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Original Article

Awareness of Stroke Warning Signs and Risk Factors Among Patients with Hypertension and Diabetes Mellitus at a Tertiary-Care Hospital in Quetta, Pakistan: A Cross-Sectional Study

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ABSTRACT

Background: Stroke remains a major cause of death, disability, and long-term functional dependence, particularly in populations with modifiable vascular risk factors such as hypertension and diabetes mellitus. Objective: To assess awareness of stroke warning signs and risk factors among patients with hypertension and/or type 2 diabetes mellitus attending a tertiary-care hospital in Quetta, Pakistan, and to identify factors associated with overall stroke awareness. Methods: This cross-sectional study was conducted from July to December 2025. Using convenience sampling, 210 consenting adults with hypertension, type 2 diabetes mellitus, or both were enrolled. Awareness was assessed using 10 warning-sign and 12 risk-factor items. Composite awareness scores were analyzed using descriptive statistics, group comparisons, correlation analysis, and multiple linear regression in IBM SPSS Statistics version 26.0. Results: Mean age was 55.54 ± 11.86 years. Mean warning-sign awareness was 40.90 ± 19.60%, risk-factor awareness was 48.89 ± 15.85%, and composite awareness was 44.90 ± 14.34%. Only 23.8% had good overall awareness. Unilateral weakness (58.1%) and speech difficulty (51.9%) were the best-recognized warning signs, while hypertension (79.5%) was the best-recognized risk factor. Although 86.2% intended to seek hospital care, only 24.8% would call an ambulance. Increasing age independently predicted lower awareness, whereas urban residence, higher educational attainment, and knowing someone with stroke were associated with greater awareness. Conclusion: Stroke awareness was suboptimal despite established vascular risk. Routine hypertension and diabetes care should integrate targeted education that emphasizes acute warning signs, ambulance activation, and groups with lower awareness, particularly older, rural, and less-educated patients. Keywords: Stroke; Awareness; Warning Signs; Risk Factors; Hypertension; Diabetes Mellitus; Quetta; Pakistan.

INTRODUCTION

Stroke remains one of the leading causes of death, neurological disability, functional dependence, and health-system burden worldwide. Global Burden of Disease analyses indicate that although age-standardized stroke rates have declined in several settings, the absolute number of people affected remains substantial because of population growth, ageing, and continued exposure to modifiable vascular risk factors (1,2). The burden is

particularly important in low- and middle-income countries, where demographic transition is occurring alongside increasing prevalence of hypertension, diabetes mellitus, obesity, dyslipidaemia, smoking, and physical inactivity (1-3).

Hypertension is one of the most important modifiable determinants of stroke, while diabetes mellitus contributes independently through accelerated atherosclerosis, endothelial dysfunction, vascular inflammation, and interaction with other cardiometabolic abnormalities (1,4,5). A recent meta-analysis demonstrated that hypertension and diabetes mellitus are both associated with increased stroke risk, reinforcing the importance of prevention among patients with established cardiometabolic disease (6). Studies conducted in Pakistan have similarly identified hypertension, diabetes, dyslipidaemia, smoking, obesity, and cardiovascular disease as frequent risk factors among patients presenting with stroke (7-10). These findings support the importance of targeting patients with hypertension and diabetes before a cerebrovascular event occurs.

Effective stroke prevention requires more than diagnosis and pharmacological management of vascular risk factors. Patients must understand how their chronic conditions contribute to stroke risk and recognize the lifestyle and medical factors that can be modified (11,12). However, recent evidence suggests that patients with hypertension or diabetes often have incomplete knowledge despite regular contact with healthcare services. Tuli et al. reported mean knowledge scores of only 44.1% for stroke risk factors and 49.7% for stroke prevention among hypertensive patients attending an Ethiopian tertiary hospital (13). Similarly, a 2024 study among hypertensive patients in Nepal found that approximately half had only fair awareness, and awareness varied significantly according to residence and educational attainment (14).

Recognition of acute warning signs is equally important because stroke treatment is highly time-sensitive. Sudden unilateral weakness, facial weakness, speech disturbance, visual impairment, gait difficulty, and loss of balance require urgent evaluation, yet these manifestations are not recognized consistently across populations (15-17). A 2023 Pakistani study conducted in Rawalpindi found substantially better recognition of sudden weakness than visual symptoms, while hypertension was more frequently identified than several other risk factors (18). Recent studies from Saudi Arabia and India have likewise demonstrated considerable variation in recognition of warning symptoms even among patients with diabetes, hypertension, or regular healthcare contact (19-21).

The difference between recognizing a stroke and responding appropriately is also clinically important. Awareness that hospital treatment is required does not necessarily translate into immediate activation of emergency medical services. In a study involving patients with diabetes and hypertension, only 22.8% reported that they would immediately call an ambulance for suspected stroke (22). Hospital-based surveys in India have similarly found deficiencies in knowledge of ambulance services, emergency response, and the need for rapid hospital presentation despite better general recognition that stroke requires medical treatment (20,23). Registry data further suggest that having a history of hypertension or diabetes does not automatically increase ambulance use at stroke onset (24).

Social determinants of health appear to influence stroke awareness substantially. Educational attainment, residence, income, healthcare access, prior exposure to stroke, and access to reliable health information have repeatedly been associated with knowledge levels (13,14,19,25). In a 2025 study among hypertensive patients in Tanzania, urban residence, tertiary education, and previous exposure to a person with stroke were strongly associated with greater knowledge of warning signs and risk factors (25). A 2024 study from Morocco also identified age, education, residence, and previous stroke exposure as correlates of knowledge among hypertensive patients (26). These findings suggest that stroke knowledge is influenced not only by clinical risk status but also by health literacy, social context, and opportunities for health education.

Evidence from Pakistan remains comparatively limited for patients who already have hypertension or diabetes but have not necessarily experienced stroke. Recent Pakistani studies have documented inadequate recognition of risk factors in tertiary-care populations, demonstrated the high prevalence of modifiable vascular risks among patients with established stroke, and shown variability in stroke knowledge across educational groups (7-10,18,27). A study among university students in Quetta reported relatively good general awareness but acknowledged that the educated study population substantially limited generalizability to the wider community (27). Therefore, evidence from patients with chronic cardiometabolic disease in Quetta is needed because this group is both clinically vulnerable and readily accessible through routine healthcare services.

The present study aimed to assess awareness of stroke warning signs and risk factors among patients with hypertension and/or type 2 diabetes mellitus attending a tertiary-care hospital in Quetta, Pakistan. It also evaluated intended emergency responses and examined demographic, socioeconomic, clinical, and informational characteristics associated with overall stroke awareness.

MATERIALS AND METHODS

A cross-sectional study was conducted at a tertiary-care hospital in Quetta, Pakistan, from July to December 2025. Ethical approval was obtained from the Quetta Institute of Medical Sciences, Quetta, before initiation of participant recruitment. The study population comprised adults with established hypertension, type 2 diabetes mellitus, or both conditions who attended the study setting during the recruitment period.

Participants were recruited using a non-probability convenience sampling technique. Individuals were eligible if they had hypertension alone, type 2 diabetes mellitus alone, or concurrent hypertension and type 2 diabetes mellitus and were able to participate in the awareness assessment. Participation was voluntary, and informed consent was obtained before data collection. A total of 210 participants were included in the final analysis.

The study collected information regarding age, sex, place of residence, education, income, marital status, clinical diagnosis, duration of hypertension and diabetes where applicable, family history of stroke, personal acquaintance with someone who had experienced stroke, smoking, obesity, dyslipidaemia, heart disease, previous transient ischaemic attack, source of stroke-related information, recognition of warning signs and risk factors, and intended action during suspected stroke.

Stroke warning-sign awareness was assessed using 10 items: unilateral weakness, speech difficulty, sudden dizziness, difficulty walking, loss of balance or coordination, severe headache, fainting, vision loss, double vision, and confusion or memory loss. Each correctly recognized item contributed one point, producing a score from 0 to 10. The total was converted into a percentage.

Risk-factor awareness was assessed using 12 items: hypertension, diabetes mellitus, smoking, obesity, physical inactivity, older age, high cholesterol, stress, excessive alcohol consumption, family history, heart disease, and sex. Each correctly identified risk factor contributed one point, yielding a score from 0 to 12, which was converted into a percentage. The warning-sign and risk-factor percentages were combined into a composite stroke-awareness percentage. Based on the study scoring structure, composite awareness was classified as poor at <40%, moderate at 40% to <55%, and good at ≥55%.

Intended response to suspected stroke was assessed because knowledge of warning symptoms does not always correspond to appropriate emergency action, particularly among patients with chronic vascular disease (22-24). Response options included going directly to hospital, calling an ambulance followed by hospital care, waiting for spontaneous recovery, using an alternative remedy or rest, and not knowing how to respond.

Data were analysed using IBM SPSS Statistics version 26.0. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized using mean ± standard deviation and, where appropriate, median and interquartile range. Welch's independent-samples t-test and one-way analysis of variance were used for comparisons of mean awareness scores. Pearson's chi-square test assessed associations involving categorical awareness groups, and Cramér's V was used to quantify the strength of selected associations. Pearson correlation analysis was used to evaluate relationships between continuous measures.

Multiple linear regression was performed using composite awareness percentage as the dependent variable. Age, sex, residence, education, income, clinical group, family history of stroke, knowing someone with stroke, and main source of information were included in the adjusted model. Regression coefficients were reported with 95% confidence intervals and p-values. Statistical significance was set at $p<0.05$.

RESULTS

A total of 210 participants were included, with a mean age of 55.54 ± 11.86 years. Women comprised 61.0% of the sample, 65.2% were urban residents, and 53.8% had at least secondary education. Hypertension alone was present

in 37.6%, type 2 diabetes mellitus alone in 21.0%, and both conditions in 41.4%. Nearly half of participants (47.6%) personally knew someone who had experienced stroke (Table 1).

Table 1. Sociodemographic and Clinical Characteristics of Participants (N = 210)

Characteristic	Category	n (%)
Age, years	Mean ± SD	55.54 ± 11.86
Sex	Female	128 (61.0)
	Male	82 (39.0)
Residence	Urban	137 (65.2)
	Rural	73 (34.8)
Education	No formal education	27 (12.9)
	Primary	70 (33.3)
	Secondary	68 (32.4)
	College or above	45 (21.4)
Income	Low	72 (34.3)
	Middle	101 (48.1)
	High	37 (17.6)
Clinical group	Hypertension only	79 (37.6)
	Type 2 diabetes only	44 (21.0)
	Hypertension + diabetes	87 (41.4)
Family history of stroke	Yes	59 (28.1)
Knows someone with stroke	Yes	100 (47.6)
Current smoking	Yes	27 (12.9)
Obesity	Yes	83 (39.5)
Dyslipidaemia	Yes	68 (32.4)
Heart disease	Yes	29 (13.8)
Previous TIA	Yes	11 (5.2)

Mean warning-sign awareness was 40.90 ± 19.60%, mean risk-factor awareness was 48.89 ± 15.85%, and mean composite awareness was 44.90 ± 14.34%. Unilateral weakness (58.1%) and speech difficulty (51.9%) were the most frequently recognized warning signs. Confusion or memory loss (25.7%) and double vision (27.6%) were least recognized. Hypertension was the best-recognized stroke risk factor (79.5%), followed by diabetes mellitus (59.5%) and smoking (55.7%). Awareness was lowest for sex (28.1%), heart disease (31.0%), and family history of stroke (39.5%) (Table 2).

Table 2. Recognition of Stroke Warning Signs and Risk Factors

Awareness item	Recognized, n (%)
Warning signs	
Unilateral weakness	122 (58.1)
Speech difficulty	109 (51.9)
Sudden dizziness	98 (46.7)
Trouble walking	93 (44.3)
Loss of balance or coordination	91 (43.3)
Severe headache	82 (39.0)
Fainting	77 (36.7)
Vision loss	75 (35.7)
Double vision	58 (27.6)
Confusion or memory loss	54 (25.7)
Risk factors	
Hypertension	167 (79.5)
Diabetes mellitus	125 (59.5)
Smoking	117 (55.7)
Obesity	111 (52.9)
Physical inactivity	106 (50.5)
Older age	104 (49.5)
High cholesterol	100 (47.6)
Stress	99 (47.1)
Excess alcohol consumption	96 (45.7)
Family history	83 (39.5)
Heart disease	65 (31.0)
Sex	59 (28.1)

Awareness scores: warning signs, 40.90 ± 19.60%; risk factors, 48.89 ± 15.85%; composite awareness, 44.90 ± 14.34%.

Overall, 79 participants (37.6%) had poor awareness, 81 (38.6%) had moderate awareness, and only 50 (23.8%) had good awareness. Friends and family were the most common source of stroke information (39.5%), whereas only 21.4% identified a healthcare professional as their main information source. Although 181 participants (86.2%) indicated that they would seek hospital care for suspected stroke, only 52 (24.8%) reported that they would call an ambulance. Awareness category was not significantly associated with intended emergency response ($\chi^2 = 4.96$, df = 8, p = 0.762). Mean composite awareness also did not differ significantly among participants with hypertension alone, diabetes alone, or both conditions (p = 0.700) (Table 3).

Table 3. Overall Awareness, Information Source, Emergency Response, and Clinical Group

Variable	Category	n (%) or Mean %
Awareness category	Poor	79 (37.6)
	Moderate	81 (38.6)
	Good	50 (23.8)
Main information source	Friends/family	83 (39.5)
	Television/radio/social media	52 (24.8)
	Health professional	45 (21.4)
	No previous information	30 (14.3)
Intended response	Go directly to hospital	129 (61.4)
	Call ambulance then hospital	52 (24.8)
	Wait/recover	12 (5.7)
	Alternative remedy/rest	9 (4.3)
	Do not know	8 (3.8)
Composite awareness by clinical group	Hypertension only	43.85
	Diabetes only	45.17
	Hypertension + diabetes	45.71

Clinical-group comparison: one-way ANOVA, p = 0.700. Association between awareness category and intended response: $\chi^2 = 4.96$, df = 8, p = 0.762.

In bivariate analyses, mean composite awareness was higher among urban than rural participants (47.4% vs 40.1%, p<0.001), increased across educational categories from 39.0% among participants with no formal education to 51.4% among those with college-level education or above (p<0.001), and was higher among participants who personally knew someone with stroke (47.6% vs 42.5%, p = 0.010). Income was also associated with awareness (p = 0.044). Increasing age was inversely correlated with composite awareness (r = -0.275, p<0.001), whereas duration of hypertension (r = -0.091, p = 0.244) and diabetes (r = 0.048, p = 0.583) showed no significant correlations. Warning-sign and risk-factor awareness were positively correlated (r = 0.301, p<0.001).

Table 4. Independent Predictors of Composite Stroke Awareness

Predictor	Adjusted B	95% CI	p-value
Age, per year	-0.30	-0.46 to -0.13	<0.001
Male sex	-0.42	-4.11 to 3.26	0.822
Urban residence	7.36	3.58 to 11.14	<0.001
No formal education vs college+	-8.69	-15.04 to -2.34	0.007
Primary education vs college+	-8.30	-13.18 to -3.41	<0.001
Secondary education vs college+	-2.08	-6.89 to 2.73	0.396
Low income vs high	-3.68	-8.68 to 1.32	0.149
Middle income vs high	-6.42	-11.17 to -1.68	0.008
Hypertension only vs HTN + DM	0.20	-3.85 to 4.25	0.922
Diabetes only vs HTN + DM	0.96	-3.49 to 5.40	0.673
Family history of stroke	0.73	-3.30 to 4.75	0.723
Knows someone with stroke	4.17	0.64 to 7.69	0.021
Health professional vs friends/family	3.30	-1.47 to 8.07	0.175
No previous information vs friends/family	-2.12	-7.34 to 3.10	0.426
Television/media vs friends/family	2.67	-2.30 to 7.63	0.293

Dependent variable: composite stroke-awareness percentage. Model $R^2 = 0.274$; adjusted $R^2 = 0.218$; overall p<0.001. Reference categories were female sex, rural residence, college-level education or above, high income, hypertension plus diabetes, no family history of stroke, not personally knowing someone with stroke, and friends/family as the information source. HTN, hypertension; DM, diabetes mellitus.

The multiple linear regression model was significant ($R^2 = 0.274$; adjusted $R^2 = 0.218$; overall p<0.001). Increasing age independently predicted lower awareness (B = -0.30 per year, 95% CI -0.46 to -0.13), while urban residence predicted

a 7.36-point higher composite score (95% CI 3.58 to 11.14). Compared with participants with college-level education or above, those with no formal education and primary education had lower adjusted awareness scores by 8.69 and 8.30 points, respectively. Personally knowing someone with stroke was associated with a 4.17-point higher awareness score. Clinical group, sex, family history of stroke, and main source of stroke information were not independently associated with composite awareness (Table 4).

DISCUSSION

The present study identified substantial deficiencies in stroke awareness among patients who were already living with hypertension, type 2 diabetes mellitus, or both conditions. Mean composite awareness was 44.9%, fewer than one quarter of participants achieved good awareness, and recognition of warning signs was poorer than recognition of risk factors. These findings are important because hypertension and diabetes are established contributors to stroke risk, yet their presence did not appear to ensure that patients possessed adequate knowledge of stroke prevention or acute presentation (1,4-6).

The magnitude of the awareness deficit is broadly consistent with recent studies conducted among high-risk patients. Tuli et al. reported mean knowledge scores of 44.1% for stroke risk factors and 49.7% for prevention among hypertensive patients attending an Ethiopian tertiary hospital (13). These values are closely comparable to the 48.9% mean risk-factor awareness observed in the present study. Ghimire and Acharya also found that most hypertensive patients in a Nepalese tertiary hospital had fair rather than good stroke awareness (14). More recently, Gosse et al. found that fewer than half of hypertensive participants had adequate knowledge of either risk factors or warning signs (25). Collectively, these findings indicate that inadequate stroke knowledge among high-risk patients is not confined to one healthcare system or country.

Risk-factor recognition in the present study showed a clear hierarchy. Hypertension was correctly identified by 79.5% of participants, followed by diabetes mellitus, smoking, obesity, and physical inactivity, whereas heart disease, family history, and sex were substantially less frequently recognized. Similar patterns have been reported in Pakistan and other recent studies. Mumtaz et al. identified hypertension as the most frequently recognized risk factor in a Rawalpindi tertiary-care population (18), while a recent study among diabetic patients in Saudi Arabia identified hypertension, smoking, diabetes, and hypercholesterolaemia among the best-recognized risk factors (19). A 2025 study involving acute stroke patients also found better awareness of hypertension and diabetes than sedentary lifestyle, obesity, or family history (28). These findings suggest that public messaging may emphasize selected vascular factors while leaving patients with an incomplete understanding of the broader stroke-risk profile.

The warning-sign results were more concerning. Only 58.1% recognized unilateral weakness and 51.9% recognized speech difficulty, while recognition of double vision and confusion or memory loss was below 30%. In Rawalpindi, sudden weakness was also recognized more frequently than visual symptoms (18). Similarly, hospital-based studies from India have reported substantial deficiencies in warning-sign knowledge, even when participants were relatively more familiar with hypertension and other risk factors (20,23). In contrast, Alkhalifah et al. reported recognition of unilateral weakness and speech difficulty above 80% among diabetic patients in Saudi Arabia (19). The difference between these populations indicates that substantially better awareness is achievable and may depend on structured education, healthcare communication, and population health literacy.

The present findings also support the distinction between risk-factor knowledge and warning-sign recognition. Mean risk-factor awareness exceeded warning-sign awareness, and the two domains were only moderately correlated. Other investigators have reported similar discrepancies, with patients demonstrating greater familiarity with chronic risk factors than with the acute manifestations that require urgent intervention (20,23,29). This distinction has clinical importance because prevention-oriented counselling alone may not prepare patients to respond appropriately if stroke occurs.

One of the strongest determinants of awareness was educational attainment. Participants with no formal education had an adjusted awareness score 8.69 percentage points lower than those with college-level education or above, and primary education was associated with an 8.30-point deficit. Recent studies support this relationship. Educational level was significantly related to stroke knowledge in hypertensive populations in Ethiopia and Nepal (13,14), diabetic populations in Saudi Arabia (19,30), and hypertensive patients in Tanzania and Morocco (25,26).

Education may influence health literacy, access to written and digital information, ability to interpret clinical counselling, and confidence in navigating health services. These mechanisms were not directly tested in the present study, but they provide plausible explanations for the consistent educational gradient observed across settings.

Residence was another independent determinant. Urban participants had approximately 7.4 percentage points higher adjusted awareness than rural participants. Similar associations have been demonstrated in hypertensive populations in Ethiopia, Nepal, Tanzania, and Morocco (13,14,25,26). A 2024 Vietnamese study involving family members of stroke patients also found better warning-sign and risk-factor knowledge among residents of an urban centre compared with participants living elsewhere (31). Rural disadvantage may therefore reflect differences in access to healthcare, educational resources, mass media, internet connectivity, specialist services, and repeated preventive counselling.

Increasing age was independently associated with poorer awareness. This finding is clinically important because older adults have increasing vascular risk and may therefore have greater need for rapid recognition of stroke symptoms. Recent studies have reported associations between age and stroke knowledge, although the direction has not been uniform across populations (19,22,26,31). In some settings, younger participants demonstrated better symptom knowledge, while other studies found higher awareness among older diabetic patients with greater cumulative healthcare exposure (19,31). Variation across studies may reflect differences in educational attainment, disease duration, healthcare contact, instrument design, and social context. In the present population, however, older age remained independently associated with lower awareness after adjustment for multiple covariates.

Personally knowing somebody who had experienced stroke was associated with an adjusted 4.17-percentage-point increase in awareness. Similar findings have been reported among hypertensive patients in Tanzania, where previous exposure to a person with stroke was strongly associated with knowledge of warning signs (25), and among patients with diabetes or hypertension in other settings where family history or prior exposure improved awareness (19,26,30). Direct observation of sudden neurological deficits, hospitalization, disability, or rehabilitation may make stroke information more salient. Nevertheless, reliance on experiential learning is inadequate for prevention because knowledge should ideally be established before a stroke occurs within the patient's family or social network.

The discrepancy between hospital-seeking intention and ambulance activation was one of the most clinically important findings. Although 86.2% reported that they would seek hospital care, only 24.8% would call an ambulance. Ananchaisarp and Sa-a reported a remarkably similar figure, with only 22.8% of hypertensive or diabetic patients indicating that they would immediately use an ambulance for suspected stroke (22). Deepthi et al. found that knowledge of ambulance services and stroke helplines remained limited despite broader recognition that stroke required urgent treatment (20). Lawrence and Wilson also identified poor knowledge of appropriate emergency response and treatment timelines in a hospital-based population (29). These studies support the interpretation that awareness of the need for hospital treatment is not equivalent to understanding the urgency or preferred route of emergency care.

This distinction is important because delays in emergency response can reduce access to time-dependent acute stroke interventions. Patient education should therefore connect recognition of sudden neurological symptoms directly with immediate emergency action rather than treating warning-sign knowledge and healthcare-seeking behaviour as separate topics (20,22-24). Chronic-disease clinics offer an opportunity to repeat a simple sequence: recognize sudden neurological deficits, treat the event as an emergency, and activate emergency medical services without waiting for spontaneous improvement.

Another notable finding was the absence of significant differences in awareness among participants with hypertension alone, diabetes alone, or both conditions. Similarly, disease duration was not significantly correlated with composite awareness. These results suggest that greater clinical burden or longer disease duration does not automatically generate better stroke knowledge. Mujamammi et al. evaluated stroke knowledge specifically among hypertensive and diabetic patients in a tertiary hospital and demonstrated that important knowledge gaps persisted within this high-risk population (32). Paramasivam et al. likewise found continuing educational needs among hypertensive and diabetic follow-up patients attending non-communicable disease clinics (21). The present

findings therefore support deliberate stroke education rather than assuming that repeated chronic-disease follow-up provides sufficient knowledge.

The pattern of information sources also deserves attention. Friends and family were the dominant source of stroke information, while only 21.4% of participants identified a healthcare professional as their main source. Similar reliance on informal information networks has been documented in previous awareness studies, while healthcare professionals often account for only a proportion of stroke-related knowledge acquisition (28,30). This represents a potentially modifiable gap because patients with hypertension and diabetes have repeated contact with clinicians and therefore multiple opportunities to receive standardized, evidence-based counselling.

The regional context strengthens the relevance of these findings. Recent Pakistani studies continue to demonstrate a high prevalence of hypertension, diabetes, smoking, dyslipidaemia, and other modifiable factors among patients presenting with stroke (7-10,33). In Quetta, Farooq et al. reported relatively high stroke awareness among university students but acknowledged the limitations arising from an educated study population (27). The current findings extend the local evidence by focusing on patients with established cardiometabolic disease and demonstrate that awareness in a clinically high-risk population may be considerably lower than awareness reported in educated community groups.

The study has several strengths. It assessed warning signs, risk factors, emergency response, information sources, and multiple potential sociodemographic determinants within a single high-risk population. It also incorporated adjusted regression analysis rather than relying solely on descriptive comparisons. This allowed identification of independent associations involving age, residence, education, and previous personal exposure to stroke.

Several limitations should be acknowledged. The cross-sectional design permits assessment of associations but cannot establish temporal or causal relationships. Convenience sampling and recruitment from a single tertiary-care hospital may limit generalizability to all patients with hypertension and diabetes in Quetta or other regions of Pakistan. Recognition-based questions may overestimate knowledge compared with open-ended recall, while intended emergency responses may differ from behaviour during an actual event. The composite awareness score also assigns equal weighting to individual warning signs and risk factors, although their clinical implications differ. Similar methodological limitations are common in cross-sectional stroke-awareness research and should be considered when comparing prevalence estimates between studies (13,18-23,25,26).

Despite these limitations, the findings identify clear opportunities for intervention. Education should focus particularly on older adults, rural patients, and individuals with limited formal education, as these groups demonstrated lower awareness. Contemporary studies in hypertensive and diabetic populations consistently support targeted education based on educational attainment, residence, and previous exposure to stroke (13,14,19,21,25,26,32). Routine hypertension and diabetes visits should therefore incorporate brief, repeated, health-literacy-sensitive messages covering vascular risk, the major acute warning signs, and immediate activation of emergency services.

CONCLUSION

Stroke awareness was suboptimal among patients with hypertension and/or type 2 diabetes mellitus attending a tertiary-care hospital in Quetta, despite their established vascular risk. Fewer than one quarter achieved good overall awareness, and recognition of acute warning signs was poorer than recognition of risk factors. Although most participants intended to seek hospital care, only one quarter would activate ambulance services. Older age and limited education were associated with poorer awareness, whereas urban residence and personally knowing someone with stroke were associated with greater knowledge. These findings support integrating structured, health-literacy-sensitive stroke education into routine hypertension and diabetes care, with particular emphasis on warning-sign recognition and immediate emergency response.

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