



Knowledge of ischemic stroke symptoms among healthcare professionals based on healthcare levels in an upper middle-income country: A cross-sectional questionnaire study in greater Gaborone, Botswana

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Abstract

Objectives: In this cross-sectional study from Botswana, we investigated awareness and knowledge of ischemic stroke symptoms among healthcare professionals based on healthcare levels.

Method: Questionnaires including five common stroke symptoms and three detractors were administered to a representative selection of doctors, nurses, and paramedics working in both government and private primary and secondary healthcare facilities. The response rate was 61.4% (344/560), comprising 84 doctors, 227 nurses and 33 paramedics. Of all respondents, 174 were from primary healthcare (50.6%) while 218 were females (65.1%).

Results: Overall, 83% recognized at least 80% of stroke symptoms. Awareness rate of numbness or weakness in the face, arms, or legs especially on one side of the body

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was highest (93.3%) while severe headache of no known cause was the lowest (77.3%). Healthcare levels and other demographic factors had no influence on awareness of stroke symptoms.

Clinical experience influenced knowledge of stroke symptoms among all healthcare professionals in secondary healthcare, due to those with >1-5.0 years' having higher knowledge score than >5-10.0 years' experience (4.71 vs 3.90, $p=0.039$). Also, among doctors, those with clinical experience 0-1.0 year had higher knowledge than those with 5.1-10.0 years' (5.00 vs 3.95, $p=0.010$), and 10.1-15.0 years' (5.00 vs 4.05, $p=0.041$). Education level influenced knowledge of stroke among paramedics, bachelor's degree holders had higher knowledge than certificate holders (5.00 vs 4.10, $p=0.009$). Region influenced knowledge of stroke among primary healthcare nurses, those in urban areas demonstrated higher knowledge than those in rural areas (4.79 vs 4.10, $p=0.001$).

Conclusion: There is adequate awareness and knowledge of stroke symptoms among healthcare levels and professionals. Subgroups that demonstrated lower knowledge, achieved about 70%, which is still adequate. Therefore, future studies should focus on knowledge and resources in other areas related to stroke management if we are to reduce the burden of stroke.

Introduction

Stroke is the second largest cause of death and Disability-Adjusted Life-Years (DALYs) lost globally, and the incidence is increasing. A recent study reported an increase in DALYs from 95.3 million in 1990 to 116.4 million in 2016 [1]. There were 13.7 million new stroke cases in 2016 compared to 10.3 million cases in 2013 [1-2] and according to the World Stroke Society, one in six people in the world will suffer a stroke in their lifetime [3].

The stroke incidence decreased in most regions from 1990 to 2016, while it increased in east Asia and Southern Sub-Saharan Africa (SSA) [1]. Stroke mortality rates declined for all regions except for SSA, which did not change significantly (in 2010, 71% of 5.9 million were from Low- and Middle-Income Countries (LMIC)) [1-2] resulting in a greater number of years of potential life lost [4]. Low- and Middle-Income Countries (LMIC) have undergone an epidemiological transition from infectious to non-communicable diseases including stroke as the main cause of morbidity [5]. Africa faces a big challenge of specialists in neurology compared to other regions as reported by World Health Organization (WHO); the median number of neurologists per 100,000 population in Africa is 0.03 vs. 0.07 in Southeast Asia, 0.32 in the Eastern Mediterranean, 0.77 in the Western Pacific, 0.89 in the Americas, and 4.84 in Europe [6].

Thrombolysis has been shown to be an effective treatment for acute ischemic stroke within 4.5 hours of onset of ischemic stroke, improving clinical outcome, which encompasses reducing mortality and dependency in DALYs [7-9]. Therefore, understanding and recognizing stroke symptoms by healthcare professionals is important in early diagnosis to start or transfer patients to the right hospitals for treatment since therapy is time dependent. Botswana just like other resource-constrained LMICs has shortage of healthcare professionals and resources as described by some previous studies [6,10-12].

In this study from Botswana, our objectives were:

1. To assess awareness and knowledge of ischemic stroke symptoms among healthcare professionals (medical doctors, nurses, and paramedics) based on healthcare levels.
2. To assess if demographic factors influence awareness and knowledge of ischemic stroke symptoms.

Methods

Study design and setting

The study recruited participants from greater Gaborone, Botswana. It purposively sampled a variety of healthcare professionals involved in the diagnosis, treatment, and management of diseases, including medical doctors, nurses and paramedics working in primary and secondary healthcare facilities in urban areas and rural/semi-urban areas to diversify representation. Medical doctors included general doctors, family medicine specialists and hospital specialist doctors. Administrative or other healthcare professionals whose roles are not directly involved in the provision of disease prevention, diagnosis or management were excluded. Respondents were categorized based on the following demographic characteristics: Gender (male and female), age (20-35 years and over 35 years), clinical experience (0-1, >1.0-5.0, >5.0-10.0, >10.0-15, and >15 years), education (certificate, diploma, bachelor's degree, and master's degree), region (urban and rural), healthcare sector (government and private), and healthcare level (primary and secondary).

Healthcare level was divided into primary healthcare and secondary healthcare in a resource-constrained setting. Primary healthcare refers to first line of healthcare for patients, and includes medical health clinics for outpatients, run by nurses and/ or medical doctors, but cannot admit patients. District Health Management Team (DHMT) in every district runs all public health clinics. Primary healthcare comprised all six DHMTs in greater Gaborone (Southeast, Kweneng, Lobatse, Gaborone, Ngwaketse, and Kgatleng). We considered paramedics as part of primary healthcare in this study. Paramedics were recruited from government emergency services, and 3 private emergency services (Boitekanelo Emergency, Emergency Assist, and MedRescue services). Secondary healthcare comprises of hospital healthcare staff (general doctors and some specialists (internal medicine, general surgery), nurses, laboratory technicians, etc.), and can admit patients. It included five district hospitals (Bamalete Lutheran Hospital, Deborah Retief Memorial Hospital, Lobatse Athlone Hospital, Thamaga District Hospital, and Kanye Seventh-day Adventist Hospital) and one private tertiary hospital (Bokamoso hospital). All these are academic institutions for nurses and paramedics, but none of them for doctors as the country did not have any by then.

Ethical statement

The study was approved by the Ethics Committee of the University of Botswana, Ministry of Health and Wellness in Botswana, Health Research and Development Division (ref. no. HPDME: 13/18/1) and exempted by the Regional Ethics Committee, South East, section D (ref. 2017/2169), Norway.

Sampling and recruitment

We employed a purposively sampling technique to recruit at least 50% respondents in each cadre in each primary and secondary healthcare facility from 1st July to 31st October 2018. All healthcare study sites were formally contacted, and their

participation solicited using an official letter of invitation with information about the study and all ethical approval letters. Eligible respondents in each study site were invited and contacted directly using official letter, those willing to participate were informed about the study and their written consent solicited before filling out the questionnaires.

Data collection instrument

The survey instruments were adapted from previous surveys [13-14] with some modifications. The instruments were anonymous, paper-based, structured questionnaires written and administered in English. Questions were mostly closed-ended in nature. Questions were developed to reflect the recent American Heart Association/American Stroke Association (AHA/ASA) guidelines and European Stroke Organization guidelines [15-16]. The survey questionnaires were physical delivered to healthcare professionals in clinics and hospitals in greater Gaborone. The questionnaire was divided into 2 sections (eFigure 1). Section 1 comprised demographic factors of respondents.

Section 2 comprised awareness of five stroke symptoms: Numbness or weakness in the face, arms, or legs especially on one side of the body; difficulty speaking or understanding speech; severe headache with no known cause; dizziness, loss of balance or coordination; and vision disturbances in one or both eyes. In addition, three detractors, chest pain, breathing difficulties, and nausea were added to avoid respondents crossing all answers correct for convenience.

We defined awareness as the awareness rate of recognizing each individual stroke symptom, while we defined knowledge as mean score of total recognized stroke symptoms out of five. Each correct answer scored 1 point, and each incorrect, unanswered, or unknown answer scored 0 point, giving a maximum score of 5 points for stroke symptoms and 3 points for detractors. Recognizing each stroke symptom/ detractor was considered being aware, otherwise unaware.

Statistical analysis

Continuous and normally distributed variables were expressed as mean \pm Standard Deviation (SD). Categorical data were described using frequency and percentages. The total number of respondents who filled out and returned the consented questionnaire was the denominator for all proportion calculations. Missing data under sub-/groups were not included in calculations.

We used Chi-square tests to compare awareness rates among healthcare professionals, care levels and other demographic factors. One-way ANOVA analysis (with Bonferroni for Post Hoc test if equal variance assumed, otherwise Games-Howell) was used to test for associations between stroke symptoms' knowledge and demographic factors. If data was not normal distributed, Mann-Whitney U or Kruskal Wallis H was used. Bonferroni correction was used for multiple comparisons. Two-sided P-values <0.05 were considered statistically significant. All statistical analyses were completed using SPSS 25 statistical software (SPSS Inc., Chicago, Illinois, USA).

Results

Participants' demographics

Out of 560 questionnaires distributed, 344 were returned giving a valid response of 61.4%. Two hundred and sixteen respondents did not consent or participate for unknown reasons

(eFigure 2). Of the 344 healthcare professionals, 174 respondents (50.6%) were from primary healthcare, aged between 22–58 years, with mean age of 36.7 ± 8.9 years, and comprising of 108 females (63.2%). One hundred and seventy (49.4%) were from secondary healthcare, aged 23-67 years, with mean age of 37.3 ± 9.2 years, and comprising of 110 females (67.1%). Further demographic details for respondents are shown in Table 1.

Table 1: Demographic characteristics for healthcare professionals based on healthcare levels.

	Primary healthcare	Secondary healthcare	Total
	n=174	n=170	n=344
	n (%)	n (%)	n (%)
<i>Profession</i>			
Doctors	40 (23.0)	44 (25.9)	84 (24.4)
Nurses	101 (58.0)	126 (74.1)	227 (66.0)
Paramedics	33 (19.0)	0 (0.0)	33 (9.6)
<i>Gender</i>	(missing 3)	(missing 6)	(missing 9)
Male	63 (36.8)	54 (32.9)	117 (34.9)
Female	108 (63.2)	110 (67.1)	218 (65.1)
<i>Age (years)</i>	(missing 30)	(missing 33)	(missing 63)
20-35	76 (52.8)	73 (53.3)	149 (53.0)
Over 35	68 (47.2)	64 (46.7)	132 (47.0)
<i>Region</i>			
Rural	109 (62.6)	132 (77.6)	241 (70.1)
Urban	65 (37.4)	38 (22.4)	103 (29.9)
<i>Education level</i>			
Certificate	20 (11.5)	1 (0.6)	21 (6.1)
Diploma	92 (52.9)	94 (55.3)	186 (54.1)
Bachelor's degree	53 (30.5)	66 (38.8)	119 (34.6)
Master's degree	9 (5.2)	9 (5.3)	18 (5.2)
<i>Clinical experience (years)</i>	(missing 15)	(missing 8)	(missing 23)
0 -1.0	9 (5.7)	10 (6.2)	19 (5.9)
>1.0-5.0	38 (23.9)	37 (22.8)	75 (23.4)
>5.0-10.0	37 (23.3)	40 (24.7)	77 (24.0)
>10.0-15.0	34 (21.4)	32 (19.8)	66 (20.6)
>15.0	41 (25.8)	43 (26.5)	84 (26.2)
<i>Sector</i>			
Government	139 (79.9)	165 (97.1)	304 (88.4)
Private	35 (20.1)	5 (2.9)	40 (11.6)
<i>District</i>			
Gaborone	63 (36.2)	0 (0)	63 (18.3)
Kgatleng	0 (0)	22 (12.9)	22 (6.4)
Southeast	32 (18.4)	57 (33.5)	89 (25.9)
Kweneng	38 (21.8)	24 (14.1)	62 (18.0)
Ngwaketse	40 (23.0)	34 (20.0)	74 (21.5)
Lobatse	1 (0.6)	33 (19.4)	34 (9.9)

Awareness of ischemic stroke symptoms and detractors

There were no significant awareness differences for stroke symptoms among all 3 healthcare professions (Table 2). Awareness rate was highest for numbness or weakness in the face, arms, or legs especially on one side of the body (93.3%), and lowest for severe headache with no known cause (77.3%).

Each healthcare profession had highest awareness rate for numbness or weakness in the face, arms, or legs especially on one side of the body (doctors 94.0%, nurses 93.0%, and paramedics 93.9%). Doctors and paramedics had lowest awareness

rates for vision disturbances in one or both eyes (79.8% and 75.8% respectively). Nurses and paramedics had lowest awareness rates for severe headache with no known cause (76.2% and 75.8% respectively).

For all-3 healthcare professionals, awareness of detractor, nausea, was highest (52.3%), and lowest for chest pain (36.0%). There were significant awareness differences for chest pain as a detractor, with doctors highest, followed by paramedics and lowest nurses (63.1% vs 36.4% vs 26.0%, $p=0.007$), due to differences between doctors and nurses ($p=0.002$).

Table 2: Awareness of stroke symptoms and detractors among healthcare professions.

	Doctors	Nurses	Paramedics	Total	
	n=84	n=227	n=33	n=344	
	n (%)	n (%)	n (%)	n (%)	p
<i>Symptoms</i>					
Numbness or weakness in the face, arms or legs especially on one side of the body	79 (94.0)	211 (93.0)	31 (93.9)	321 (93.3)	0.998
Difficulty speaking or understanding speech	78 (92.9)	197 (86.8)	29 (87.9)	304 (88.4)	0.939
Severe headache with no known cause	68 (81.0)	173 (76.2)	25 (75.8)	266 (77.3)	0.954
Dizziness, loss of balance or coordination	72 (85.7)	196 (86.3)	28 (84.8)	296 (86.0)	0.998
Vision disturbances in one or both eyes	67 (79.8)	181 (79.7)	25 (75.8)	273 (79.4)	0.985
<i>Detractors</i>					
Breathing difficulties	44 (52.4)	80 (35.2)	12 (36.4)	136 (39.5)	0.348
Chest pain	53 (63.1)	59 (26.0)	12 (36.4)	124 (36.0)	0.007
Nausea	40 (47.6)	129 (56.8)	11 (33.3)	180 (52.3)	0.368

Healthcare levels and other demographic factors' influence on awareness of ischemic stroke symptoms

Healthcare levels had no significant influence on awareness of stroke symptoms or detractors among healthcare professionals (Table 3). For all 3 healthcare professionals in primary healthcare, awareness rate was highest for numbness or weakness in the face, arms, or legs especially on one side of the body (94.3%), and lowest for severe headache with no known cause (75.2%). For secondary healthcare, awareness was highest for numbness or weakness in the face, arms, or legs especially on one side of the body (92.4%), and lowest for vision disturbances in one or both eyes (76.5%).

For primary healthcare, each profession had highest awareness rate for numbness or weakness in the face, arms, or legs especially on one side of the body (doctors 92.5%, nurses 95.0%, and paramedics 93.9%). Doctors and nurses had lowest awareness rates for severe headache with no known cause (77.5% and 74.3% respectively). For paramedics, lowest awareness rates were the same as for total paramedics as described in Table 2 since all paramedics were from primary healthcare.

Similarly, for secondary healthcare, doctors and nurses had highest awareness rates for numbness or weakness in the face, arms, or legs especially on one side of the body (95.5% and 91.3% respectively). In addition, doctors had also highest awareness for confusion, difficulty speaking or understanding speech (95.5%). Doctor and nurses had lowest awareness rates for vision disturbances in one or both eyes (77.3% and 76.2% respectively).

Table 3: Awareness of ischemic stroke symptoms by healthcare levels among respondents.

	All healthcare professions*			Doctors		p
	Primary healthcare	Secondary healthcare		Primary healthcare	Secondary healthcare	
	n=141	n=170		n=40	n=44	
	%	%	p	%	%	p
<i>Symptoms</i>						
Numbness or weakness in the face, arms or legs especially on one side of the body	94.3	92.4	0.899	92.5	95.5	0.921

Confusion, difficulty speaking or understanding speech	85.8	90.6	0.752	90.0	95.5	0.855
Severe headache with no known cause	75.2	79.4	0.765	77.5	84.1	0.812
Dizziness, trouble walking, loss of balance or coordination	83.7	88.2	0.761	80.0	90.9	0.702
Vision disturbances in one or both eyes	83.7	76.5	0.617	82.5	77.3	0.850
<i>Detractors</i>						
Breathing difficulties	37.6	41.8	0.681	50.0	54.5	0.839
Chest pain	35.5	36.5	0.917	57.5	68.2	0.662
Nausea	53.9	54.7	0.946	47.5	47.7	0.991
*: between doctors and nurses						
	Nurses			Paramedics		
	Primary healthcare	Secondary healthcare		Primary healthcare	Secondary healthcare	
	n=101	n=126		n=33	NA	
	%	%	<i>p</i>	%	%	<i>p</i>
<i>Symptoms</i>						
Numbness or weakness in the face, arms or legs especially on one side of the body	95.0	91.3	0.836	93.9	NA	NA
Confusion, difficulty speaking or understanding speech	84.2	88.9	0.788	87.9	NA	NA
Severe headache with no known cause	74.3	77.8	0.831	75.8	NA	NA
Dizziness, trouble walking, loss of balance or coordination	85.1	87.3	0.902	84.8	NA	NA
Vision disturbances in one or both eyes	84.2	76.2	0.637	75.8	NA	NA
<i>Detractors</i>						
Breathing difficulties	32.7	37.3	0.679	36.4	NA	NA
Chest pain	26.7	25.4	0.890	36.4	NA	NA
Nausea	56.4	57.1	0.960	33.3	NA	NA
NA: not applicable						

Other demographic factors had no significant influence on awareness of stroke symptoms or detractors among healthcare professionals (eTable 1, eTable 2, eTable 3, and eTable 4).

Demographic influence on knowledge of ischemic stroke symptoms

Two hundred and fourteen healthcare professionals (62.2 %) correctly recognized all five ischemic stroke symptoms, while 5.2% recognized none (Figure 1). Among primary healthcare professionals, 60.9% correctly recognized all five stroke symptoms and 4.6% recognized none. The corresponding numbers among secondary healthcare respondents, were 63.5% and 5.9% (Figure 2). Among primary healthcare doctors, 62.5% recognized all five symptoms and 7.5% recognized none, while 72.7% recognized all five symptoms and 4.5% none among secondary healthcare doctors (eFigure 3). For primary healthcare nurses, 59.4% recognized all five symptoms and 3.0% none, while 60.3% recognized all five symptoms and 6.3% none among secondary healthcare nurses (eFigure 4).

There were no significant knowledge differences between healthcare professionals (eTable 5). Clinical experience influenced knowledge of stroke symptoms among all healthcare professionals in secondary healthcare, due to those with >1-5.0 years' having higher knowledge than >5-10.0 years' experience (4.71 vs 3.90, $p=0.039$). Also, among doctors, those with clinical experience 0-1.0 year had significantly higher knowledge of stroke symptoms than those with 5.1-10.0 years (5.00 vs 3.95, $p=0.010$), and 10.1-15.0 years (5.00 vs 4.05, $p=0.041$). For primary healthcare doctors, those with >15 years' clinical experience

had higher knowledge than those with >10-15.0 years' experience (5.00 vs 3.40, $p=0.040$). Education level influenced knowledge of stroke among paramedics, with bachelor's degree holders having higher knowledge than certificate holders (5.00 vs 4.10, $p=0.009$). Region influenced knowledge of stroke among primary healthcare nurses, with those in urban areas showing higher knowledge than those in rural areas (4.79 vs 4.10, $p=0.001$). Primary healthcare nurses working in Gaborone had higher knowledge of stroke than those in Kweneng district (4.78 vs 3.87, $p=0.008$).

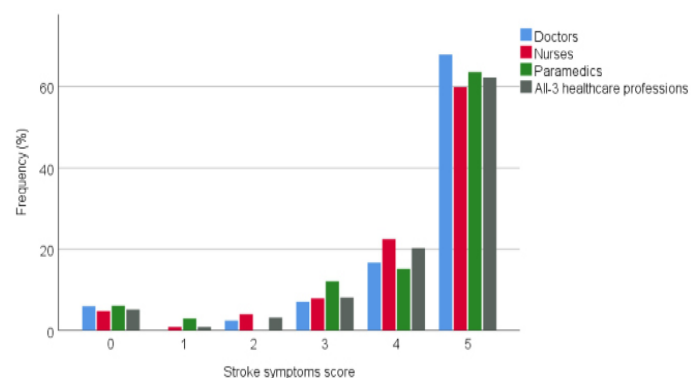


Figure 1: Frequencies of stroke symptoms' scores for health care professionals.

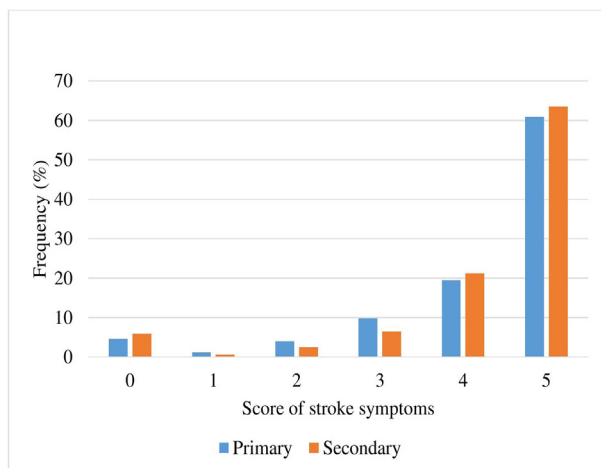


Figure 2: Frequency scores of stroke symptoms among all-3 health care professionals stratified by health care levels.

Discussion

Our study adds to the very sparse literature on awareness of stroke symptoms that focused on either doctors and nurses [13] or hospital workers [14,17]. First, to our knowledge, this is the first study to determine knowledge and awareness among the three healthcare professions (doctors, nurses, and paramedics) concurrently and stratified by healthcare levels. Overall, 83% recognized 80% of ischemic stroke symptoms. Around 90% identified unilateral numbness and weakness, and speech disturbances as the highest awareness rate, while lowest rate was 77% for severe headache with no known cause. Healthcare levels, professions and other demographic factors had no influence on awareness of stroke symptoms. Clinical experience influenced knowledge of stroke among all healthcare professions in secondary healthcare and doctors, while region among primary healthcare nurses and education level among paramedics. Even though some subgroups had lower knowledge compared to others, they achieved about 70%, which is still adequate. Therefore, future studies should focus on other areas of stroke care and resources available.

Healthcare professionals' awareness

All-3 healthcare professionals had significantly highest awareness rate for numbness or weakness in the face, arms, or legs especially on one side of the body (93.3%). This was also the most identified symptom in a study among 370 Nigerian hospital workers [14], even though the proportion in that study was substantially lower (61.9%). In the Nigerian study, loss of vision was the least recognized symptom (24.3%), compared to severe headache with no known cause (77.3%) in our study. These contrast a study among clinicians at the University Hospital in Cairo, Egypt, which found highest awareness for slurring of speech, or fainting/ altered state of consciousness (53.1% each) and lowest for numbness or weakness in the face, arms, or legs on one side of the body (25.0%) [17]. Awareness of difficulty speaking or understanding speech was, as in the Nigerian study [14], the second most common recognized but at a higher proportion (88.4% vs 52.2%) and was significantly higher than severe headache with no known cause (77.3% vs 47.3%). Also, the Egyptian study [17] found higher awareness rate of difficulty speaking or understanding speech (53.1%) than severe headache with no known cause (31.3%). However, overall awareness rates in our study were higher than for these two studies.

We found that doctors and nurses had equally highest awareness rate for numbness or weakness in the face, arms, or legs especially on one side of the body (94% and 93%, respectively). Among doctors, awareness was lowest for vision disturbances in one or both eyes (79.8%), whereas among nurses, lowest awareness was for severe headache with no known cause (76.2%). This compares well to a community study from China [13] that found unilateral weakness and numbness to be the most recognized stroke symptom by both doctors and nurses even though at lower rates (67.9% and 63.6% respectively). In the same study [13], doctors and nurses had lowest awareness rates for dizziness, trouble with walking, loss of balance or coordination (12.3% and 17.0% respectively). Differences between professions can be attributed to differences in patients' exposure in practice, in education levels, and that some symptoms may be less common than others. We found no significant awareness differences for any stroke symptom between healthcare professions. In contrast, the Chinese study showed that there were significant awareness differences for confusion, difficulty speaking or understanding speech between doctors and nurses [13]. These discrepancies between studies can be attributed to differences in study population (study place, time of conducting the study, gender and age distribution, number of respondents, and stroke care resources available in the country).

For detractor chest pain, doctors had significantly highest awareness, followed by nurses and paramedics lowest. This could be explained by differences in education level, and may be differences in patients' exposure between professions. About 1 out of 3 respondents recognized chest pain as detractor. This compares well to previous studies [14, 17] that showed low awareness rates for detractor chest pain even though lower rates than ours (18.4% and 12.5% respectively). This can be explained by differences in study population.

Healthcare levels' awareness

Healthcare levels did not influence awareness of stroke symptoms or detractors. For each healthcare profession in primary and secondary healthcare, awareness rate was highest for numbness or weakness in the face, arms, or legs especially on one side of the body. In addition, among secondary healthcare doctors, awareness was highest also for confusion, difficulty speaking or understanding speech. This resonates well with the Nigerian study among secondary healthcare workers [14], despite lower rate (61.9%). This partly compares to an Egyptian study among secondary healthcare clinicians at the University Hospital in Cairo, which found highest awareness for slurring of speech, or fainting/ altered state of consciousness (53.1% each) even though lower rate than ours (95.5%) [17].

For primary healthcare level in each profession, awareness rate was lowest for severe headache with no known cause, while vision disturbances in one or both eyes for secondary healthcare. Paramedics as part of primary healthcare had also in addition lowest awareness for vision disturbances in one or both eyes. This compares to the Nigerian study among secondary healthcare workers [14], which showed loss of vision was also the least recognized symptom (24.3%), even though lower rate than in our study (76.5%). It contrasts the Egyptian study among secondary healthcare clinicians, which showed lowest awareness for numbness or weakness in the face, arms, or legs on one side of the body (25.0%) [17]. The discrepancies can be explained by study population differences.

Knowledge of stroke symptoms

We found no significant knowledge differences between healthcare professionals. This compares partly well to one study [13] that did not show any significant differences among doctors and nurses even though it assessed both symptoms and stroke management knowledge together. Clinical experience influenced knowledge of stroke symptoms among all healthcare professionals in secondary healthcare, due to those with >1-5.0 years' having higher knowledge than >5-10.0 years' experience (4.71 vs 3.90, $p=0.039$). For all doctors, 0-1.0 year' clinical experience had better knowledge than 10.1-15.0 years' and 5.1-10.0 years' experience, even though overall difference between all clinical experience categories was not significant. This may partly be due to 6.1% and 7.9% variance explained by clinical categories in the response rate among all healthcare professionals and all doctors respectively. Alternatively, for recently graduated respondents who just finished their studies, stroke as a global burden might have been more emphasized during their studies. This contrasts with doctors in primary healthcare where >15 years' clinical experience had higher knowledge than >10-15.0 years (5.00 vs 3.40, $p=0.040$), due partly to 17.8% variance. This partly shows that high experience can have influence especially in primary healthcare where resources are even scarcer. Region influenced knowledge of stroke among primary healthcare nurses, with those in urban areas showing higher knowledge than those in rural areas (4.79 vs 4.10, $p=0.001$). This is also partly due to 58.7% variance in region category. Primary healthcare nurses working in Gaborone city had higher knowledge of stroke than those in Kweneng district (4.78 vs 3.87, $p=0.008$). The difference may be due to patients' exposure in practice, and better stroke care resources in urban areas compared to rural areas in addition to 7.7% variance. Education level influenced knowledge of stroke among paramedics, with bachelor's degree holders having higher knowledge than certificate holders (5.00 vs 4.10, $p=0.009$), due partly to 12.9% variance in our study.

Limitations

There are some limitations in this study. First, the survey was conducted in only communities in greater Gaborone and not all healthcare professionals were represented, therefore it may not represent all communities in the country. Second, not all stroke symptoms included in this study should be weighted equally because some are easily identifiable and more common than others. Third, some subgroups were small in numbers (like private sector) therefore reducing statistical power to show differences. Lastly, there may be differences in demographic factors between responders and non-responders that we are unable to account for. Despite all this, a reasonable high response rate of 61.4% was attained, therefore these results represent current knowledge of healthcare professionals delivering healthcare to patients and the public in greater Gaborone, Botswana.

Conclusion

In summary, the survey results revealed adequate awareness and knowledge of stroke symptoms among healthcare levels and professionals. Despite, clinical experience influencing knowledge of total healthcare professionals in secondary healthcare and doctors, region influencing knowledge among primary healthcare nurses and education level among paramedics, still those who demonstrated lower knowledge compared to others achieved about 70%, which is still adequate. Future studies could assess knowledge and resources in other

areas of stroke management if we are to reduce stroke-related disability and mortality in Botswana.

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Author contributions

All authors contributed substantially in producing this manuscript.

Consent for publication

All authors have read and approved the manuscript for submission.

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Availability of data and materials

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

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