MEDDOCS Open Access Publisher

ISSN: 2641-0362

Neurology and Neurological Sciences: Open Access

Open Access | Research Article

Knowledge of Cardiovascular Diseases as Stroke Risk Factors, and Acute Stroke Treatment and Secondary Prevention Among Medical Doctors in an Upper Middle-Income Country: A Cross-Sectional Questionnaire Study in Greater Gaborone, Botswana

Ookeditse Ookeditse[1,2,3]; Thusego R Motswakadikgwa[4]; Kebadiretse K Ookeditse[5]; Gosiame Masilo[6]; Yaone Bogatsu[3]; Baleufi C Lekobe[7]; Mosepele Mosepele[3,8]; Henrik Schirmer [10,11,12]; Stein H Johnsen[9,10]

[1]Trust hospital in Vestfold, Kysthospitalet Sykehuset, Department of Physical Medicine and Rehabilitation, Division of Neurorehabilitation Medicine, Tønsberg, Norway.

[2]Sidilega Private Hospital, Division of Neurology and Neurorehabilitation Medicine, Gaborone, Botswana.

[3]University of Botswana, Faculty of Medicine, Gaborone, Botswana.

[4]Sidilega Private Hospital, Department of Internal Medicine, Division of cardiology, Gaborone, Botswana.

[5]Sidilega Private Hospital, Division of Family Medicine and Occupational Medicine, Gaborone, Botswana.

[6]Nanset Medical Clinic, Division of Family Medicine, Larvik, Norway.

[7]Sidilega Private Hospital, Division of Neurology, Gaborone, Botswana.

[8]Princess Marina Referral Hospital, Gaborone, Botswana.

[9]University Hospital of North Norway, Department of Neurology, Tromsø, Norway.

[10]UIT The Arctic University of Norway, Institute of Clinical Medicine, Tromsø, Norway.

[11]Akershus University hospital, Department of Cardiology, Lørenskog, Norway.

[12]University of Oslo, Institute of Clinical Medicine, Oslo, Norway.

***Corresponding Author(s): Ookeditse Ookeditse**

Trust Hospital in Vestfold, Department of Physical Medicine and Rehabilitation, Division of Neurorehabilitation Medicine, Tønsberg, Norway.

Tel: 0047-922-69-105 & 0047-3313-4000;
Email: oozah@yahoo.com & ookook@siv.no

Received: Jun 13, 2022

Accepted: Jul 03, 2023

Published Online: Jul 10, 2023

Journal: Neurology and Neurological Sciences: Open Access
Publisher: MedDocs Publishers LLC

Online edition: http://meddocsonline.org/

Abstract

Aims: In this cross-sectional study from Botswana (upper middle-income country), the objective was to investigate awareness and knowledge of cardiovascular diseases as stroke risk factors, acute stroke treatment and secondary prevention among medical doctors.

Methods: Structured, pretested questionnaires reflecting recent stroke guidelines were administered to a representative selection of medical doctors in greater Gaborone. The response rate was 60.0% (84/140). Categorical data were described using percentages and Chi-square tests. Associations between knowledge of stroke risk factors, acute stroke treatment and secondary prevention and demographic factors were analyzed using one-way ANOVA.

Cite this article: Ookeditse O, Motswakadikgwa TR, Ookeditse KK, Masilo G, Bogatsu Y, et al. Knowledge of Cardiovascular Diseases as Stroke Risk Factors, and Acute Stroke Treatment and Secondary Prevention Among Medical Doctors in an Upper Middle-Income Country: A Cross-Sectional Questionnaire Study in Greater Gaborone, Botswana. Neurol Neurol Sci Open Access. 2023; 6(2): 1031.

Results: Overall, 35.7% recognized all 8 stroke risk factors while 7.1% achieved at least 66.7% on acute stroke treatment and secondary prevention. Awareness of prior Transient Ischemic Attack (TIA) was highest (96.4%), followed by atrial fibrillation (AF, 94.0%), carotid plaque (91.7%), prior minor stroke (91.7%), coronary artery diseases (89.3%), hypercoagulopathy (89.3%), carotid stenosis (83.3%), and lowest for obstructive sleep apnea syndrome (44.0%).

Awareness rates were lowest for time window for thrombolytic therapy (15.5%), "if long term warfarin therapy is recommended whether or not AF is present in ischemic stroke or TIA patients with rheumatic mitral stenosis" and for recommended use of Aspirin as suppository in stroke/ TIA patients with AF who are unable to take oral anticoagulants (11.9% each). Primary healthcare had higher awareness rate than secondary healthcare level for "approximate percentage of cardiogenic cerebral embolism in all ischemic stroke" (37.5% vs 9.1%, p=0.045).

Only 38.1% of doctors were aware of CHA2Ds2VASc (highest) and 11.9% for Scandinavian Stroke Scale (SSS) (lowest).

Conclusion: In summary, the survey results revealed better awareness and knowledge of stroke risk factors but low awareness and knowledge of acute stroke treatment and secondary prevention. The results call for health policymakers and other stakeholders to ensure that healthcare professionals get further education on acute stroke treatment and secondary prevention if we are to reduce the burden of stroke-associated morbidity and mortality.

Highlights of the study

- This is the first study in Africa assessing knowledge of cardiovascular diseases as stroke risk factors, and acute stroke treatment and secondary prevention concurrently among medical doctors.
- Understanding stroke risk factors, acute stroke treatment and secondary prevention is paramount for healthcare professionals as counsellors, sources of information and managers of stroke.
- Overall, only 35.7% of respondents recognized 100% of stroke risk factors, while only 7.1% recognized at least 66.7% of acute stroke treatment and secondary prevention.
- Demographic factors had no significant influence on awareness and knowledge of stroke risk factors.
- Demographic factors had no significant influence on knowledge of acute stroke treatment and secondary prevention, while healthcare level influenced awareness.
- Further education or training on acute stroke treament and secondary prevention is needed.

Keywords: Stroke risk factors; Cardiovascular diseases; Secondary prevention; Acute treatment; Thrombolysis; Awareness; Knowledge.

Background

Stroke was the second largest cause of death and the third largest cause of Disability-Adjusted Life-Years (DALYs) lost while cardiovascular diseases were the largest cause of death and the second largest cause of DALYs lost globally in 2019 according to World Health Organization (WHO) estimates [1]. One study reported an increase in DALY from 95.3 million in 1990 to 116.4 million in 2016 globally [2-3]. The burden of stroke shifted from high-income countries (HIC) to low- and middle-income countries (LMIC) already in 2010 with 21.5 million DALYs compared to 91.4 million respectively [4]. Globally, the highest age-standardized incidence of stroke is in Africa [5]. The incidence of stroke decreased in most regions from 1990 to 2016 while it increased in East Asia and southern sub-Saharan Africa (SSA) [2]. Death rates due to stroke declined for all regions except for SSA which did not change [2], resulting in a greater number of years of potential life lost [6]. Stroke and cardiovascular diseases were sixth and fifth most common cause of deaths respectively in Africa in 2019, both showing an increasing trend from eight and ninth positions in 2000 respectively, according to WHO estimates [1].

Healthcare services providers are integral for an efficient and effective healthcare system and their worldwide shortage (mostly in LMIC) is a barrier to achievement of Millennium Development Goals. According to WHO the health workforce shortage will reach up to 12.9 million by the year 2035 [7]. Botswana, just like other LMICs has insufficient healthcare professionals' workforce, such that the few doctors it has are mostly based in urban areas [8]. It has been mentioned that lack of knowledge and resources for stroke prevention and treatment may explain poor stroke care in Africa [9], eventually increasing stroke incidence and DALYs lost in SSA.

Early detection of cardiovascular diseases or stroke risk factors and stroke symptoms is important to initiate prevention and treatment early to reduce morbidities and mortalities. It is crucial that health workers as both sources of stroke information, counsellors and providers of stroke care management are aware of stroke risk factors, stroke treatment and secondary prevention if we are to help in reducing the burden of stroke in SSA.

Therefore, the objectives of this study were:

To investigate awareness and knowledge of cardiovascular diseases as stroke risk factors.

To investigate awareness and knowledge of acute treatment and secondary prevention of stroke/ Transient Ischemic Attack (TIA).

To assess whether demographic factors influence awareness and knowledge of stroke.

Methods

Study design and setting

The study participants were recruited from Botswana. To diversify representation, we sampled medical doctors involved in disease diagnostics, treatment, and management, including general doctors, family medicine specialists and hospital specialists working in public and private healthcare facilities in urban and rural areas. Medical doctors whose roles are not directly involved in the provision of disease prevention, diagnosis or management were excluded. Respondents' demographic

characteristics were presented as follows: Education: bachelor's degree, and master's degree. Clinical experience: 0-5 years, 5.1-10 years, and more than 10 years. Age categories: 20-35 years and over 35 years. Gender: males and females. Region: Rural and urban. Healthcare level: primary and secondary. Healthcare sector: government and private.

Healthcare level in this context refers to primary healthcare and secondary healthcare in a resource-constrained setting. Primary healthcare refers to first line of healthcare for patients, included medical health clinics for outpatients where there are medical doctors but cannot admit patients. District Health Management Team (DHMT) in every district runs all public health clinics. Primary healthcare included all six DHMTs in greater Gaborone (Kweneng, Kgatleng, Southeast, Gaborone, Lobatse, and Ngwaketse). Secondary healthcare refers to where primary healthcare refers to, consists of hospital healthcare staff (general doctors and some specialists (internal medicine, general surgery), nurses, laboratory technicians, etc.), and can admit patients. Secondary healthcare 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

A purposively sampling technique was employed to recruit at least 50% of respondents in each healthcare facility. All 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, 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 [10-12] with some modifications to reflect the recent American Heart Association/American Stroke Association (AHA/ASA) guidelines and European Stroke Organization guidelines [13-14]. The questionnaire instruments were anonymous, pretested, standardized, paper-based, written and administered in English, mostly closed-ended in nature, and categorized into 4 sections (eFigure 1).

Section 1 included demographic factors. Section 2 included awareness rates of six cardiovascular diseases: carotid stenosis, carotid plaque, Coronary Artery Diseases (CAD), Atrial Fibrillation (AF), prior minor stroke, and prior Transient Ischemic Attack (TIA), in addition to two other stroke risk factors (hypercoagulopathy and Obstructive Sleep Apnea Syndrome (OSAS)). Each correct answer scored 1 point and was considered being aware. Each incorrect, unanswered, or unknown answer scored 0 points and was considered being unaware. The questions gave a maximum score of 8 points. We defined awareness as awareness rate of each individual stroke risk factor, while we defined knowledge as mean scores of total recognized risk factors out of eight.

Section 3 comprised of 15 questions about acute treatment and secondary prevention of stroke. These questions were closed-ended with 3-4 multiple-choice answers. Each incorrect, unanswered, or unknown answer scored 0 points and was considered being unaware, while a correct answer determined awareness. The questions gave a maximum score of 15 points. We defined awareness as awareness rate of each individual question, while we defined knowledge as mean scores of total correct answers out of 15 questions.

Section 4 included stroke/ TIA scales; National Institutes of Health Stroke Scale (NIHSS), Scandinavian Stroke Scale (SSS), CHA2Ds2VASc, and ABCD2 [15-19]. Awareness was considered as being aware while those who were not aware or did not answer were considered unaware. Willingness to use the scales was also considered.

Statistical analysis

Continuous and normally distributed variables were expressed as mean ± 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 considered as the denominator for all proportion calculations.

Chi-square tests were used to assess influence of demographic factors on awareness rates. One-way ANOVA analysis (with Bonferroni for Post Hoc test if equal variance assumed, otherwise Games-Howell) were performed to test associations between knowledge of stroke risk factors, and acute stroke treatment and secondary prevention and demographic factors. We used Bonferroni correction to adjust for multiple comparisons. We considered *P*-values <0.05 statistically significant. All statistical analyses were completed using SPSS 25 statistical software (SPSS Inc., Chicago, Illinois, USA).

Results

Participant demographics

A total of 140 questionnaires were physically delivered to medical doctors in clinics and hospitals in greater Gaborone, Botswana from 20th July to 31st October 2018. Fifty-six respondents (40.0%) were excluded because they did not consent or participate for unknown reasons. Eighty-four (84) questionnaires were valid, giving a response rate of 60.0%. Of the 84 doctors, 49 were males (61.3%), all respondents aged 26–60 years, with a mean age of 38.2 ± 8.1 years, and 47.6% from primary healthcare services. More information on demographic factors is shown in Table 1.

Table 1: Demographic factors of respondents.

	N=84
	n (%)
Gender	(missing 4)
Male	49 (61.3)
Female	31 (38.8)
Age (years)	(missing 16)
20-35	30 (44.1)
>35	38 (55.9)
Region	
Rural	58 (69.0)
Urban	26 (31.0)
Education level	
Bachelor's degree	71 (84.5)
Master's degree	13 (15.5)
Clinical experience (years)	(missing 4)
0-5.0	29 (36.3)
5.1-10.0	21 (26.3)
>10.0	30 (37.5)
Sector	
Government	74 (88.1)
Private	10 (11.9)
Care level	
Primary	40 (47.6)
Secondary	44 (52.4)
Location/ district	
Gaborone	12 (14.3)
Kgatleng	9 (10.7)
Southeast	20 (23.8)
Kweneng	16 (19.0)
Ngwaketse	19 (22.6)
Lobatse	8 (9.5)

Awareness of cardiovascular diseases as stroke risk factors.

Awareness rate was highest for prior TIA (96.4%) and lowest for OSAS (44.0%) (Table 2).

Table 2: Awareness of cardiovascular diseases as stroke risk factors.

	N=84
	n (%)
Atrial fibrillation	79 (94.0)
Coronary artery diseases	75 (89.3)
Prior minor stroke	77 (91.7)
Prior transient ischaemic attack	81 (96.4)
Carotid stenosis	70 (83.3)
Carotid plaque	77 (91.7)
Hypercoagulopathy	75 (89.3)
Obstructive sleep apnea syndrome	37 (44.0)

Awareness of acute stroke treatment and secondary prevention

Awareness rates were highest for "medications recommended to reduce the risk of recurrent stroke and other cardiovascular events in patients with non-cardioembolic ischemic stroke/ TIA" (76.2%), followed by "time to start anticoagulation therapy in ischemic stroke/TIA patients with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques" (75.0%), and "if postmenopausal hormone therapy is recommended for women with ischemic stroke /TIA" (66.7%) (Table 3).

Awareness rates were lowest for "time window for thrombolytic therapy" (15.5%), "if long term warfarin therapy is recommended whether or not AF is present in ischemic stroke or TIA patients with rheumatic mitral stenosis" and "recommendation for use of Aspirin alone as suppository for stroke/TIA patients with AF who are unable to take oral anticoagulants" (11.9% each) (Table 3).

Table 3: Awareness of acute stroke treatment and secondary prevention by demographic factors.

	N=84
	n (%)
1. Ideal goal for target blood pressure level to prevent recurrent stroke	19 (22.6)
2. Time recommended to start antihypertensive therapy to prevent recurrent stroke	45 (53.6)
3. Time window for thrombolytic therapy	13 (15.5)
4. Goal for international normalized ratio level for ischemic stroke/ transient ischemic attack (TIA) patients with atrial fibrillation receiving warfarin therapy	49 (58.3)
5. Alternative drug for ischemic stroke/TIA patients with atrial fibrillation who are unable to take oral anticoagulants	10 (11.9)
6. What is the approximate percentage of cardiogenic cerebral embolism in all ischemic strokes?	19 (22.6)
7. For ischemic stroke/TIA patients with atrial fibrillation, what is the recommended first choice medication?	40 (47.6)
8. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, when should we start anticoagulation therapy?	63 (75.0)
9. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, for at least how long should the patients be treated with oral anticoagulation?	40 (47.6)
10. For ischemic stroke or TIA patients with rheumatic mitral stenosis, is long-term Warfarin therapy recommended whether or not atrial fibrillation is present?	10 (11.9)
11. For patients with non-cardioembolic ischemic stroke/ TIA, what medications are recommended to reduce the risk of recurrent stroke and other cardiovascular events?	64 (76.2)
12. Is Aspirin plus Clopidogrel recommended for routine secondary prevention after ischemic stroke/TIA?	28 (33.3)
13. Is postmenopausal hormone therapy recommended for women with ischemic stroke /TIA?	56 (66.7)
14. What is the start point for treatment with statin drugs in patients with stroke or TIA?	21 (25.0)
15. What is the target goal for treatment with statin drugs in patients with stroke or TIA?	32 (38.1)

Awareness of and willingness to use stroke/ TIA scales

Awareness of stroke/TIA scales were highest for CHA2Ds-2VASc (38.1%), followed by ABCD2 (36.9%), NIHSS (31.0%), and lowest for SSS (11.9%) (eTable 1). Odds of willing to use NIHSS while being aware of it was 3.7 times higher than willing to use it while not being aware of it. Odds of willing to use CHA2Ds2VASc while being aware of it was 33.5 times higher than willing to use it without being aware of it. Odds of willing to use ABCD2 while aware of it was 14 times higher than willing to use it while unaware of it. Similar findings were observed also for those aware of these scales while willing to use them than those aware of them without willing to use them. Most respondents were willing to use either CHA2Ds2VASc or ABCD2 (66.7%), followed by NIHSS (61.9%), and the least SSS (53.6%) to evaluate neurological deficits or potential stroke/TIA patients in their practice. However, the differences were not significant.

Demographic factors influence on awareness of stroke risk factors, and acute stroke treatment and secondary prevention

Demographic factors had no significant effect on awareness of cardiovascular diseases as stroke risk factors (section 2 in the questionnaire, eTable 2), or awareness of/willingness to use stroke/TIA scales (section 4 in the questionnaire, eTable 4). In section 3 (eTable 3), acute treatment and secondary prevention of stroke, primary healthcare level had higher awareness rate than secondary healthcare level for "approximate percentage of cardiogenic cerebral embolism in all ischemic stroke" (37.5% vs 9.1%, *p*=0.045).

Demographic factors' influence on knowledge of stroke risk factors, and acute stroke treatment and secondary prevention

About one-third of healthcare professionals (35.7%) correctly recognized all eight-stroke risk factors, while 1.2% could not recognize any (Figure 1). Respondents achieved a mean score (SD) of 6.80 ± 1.45. No respondents got all 15 correct answers, while only 7.1% got 10 questions correct as the highest score, and 4.8% could not recognize any acute stroke treatment and secondary stroke prevention question (Figure 2). Respondents achieved a mean score (SD) of 6.06 ± 2.41.

Demographic factors had no significant effect on knowledge of cardiovascular diseases as stroke risk factors, or acute stroke treatment and secondary prevention (eTable 5).

eTable 1: Awareness of and willingness to use stroke /TIA scales among respondents.

	Awareness of	Not willing to use	Willing to use		Odds ratio
	N(%)	N(%)	N(%)	*p*	
NIHSS				0.011	3.7
Yes	26(31.0)	5(15.6)	21(40.4)		
No	58(69.0)	27(84.4)	31(59.6)		
CHA2Ds2VASc				<0.001	33.5
Yes	32(38.1)	1(3.6)	31(55.4)		
No	52(61.9)	27(96.4)	25(44.6)		
ABCD2				<0.001	14
Yes	31(36.9)	2(7.1)	29(51.8)		
No	53(63.1)	26(92.9)	27(48.2)		
SSS				0.058	-
Yes	10(11.9)	2(5.1)	8(17.8)		
No	74(88.1)	37(94.9)	37(82.2)		
	Willing to use	Unaware of	Aware of		
NIHSS				0.011	3.7
Yes	52(61.9)	31(53.4)	21(80.8)		
No	32(38.1)	27(46.6)	5(19.2)		
CHA2Ds2VASc				<0.001	33.5
Yes	56(66.7)	25(48.1)	31(96.9)		
No	28(33.3)	27(51.9)	1(3.1)		
ABCD2				<0.001	14
Yes	56(66.7)	27(50.9)	29(93.5)		
No	28(33.3)	26(49.1)	2(6.5)		
SSS				0.058	-
Yes	45(53.6)	37(50.00)	8(80.0)		
No	39(46.4)	37(50.0)	2(20.0)		

P: Fisher's exact, NIHSS: National Institutes of Health Stroke Scale, SSS: Scandinavian Stroke Scale.

Abbreviations: ABCD2= A: age >60 years, B: blood pressure >140/90, C: clinical features of TIA, D: duration of symptoms, D: diabetes.

CHA2Ds2VASc= C: congestive heart failure, H: hypertension, A: age >75 years, D: diabetes, S: stroke, TIA or thromboembolism, V: vascular disease, A: age 65-74 years, S: sex category

eTable 2: Awareness of cardiovascular diseases as stroke risk factors by demographic factors.

	GENDER			AGE GROUP (years)			REGION			SECTOR		
	Male	Female		20-35	>35		Urban	Rural/ semi-urban		Government	Private	
	n=49	n=31		n=30	n=38		n=26	n=58		n=74	n=10	
	%	%	*p*	%	%	*p*	%	%	*p*	%	%	*p*
Atrial fibrillation	93.9	93.5	0.992	93.3	94.7	0.967	88.5	96.6	0.801	95.9	80.0	0.721
Coronary artery diseases	87.8	93.5	0.851	90.0	86.8	0.923	92.3	87.9	0.890	89.2	90.0	0.986
Prior minor stroke	89.8	93.5	0.904	100.0	84.2	0.634	88.5	93.1	0.884	90.5	100.0	0.839
Prior TIA	95.9	96.8	0.979	96.7	94.7	0.955	96.2	96.6	0.990	97.3	90.0	0.874
Carotid stenosis	81.6	87.1	0.855	86.7	86.8	0.996	80.8	84.5	0.903	83.8	80.0	0.930
Carotid plaque	89.8	96.8	0.824	96.7	89.5	0.829	88.5	93.1	0.884	91.9	90.0	0.967
Other												
Hypercoagulopathy	87.8	90.3	0.933	90.0	89.5	0.987	92.3	87.9	0.890	89.2	90.0	0.986
Obstructive sleep apnea syndrome	53.1	32.3	0.323	30.0	52.6	0.304	50.0	41.4	0.702	45.9	30.0	0.586
TIA: transient ischemic attack												

	CARE LEVEL			EXPERIENCE (years)			
	Primary	Secondary		0-5.0	5.1-10	>10	
	n=40	n=44		n=29	n=21	n=30	
	%	%	*p*	%	%	%	*p*
Atrial fibrillation	90.0	97.7	0.796	96.6	90.5	93.3	0.988
Coronary artery diseases	92.5	86.4	0.834	89.7	90.5	86.7	0.994
Prior minor stroke	87.5	95.5	0.788	96.6	90.5	86.7	0.961
Prior TIA	95.0	97.7	0.928	100.0	90.5	96.7	0.971
Carotid stenosis	72.5	93.2	0.461	89.7	81.0	80.0	0.954
Carotid plaque	87.5	95.5	0.788	96.6	90.5	90.0	0.980
Other							
Hypercoagulopathy	90.0	88.6	0.963	89.7	90.5	86.7	0.994
Obstructive sleep apnea syndrome	47.5	40.9	0.748	31.0	57.1	50.0	0.570
TIA: transient ischemic attack							

	EDUCATION			LOCATION						
	Degree	Masters		Gaborone	Kgatleng	Southeast	Kweneng	Ngwaketse	Lobatse	
	n=71	n=13		n=12	n=9	n=20	n=16	n=19	n=8	
	%	%	*p*	%	%	%	%	%	%	*p*
Atrial fibrillation	94.4	92.3	0.960	83.3	100.0	95.0	93.8	100.0	87.5	0.999
Coronary artery diseases	90.1	84.6	0.890	91.7	66.7	85.0	93.8	94.7	100.0	0.995
Prior minor stroke	91.5	92.3	0.985	83.3	100.0	90.0	93.8	94.7	87.5	0.999
Prior TIA	97.2	92.3	0.907	91.7	88.9	95.0	100.0	100.0	100.0	0.999
Carotid stenosis	83.1	84.6	0.969	58.3	100.0	85.0	81.3	84.2	100.0	0.977
Carotid plaque	93.0	84.6	0.836	75.0	100.0	90.0	87.5	100.0	100.0	0.997
Other										
Hypercoagulopathy	88.7	92.3	0.930	91.7	66.7	95.0	87.5	94.7	87.5	0.996
Obstructive sleep apnea syndrome	42.3	53.8	0.695	41.7	44.4	35.0	25.0	57.9	75.0	0.841
TIA: transient ischemic attack										

eTable 3: Awareness of acute stroke treatment and secondary prevention by demographic factors.

	Gender			Age group (years)			Region		
	Male	Female		20-35	>35		Urban	Rural/ semi-urban	
	N=49	N=31		N=30	N=38		N=26	N=58	
	%	%	*p*	%	%	*p*	%	%	*p*
1. Ideal goal for target BP level to prevent recurrent stroke	20.4	29.0	0.592	26.7	26.3	0.984	19.2	24.1	0.752
2. Time recommended to start antihypertensive therapy to prevent recurrent stroke	55.1	48.4	0.774	40.0	63.2	0.348	53.8	53.4	0.987
3. Time window for thrombolytic therapy	16.3	16.1	0.988	10.0	21.1	0.410	11.5	17.2	0.611
4. Goal for INR level for ischemic stroke/TIA patients with atrial fibrillation receiving warfarin therapy	57.1	61.3	0.868	70.0	55.3	0.589	42.3	65.5	0.341
5. Alternative drug for ischemic stroke/TIA patients with atrial fibrillation who are unable to take oral anticoagulants	8.2	19.4	0.342	13.3	7.9	0.626	11.5	12.1	0.963
6. What is the approximate percentage of cardiogenic cerebral embolism in all ischemic strokes?	16.3	35.5	0.238	30.0	18.4	0.493	15.4	25.9	0.487
7. For ischemic stroke/TIA patients with atrial fibrillation, what is the recommended first choice medication?	44.9	54.8	0.664	53.3	47.4	0.808	53.8	44.8	0.700
8. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, when should we start anticoagulation therapy?	71.4	80.6	0.745	63.3	81.6	0.534	73.1	75.9	0.923
9. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, for at least how long should the patients be treated with oral anticoagulation?	38.8	61.3	0.324	50.0	47.4	0.913	34.6	53.4	0.393
10. For ischemic stroke or TIA patients with rheumatic mitral stenosis, is long-term Warfarin therapy whether or not atrial fibrillation is present?	12.2	12.9	0.954	10.0	10.5	0.962	7.7	13.8	0.574
11. For patients with non-cardioembolic ischemic stroke/ TIA, what medications are recommended to reduce the risk of recurrent stroke and other cardiovascular events?	71.4	83.9	0.663	80.0	71.1	0.766	69.2	79.3	0.726
12. Is Aspirin plus Clopidogrel recommended for routine secondary prevention after ischemic stroke/ TIA?	38.8	22.6	0.364	36.7	34.2	0.905	26.9	36.2	0.620
13. Is postmenopausal hormone therapy recommended for women with ischemic stroke /TIA?	73.5	54.8	0.472	73.3	63.2	0.721	57.7	70.7	0.627
14. What is the start point for treatment with statin drugs in patients with stroke or TIA?	30.6	19.4	0.485	30.0	23.7	0.724	30.8	22.4	0.626
15. What is the target goal for treatment with statin drugs in patients with stroke or TIA?	42.9	32.3	0.593	40.0	36.8	0.883	38.5	37.9	0.979
TIA: transient ischemic attack, BP: blood pressure, INR: international normalized ratio, AF: atrial fibrillation									

	Sector			Care level			Clinical experience (years)			
	Government	Private		Primary	Secondary		0-5.0	5.1-10.0	>10	
	N=74	N=10		N=40	N=44		N=29	N=21	N=30	
	%	%	*p*	%	%	*p*	%	%	%	*p*
1. Ideal goal for target BP level to prevent recurrent stroke	23.0	20.0	0.893	25.0	20.5	0.756	24.1	23.8	23.3	0.999
2. Time recommended to start antihypertensive therapy to prevent recurrent stroke	54.1	50.0	0.906	55.0	52.3	0.904	41.4	66.7	56.7	0.677
3. Time window for thrombolytic therapy	16.2	10.0	0.718	17.5	13.6	0.751	17.2	14.3	13.3	0.962
4. Goal for INR level for ischemic stroke/TIA patients with AF receiving warfarin therapy	60.8	40.0	0.538	55.0	61.4	0.787	72.4	71.4	40.0	0.418
5. Alternative drug for ischemic stroke/TIA patients with AF who are unable to take oral anticoagulants	12.2	10.0	0.892	10.0	13.6	0.731	24.1	0	10.0	0.151

6. What is the approximate percentage of cardiogenic cerebral embolism in all ischemic strokes	24.3	10.0	0.465	37.5	9.1	0.045	24.1	28.6	16.7	0.807
7. For ischemic stroke/TIA patients with atrial fibrillation, what is the recommended first choice medication?	45.9	60.0	0.685	35.0	59.1	0.252	69.0	23.8	46.7	0.244
8. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, when should we start anticoagulation therapy?	75.7	70.0	0.889	72.5	77.3	0.858	75.9	76.2	73.3	0.996
9. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, for at least how long should the patients be treated with oral anticoagulation?	48.6	40.0	0.785	47.5	47.7	0.991	51.7	47.6	43.3	0.947
10. For ischemic stroke or TIA patients with rheumatic mitral stenosis, is long-term Warfarin therapy whether or not atrial fibrillation is present?	13.5	0	0.261	15.0	9.1	0.579	10.3	14.3	13.3	0.955
11. For patients with non-cardioembolic ischemic stroke/ TIA, what medications are recommended to reduce the risk of recurrent stroke and other cardiovascular events?	79.7	50.0	0.437	67.5	84.1	0.537	79.3	76.2	73.3	0.983
12. Is Aspirin plus Clopidogrel recommended for routine secondary prevention after ischemic stroke/ TIA?	33.8	30.0	0.888	30.0	36.4	0.720	44.8	33.3	26.7	0.706
13. Is postmenopausal hormone therapy recommended for women with ischemic stroke /TIA?	68.9	50.0	0.606	57.5	75.0	0.486	69.0	66.7	66.7	0.996
14. What is the start point for treatment with statin drugs in patients with stroke or TIA?	27.0	10.0	0.402	27.5	22.7	0.758	20.7	38.1	23.3	0.705
15. What is the target goal for treatment with statin drugs in patients with stroke or TIA?	40.5	20.0	0.431	32.5	43.2	0.573	51.7	42.9	26.7	0.534

TIA: transient ischemic attack, BP: blood pressure, INR: international normalized ratio, AF: atrial fibrillation, LDL: low density lipoprotein

	Education			**District**						
	Degree	Masters		Gaborone	Kgatleng	Southeast	Kweneng	Ngwaketse	Lobatse	
	N=71	N=13		N=12	N=9	N=20	N=16	N=19	N=8	
	%	%	***p***	%	%	%	%	%	%	***p***
1. Ideal goal for target BP level to prevent recurrent stroke	23.9	15.4	0.650	25.0	11.1	25.0	31.3	21.1	12.5	0.973
2. Time recommended to start antihypertensive therapy to prevent recurrent stroke	50.7	69.2	0.574	66.7	33.3	70.0	43.8	52.6	37.5	0.922
3. Time window for thrombolytic therapy	14.3	0	0.140	0	0	5.0	31.3	26.3	25.0	0.317
4. Goal for INR level for ischemic stroke/TIA patients with AF receiving warfarin therapy	62.0	38.5	0.435	50.0	88.9	60.0	56.3	63.2	25.0	0.881
5. Alternative drug for ischemic stroke/TIA patients with AF	14.1	0	0.195	16.7	0	15.0	0	21.1	12.5	0.604
6. What is the approximate percentage of cardiogenic cerebral embolism in all ischemic strokes	23.9	15.4	0.650	25.0	22.2	15.0	12.5	47.4	0	0.512
7. For ischemic stroke/TIA patients with atrial fibrillation, what is the recommended first choice medication?	49.3	38.5	0.701	41.7	55.6	40.0	68.8	31.6	62.5	0.898
8. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, when should we start anticoagulation therapy?	73.2	84.6	0.764	58.3	55.6	75.0	75.0	89.5	87.5	0.975
9. For ischemic stroke/TIA with acute myocardial infarction complicated by left ventricular mural thrombus formation identified by echocardiography or other cardiac imaging techniques, for at least how long should the patients be treated with oral anticoagulation?	45.1	61.5	0.596	33.3	33.3	50.0	62.5	57.9	25.0	0.899

10. For ischemic stroke or TIA patients with rheumatic mitral stenosis, is long-term Warfarin therapy whether or not atrial fibrillation is present?	11.3	15.4	0.791	16.7	22.2	5.0	0	26.3	0.0	0.437
11. For patients with non-cardioembolic ischemic stroke/ TIA, what medications are recommended to reduce the risk of recurrent stroke and other cardiovascular events?	77.5	69.2	0.822	75.0	100.0	65.0	75.0	78.9	75.0	0.993
12. Is Aspirin plus Clopidogrel recommended for routine secondary prevention after ischemic stroke/ TIA?	36.6	15.4	0.325	16.7d	44.4	35.0	31.3	36.8	37.5	0.972
13. Is postmenopausal hormone therapy recommended for women with ischemic stroke /TIA?	64.8	76.9	0.735	50.0	77.8	65.0	75.0	68.4	62.5	0.994
14. What is the start point for treatment with statin drugs in patients with stroke or TIA?	26.8	15.4	0.560	33.3	33.3	5.0	25.0	26.3	50.0	0.610
15. What is the target goal for treatment with statin drugs in patients with stroke or TIA?	39.4	30.8	0.731	41.7	33.3	35.0	37.5	36.8	50.0	0.999
TIA: transient ischemic attack, LDL: low density lipoprotein, BP: blood pressure, AF: atrial fibrillation										

eTable 4: Awareness of and willingness to use stroke/TIA scales by demographic factors for doctors.

	Gender			**Age group (years)**			**Region**			**Sector**		
	Male	Female		20-35	>35		Urban	Rural/ semi-urban		Government	Private	
	N=49	N=31		N=30	N=38		N=26	N=58		N=74	N=10	
	%	%	***p***	%	%	***p***	%	%	***p***	%	%	***p***
AWARENESS												
NIHSS	30.6	29.0	0.929	30.0	26.3	0.841	38.5	27.6	0.570	27.0	60.0	0.289
SSS	12.2	12.9	0.954	10.0	10.5	0.962	19.2	8.6	0.386	12.2	10.0	0.892
CHA2Ds2VASc	38.8	35.5	0.868	43.3	31.6	0.577	30.8	41.4	0.596	40.5	20.0	0.431
ABCD2	40.8	32.3	0.662	23.3	44.7	0.282	42.3	34.5	0.705	37.8	30.0	0.777
WILLINGNESS												
NIHSS	63.3	58.1	0.837	63.3	57.9	0.840	57.7	63.8	0.815	64.9	40.0	0.470
SSS	57.1	45.2	0.605	50.0	52.6	0.915	50.0	55.2	0.831	58.1	20.0	0.196
CHA2Ds2VASc	65.3	67.7	0.927	66.7	63.2	0.900	53.8	72.4	0.483	71.6	30.0	0.217
ABCD2	71.4	58.1	0.608	60.0	68.4	0.761	57.7	70.7	0.627	71.6	30.0	0.217

	Care level			**Clinical experience (years)**			
	Primary	Secondary		0-5	5.1-10	>10	
	N=40	N=44		N=29	N=21	N=30	
	%	%	***p***	%	%	%	***p***
AWARENESS							
NIHSS	22.5	38.6	0.341	37.9	28.6	26.7	0.852
SSS	12.5	11.4	0.915	13.8	14.3	10.0	0.939
CHA2Ds2VASc	30.0	45.5	0.413	51.7	33.3	30.0	0.619
ABCD2	32.5	40.9	0.653	34.5	47.6	33.3	0.834
WILLINGNESS							
NIHSS	60.0	63.6	0.881	72.4	52.4	56.7	0.791
SSS	55.0	52.3	0.904	65.5	42.9	50.0	0.728
CHA2Ds2VASc	57.5	75.0	0.486	75.9	57.1	63.3	0.840
ABCD2	65.0	68.2	0.900	75.9	47.6	70.0	0.651

	Education			District						
	Bachelor's degree	Master's degree		Gaborone	Kgatleng	Southeast	Kweneng	Ngwaketse	Lobatse	
	N=71	N=13		N=12	N=9	N=20	N=16	N=19	N=8	
	%	%	*p*	%	%	%	%	%	%	*p*
AWARENESS										
NIHSS	26.8	53.8	0.313	41.7	22.2	25.0	37.5	36.8	12.5	0.938
SSS	9.9	23.1	0.438	33.3	0.0	0.0	6.3	26.3	0.0	0.225
CHA2Ds2VASc	35.2	53.8	0.511	16.7	55.6	30.0	50.0	36.8	50.0	0.865
ABCD2	32.4	61.6	0.315	25.0	0.0	45.0	50.0	31.6	62.5	0.456
WILLINGNESS										
NIHSS	64.8	46.2	0.557	50.0	55.6	55.0	68.8	68.4	75.0	0.993
SSS	56.3	38.5	0.542	41.7	44.4	50.0	56.3	57.9	75.0	0.988
CHA2Ds2VASc	69.0	53.8	0.650	41.7	77.8	65.0	75.0	68.4	75.0	0.971
ABCD2	69.0	53.8	0.650	50.0	55.6	70.0	68.8	73.7	75.0	0.992

eTable 5: ANOVA analysis-Mean scores of knowledge of cardiovascular diseases, and acute stroke treatment and secondary prevention.

	Cardiovascular diseases as stroke risk factors	Acute stroke treatment and secondary prevention
	Mean (95% CI)	Mean (95% CI)
GENDER		
Male	6.80 (6.39-7.20)	5.98 (5.27-6.68)
Female	6.84 (6.26-7.42)	6.32 (5.51-7.14)
p	***0.944***	***0.530***
AGE GROUP (years)		
20-35	6.83 (6.37-7.29)	6.27 (5.39-7.14)
>35	6.79 (6.24-7.34)	6.08 (5.36-6.79)
p	***0.695***	***0.734***
REGION		
Rural/semi-urban	6.81 (6.45-7.17)	6.33 (5.71-6.95)
Urban	6.77 (6.11-7.43)	5.46 (4.47-6.45)
p	***0.712***	***0.129***
EDUCATION LEVEL		
Bachelor's degree	6.80 (6.50-7.11)	6.17 (5.59-6.75)
Master's degree	6.77 (5.41-8.12)	5.46 (4.21-6.71)
p	***0.472***	***0.334***
CLINICAL EXPERIENCE (YEARS)		
0-5.0	6.90 (6.51-7.28)	6.76 (5.97-7.54)
5.1-10.0	6.81 (6.10-7.52)	6.24 (5.03-7.45)
>10	6.70 (6.03-7.37)	5.53 (4.66-6.41)
p	***0.958***	***0.137***
SECTOR		
Government	6.84 (6.51-7.17)	6.24 (5.69-6.80)
Private	6.50 (5.27-7.73)	4.70 (3.15-6.25)
p	***0.411***	***0.057***
CARE LEVEL		
Primary	6.63 (6.07-7.18)	5.85 (4.99-6.71)
Secondary	6.95 (6.61-7.29)	6.25 (5.60-6.90)
p	***0.562***	***0.451***

LOCATION		
Gaborone	6.17 (4.93-7.40)	5.50 (3.59-7.41)
Kgatleng	6.67 (5.73-7.61)	6.11 (4.81-7.41)
Southeast	6.70 (5.88-7.52)	5.65 (4.28-7.02)
Kweneng	6.63 (5.95-7.30)	6.25 (5.27-7.23)
Ngwaketse	7.26 (6.84-7.68)	6.84 (5.77-7.91)
Lobatse	7.36 (6.20-8.55)	5.63 (3.68-7.57)
p	***0.184***	***0.622***
CI: confidence interval		

Discussion

Our study adds to the little literature on awareness of stroke risk factors, and acute stroke treatment and secondary prevention that focused on either doctors [10], doctors and nurses [11] or hospital workers [12]. One third of respondents recognized all eight-stroke risk factors while only 7.1% scored 10 or more out of 15 on acute stroke treatment and secondary prevention. Highest awareness rate for stroke scales was for CHA2Ds2VASc (38.1%). Except for healthcare level that influenced awareness for "approximate percentage of cardiogenic cerebral embolism in all ischemic stroke" with primary better than secondary healthcare, other demographic factors had no influence.

Cardiovascular diseases as stroke risk factors

Awareness was highest for prior TIA (96.4%), AF (94.0%), prior minor stroke or carotid plaque (91.7%), hypercoagulopathy or CAD (89.3%), and carotid stenosis (83.3%). This compares well to a Chinese study by Chen et al [10]. They did not include hypercoagulopathy and OSAS as risk factors in their study. Awareness of AF and CAD in our study was 94.0% and 89.3% respectively. This contrasts with a Nigerian study by Akinyemi et al [12] that showed a 39.7% awareness rate of heart diseases among hospital workers even though they had fewer cardiovascular diseases as risk factors in their study. Demographic factors had no significant effect on awareness and knowledge of cardiovascular diseases as risk factors. Chen et al [10] found that gender influenced awareness of CAD; region (rural and urban areas) influenced awareness of AF, carotid stenosis, and prior minor stroke; and education influenced awareness of prior TIA and carotid plaque. These discrepancies can be explained by differences in study population.

Acute stroke treatment and secondary prevention

Only 15.5% of respondents were aware of the recommended 4.5 hours' time window for intravenous thrombolytic therapy of acute ischemic stroke, which compares to the Chinese studies by Chen et al (14.4%) [10] and Yang et al (19.8%) [11]. A systematic review from 2013 revealed that thrombolytic therapy for acute ischemic stroke was available in 19% of LMICs compared to at least 50% in HICs because of healthcare professionals' barriers (lack of workforce and stroke knowledge) [9,20]. Although these numbers may have improved in recent years, there is still reason to assume there is a big gap between LMICs and HICs. Therefore, it is of paramount importance for healthcare professionals to be aware of this time window, identify stroke symptoms immediately and rapidly transfer stroke patients to a qualified hospital to reduce pre-hospital delay.

One-fifth of respondents (22.6%) were aware of the target blood pressure level for recurrent stroke prevention. This contrasts with the Chinese studies that showed awareness rates of around 50% [10,11]. Also, the awareness rate for combined hypertension preventive measures was much lower in our study (10.7%), than in the study by Yang et al (50%) [11]. Treatment with blood pressure medications is cost-effective for prevention of stroke [21-23]. One third of the respondents in our study were aware of the recommendation to avoid dual antiplatelet therapy with Aspirin plus Clopidogrel as routine secondary prevention, compared to 40.5% in the study by Chen et al [10]. Only 11.9% of respondents were aware of the recommendation for use of Aspirin alone as suppository for stroke/TIA in AF patients unable to take oral anticoagulants, in contrast to the study by Chen et al [10] that found 26.4%. Also, awareness for target range of INR in cardioembolic ischemic stroke patients receiving warfarin therapy was lower in our study than in Chen's (58.3% vs 78.9%). Atrial fibrillation increases the risk of stroke up to five-fold, due to increased risk of thrombotic events leading to ischemic stroke [24]. Antithrombotic therapy with antiplatelet drugs reduces the risk by 20%, compared to 60% by vitamin K antagonists and novel oral anticoagulants [25].

Higher awareness rates were found in our study compared to the Chinese studies for hormone replacement therapy in postmenopausal women with ischemic stroke/ TIA (66.7% vs 46.8%) [10], warfarin therapy for prevention of recurrent stroke in patients with AF (47.6% vs 38.7%) [11], and target goal for statin treatment (38.1% vs 8.2%) [11]. About half of respondents (53.6%) were aware of the time recommended to start antihypertensive therapy, like findings by Chen et al (58.2%) [10]. Discrepancies in findings between studies maybe explained by differences in study population (time and country of study, educational levels, age, gender distribution, stroke care resources availability, and type of patients' exposure in practice).

We found that primary healthcare had better awareness rate than secondary healthcare level for percentage of cardiogenic cerebral embolism in ischemic stroke. This could be attributed to lack of neurologists and stroke physicians in the country. Therefore, those in the primary healthcare do most of the management of stroke patients. Other demographics factors were not associated with awareness of acute stroke treatment and secondary prevention. Neither did demographic factors have influence on knowledge. This contrasts the study by Yang et al [11] who found that education level and profession significantly influenced knowledge among doctors. This can be attributed to differences in study population.

Stroke and TIA scales

Thirty eight percent of physicians were aware of CHA2Ds-2VASc score, while 67% indicated they would use it to evaluate stroke risk in patients with AF in their practice. Thirty seven percent of the physicians were aware of ABCD2, while 67% indicated they would use it to evaluate potential TIA patients in their

practice. This contrasts the Chinese study by Chen et al [10], which demonstrated a higher percentage of doctors (46.9%) who were aware of the ABCD scale (ABCD2 was not in use by then), while fewer (18.9%) would use it to evaluate potential TIA patients. One third of physicians were aware of the NIHSS score, while 61.9% would use it to evaluate the neurological deficits of stroke/TIA patients. The awareness of NIHSS is in line with the study by Chen et al [10] even though the willingness to use it was lower (45.4%). Only 11.9% were aware of the SSS score, while 53.6% would use it. This contrasts with the same Chinese study [10], where 20.0% of physicians were aware of it. Demographic factors had no significant influence on awareness of or willingness to use stroke/ TIA scales in our study. Chen et al [10] found that education significantly influenced awareness of NIHSS and ABCD scales, and willingness to use the ABCD scale, while clinical experience influenced awareness of SSS, and region influenced awareness of NIHSS.

Studies assessing public knowledge of stroke in LMICs by Ching et al in Malaysia [26], Nakibuuka et al and Kaddumukasa et al in Uganda [27,28], and Hertz et al in Tanzania [29] demonstrated adequate knowledge for appropriate reaction to stroke. Poor knowledge and awareness of acute stroke treatment and prevention among medical doctors is worrisome considering that patients or public would take the appropriate action when they get stroke but get inappropriate medical assistance on arrival at the hospital, which can result in severe irreversible consequences. This poor knowledge among healthcare professionals could be contributed by inadequate medical facilities, lack of stroke care protocol, limited staff numbers, inadequate staff development opportunities, lack of health professionals, poor collaboration, limited knowledge of stroke care interventions, and lack of political will on national health policies as described by Baatiema et al and Mandizvidza et al [9,30].

Limitations

First, our study was restricted to greater Gaborone communities, and not all medical doctors were represented. Therefore, it may not be representative to all communities in the country. Second, not all stroke risk factors included in this study should be weighted equally because some are easily identifiable and more common than others. Third, several detractors under the stroke risk factors section should have been added to the study in case respondents crossed all answers correct for convenience. Fourth, not all areas under acute stroke treatment and secondary prevention were covered (e.g., dosages of thrombolysis medication, thrombectomy, carotid endarterectomy, medical contraindications, stroke rehabilitation etc.), even though the chosen ones are considered representative. Fifth, actual practice may not correlate with self-reported knowledge. Sixth, some subgroups were small in numbers (like private sector) therefore reducing statistical power to show differences. Seventh, because of the low numbers of medical doctors in the country, we did not specify their area of specialization or departments for fear of recognition since the questionnaires were anonymous. Eighth, the questions in this study were based on the previous stroke guidelines but not on the latest updated stroke guidelines that were released in 2019 [13]. Lastly, there may be differences in demographic factors between responders and non-responders that we are unable to account for. Despite these limitations, a reasonable high response rate of 60.0% was attained and therefore these results represent current knowledge of medical doctors delivering healthcare to people with stroke/TIA or risk factors in greater Gaborone.

Conclusion

In summary, the survey results revealed better awareness and knowledge of stroke risk factors but low awareness and knowledge of acute stroke treatment and secondary prevention. There were lower awareness rates of stroke scales compared to willingness to use them among respondents.

Our results show huge gaps in knowledge and awareness of acute stroke treatment and secondary prevention among doctors in Botswana. Therefore, further education is urgently needed. There is an urgent need for continuing education and training on stroke/TIA treatment and secondary prevention if we are to reduce stroke associated morbidity and mortality in Botswana. The findings call for health policy makers and other stakeholders to ensure that healthcare professionals get further training/ education on acute stroke treatment and secondary prevention.

Acknowledgments

The authors thank the chief medical officers, hospital superintendents and their staff in greater Gaborone and the funders for this survey research study.

Funding

Botswana and Norway governments' collaboration in the health sector. The funders had no role in the study methodology, data collection, analysis, and interpretation, and producing the manuscript.

Grant number: Not applicable.

Competing interests: None declared.

Availability of data and materials

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

Consent for publication

All authors have read and approved the manuscript for submission.

Author contributions

All authors contributed substantially in producing this manuscript.

References

1. WHO. Global health estimates 2019: Leading cause of death and disability: A visual summary of global and regional trends in 2000-2019. Geneva: World Health Organization, 2020.
2. GBD 2016 Stroke Collaborators. Global, regional, and national burden of stroke, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol 2019; 18: 439-58.
3. Feigin VL, Krishnamurthi RV, Parmar P, Norrving B, Mensah GA, et al. Update on the global burden of ischemic and hemorrhagic stroke in 1990-2013: The GBD 2013 study. Neuroepidemiology. 2015; 45: 161-176.
4. Moran A, Forouzanfar M, Sampson U, Chugh S, Feigin V, et al. The epidemiology of cardiovascular diseases in sub-Saharan Africa: The global burden of diseases, injuries and risk factors 2010 study. Progress in cardiovascular diseases. 2013; 56: 234-239.
5. Walker R, Whiting D, Unwin N, Mugusi F, Swai M, et al. Stroke incidence in rural and urban Tanzania: a prospective, community-based study. The Lancet Neurology. 2010; 9: 786-792.

6. Lemogoum D, Degaute JP, Bovet P. Stroke prevention, treatment, and rehabilitation in sub-Saharan Africa. Am J Prev Med. 2005; 29: 95-101.

7. News Release; Global health workforce shortage to reach 129 million in coming decades http://www.who.int/mediacentre/news/releases/2013/health-workforce-shortage/en/.

8. Nkomazana O, Phaladze N, Peersman W, Willcox M, Mash R. Human resources for health in Botswana: the results of in-country database and reports analysis. African Journal of Primary Health Care and Family Medicine. 2014; 6: 1-8.

9. Baatiema L, de-Graft Aikins A, Sav A, Mnatzaganian G, Chan CK, et al. Barriers to evidence-based acute stroke care in Ghana: a qualitative study on the perspectives of stroke care professionals. BMJ Open. 2017; 7: e015385.

10. Chen C, Qiao X, Kang H, Ding L, Bai L, et al. Community physicians' knowledge of secondary prevention after ischemic stroke: a questionnaire survey in Shanxi Province, China. BMC Med Educ. 2015; 15: 197.

11. Yang J, Zhang J, Ou S, Wang N, Wang J. Knowledge of Community General Practitioners and Nurses on Pre-Hospital Stroke Prevention and Treatment in Chongqing, China. PLoS ONE. 2015; 10: e0138476.

12. Akinyemi RO, Ogah OS, Ogundipe RF, Oyesola OA, Oyadoke AA, et al. Knowledge and perception of stroke amongst hospital workers in an African community. European journal of neurology. 2009; 16: 998-1003.

13. Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, et al. Guidelines for the Early Management of Patients with Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke. A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association. Stroke. 2019; 50: e344-e418.

14. Steiner T, Salman RA, Ntaios G. The European Stroke Organisation (ESO) guidelines. Int J Stroke 2014; 9: 838-839.

15. Brott T, Adams HP, Jr, Olinger CP, Marler JR, Barsan WG, et al. Measurements of acute cerebral infarction: a clinical examination scale. Stroke. 1989; 20: 864-870.

16. Barber M, Fail M, Shields M, Stott DJ, Langhorne P. Validity and reliability of estimating the Scandinavian Stroke scale score from medical records. Cerebrovasc Dis. 2004; 17: 224-227.

17. Camm AJ, Lip GY, De Caterina R, et al. ESC Committee for Practice Guidelines (CPG). 2012 focused update of the ESC Guidelines for the management of atrial fibrillation: an update of the 2010 ESC Guidelines for the management of atrial fibrillation. Developed with the special contribution of the European Heart Rhythm Association. Eur Heart J. 2012; 33: 2719-2747.

18. January CT, Wann LS, Alpert JS, et al. American College of Cardiology/American Heart Association Task Force on Practice Guidelines. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. J Am Coll Cardiol. 2014; 64: e1-e76.

19. Johnston SC, Rothwell PM, Nguyen-Huynh MN, et al. Validation and refinement of scores to predict very early stroke risk after transient ischaemic attack. Lancet 2007; 369: 283-292.

20. Berkowitz AL, Mittal MK, McLane HC, Shen GC, Muralidharan R, et al. Worldwide reported use of IV tissue plasminogen activator for acute ischemic stroke. Int J Stroke. 2014; 9: 349-355.

21. Gaciong Z, Siński M, Lewandowski J. Blood pressure control and primary prevention of stroke: summary of the recent clinical trial data and meta-analyses. Curr Hypertens Rep. 2013;15: 559-574.

22. Heller DJ, Coxson PG, Penko J, et al. Evaluating the impact and cost-effectiveness of statin use guidelines for primary prevention of coronary heart disease and stroke. Circulation 2017;136:1087-1098.

23. Wang W, Zhang B. Statins for the prevention of stroke: a meta-analysis of randomized controlled trials. PLoS One. 2014; 9: e92388.

24. Huisman MV, Lip GY, Diener HC, et al. Design and rationale of Global Registry on Long-Term Oral Antithrombotic Treatment in Patients with Atrial Fibrillation: a global registry program on long-term oral antithrombotic treatment in patients with atrial fibrillation. Am Heart J. 2014; 167: 329-334.

25. Hart RG, Pearce LA, Aguilar MI. Meta-analysis: Antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation. Ann Intern Med. 2007; 146: 857-867.

26. Ching S, Chia YC, Chew BN, Soo MJ, Lim HM, et al. Knowledge on the action to be taken and recognition of symptoms of stroke in a community: Findings from the May Measurement Month 2017 blood pressure screening Programme in Malaysia. BMC public health. 2019; 19: 1-2.

27. Nakibuuka J, Sajatovic M, Katabira E, Ddumba E, Byakika-Tusiime J, et al. Knowledge and perception of stroke: A population-based survey in Uganda. International Scholarly Research Notices. 2014.

28. Kaddumukasa M, Kayima J, Nakibuuka J, Mugenyi L, Ddumba E, et al. A cross-sectional population survey on stroke knowledge and attitudes in Greater Kampala, Uganda. Cogent medicine. 2017; 4: 1327129.

29. Hertz JT, Madut DB, William G, Maro VP, Crump JA, et al. Perceptions of stroke and associated health-care-seeking behavior in Northern Tanzania: A community-based study. Neuroepidemiology. 2019; 53: 41-47.

30. Mandizvidza V, London L, Bryer A. Shortfall in stroke care: A study of ischaemic stroke care practices in a South African metropole. South African Medical Journal. 2021; 111: 215-219.