Regional Referral Hospital. Written informed consent was obtained from all participants or their next of kin. Participants were informed of their right to withdraw at any time without consequences. Patients identified with USN were referred

to physiotherapy and neurology units for further care. All procedures were conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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