



Healthcare professionals' knowledge of modifiable stroke risk factors: A cross-sectional questionnaire survey in greater Gaborone, Botswana

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ABSTRACT

Background: Stroke remains the second leading cause of deaths and disability globally, with highest mortality in Africa (low- and middle-income countries). It is crucial for healthcare professionals to have sufficient stroke risk factors' knowledge in order to reduce the stroke burden.

Aims: We investigated healthcare professionals' knowledge of modifiable stroke risk factors, and identified demographic factors influencing this knowledge.

Methods: In this cross-sectional survey study from Botswana (upper middle-income country), structured questionnaires reflecting recent stroke guidelines were administered to a representative selection of healthcare workers in greater Gaborone. The response rate was 61.4%, comprising 84 doctors, 227 nurses and 33 paramedics. Categorical data were described using percentages and Chi-square tests. Associations between stroke risk factors' knowledge and demographic factors were analyzed with one-way ANOVA using SPSS 25 statistical software.

Results: Awareness rate of individual stroke risk factors was highest for hypertension (96.5%), followed by obesity (93.3%), smoking (91.9%), elevated total cholesterol (91.0%), physical inactivity (83.4%), elevated low-density lipoprotein (LDL) cholesterol (81.1%), excessive alcohol drinking (77.0%), and lowest for diabetes (73.3%). For all-8 risk factors, doctors had the highest knowledge, followed by nurses and paramedics lowest (7.11 vs 6.85 vs 6.06, $P < 0.05$).

Conclusion: In Botswana, specific healthcare professionals' subgroups need to be targeted for continuing education on stroke risk factors for improving stroke prevention and reducing stroke-related disability and mortality.

Abbreviations: DALY, Disability-adjusted life-years; LMIC, low- and middle-income countries; HIC, high-income countries; SSA, Sub-Saharan Africa; AHA/ASA, American Heart Association/American Stroke Association; SPSS, Statistical Package for the Social Sciences; USA, United States of America; SD, standard deviation; LDL, low-density lipoprotein; ANOVA, analysis of variance; P, *p*-value.

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1. Introduction

Stroke remains the second leading cause of deaths globally, with a reported 26% increase in stroke deaths between 1990 and 2010, comprising about 10% of all deaths and killing 5.5 million people each year, with 44 million disability-adjusted life-years (DALYs) lost [1–3]. According to the World Stroke Society campaign highlights, one in six people in the world will suffer a stroke in their lifetime [4]. Of the estimated 5.9 million deaths linked to stroke worldwide in 2010, 71% were from low- and middle-income countries (LMIC) [1]. In 2013, there were 10.3 million new strokes globally (67% were ischemic stroke), 6.5 million deaths from stroke (51% from ischemic stroke), and nearly 25.7 million who had survived a stroke (71% with ischemic stroke) [5]. Researchers further suggested that whereas high-income countries (HIC) have significant reductions in stroke incidence of about 42% over the last 40 years, a 100% increase in stroke incidence occurred in LMIC over the same period [6]. Stroke was the sixth most common cause of death in Africa in 2019, showing an increasing trend from eight place in 2000, according to WHO estimates [7]. Globally, the highest age-standardized incidence of stroke is in Africa [8].

Botswana, just like other LMICs has an insufficient healthcare professionals' workforce [9,10], such that the few doctors it has are mostly based in urban areas while nurses in rural areas have some doctors' responsibilities (i.e., patients' diagnosis and management). One study in Botswana by Nkomazana et al. showed that the density of doctors per inhabitants was 4/10000 (9 for urban districts and 3 for rural districts) while for nurses 42/10000 (77 for urban and 26 for rural districts). Only 21% of medical doctors were Botswana, while the rest were from other countries [11].

However, none or little is known about healthcare professionals' awareness and knowledge of stroke in Sub-Saharan Africa (SSA). In this cross-sectional study from Botswana, the issues we wanted to address were:

- (1) What are the awareness and knowledge of modifiable stroke risk factors among three healthcare professional groups: medical doctors, nurses, and paramedics?
- (2) Are awareness and knowledge of modifiable stroke risk factors influenced by demographic factors?

2. Methods

2.1. Study setting and design

The study participants were recruited from Botswana, which is an upper middle-income country in SSA. This study purposively sampled a variety of healthcare professionals involved in the diagnosis, treatment, and management of diseases, including medical doctors, nurses, and paramedics working in public and private healthcare facilities in urban areas and rural/semi-urban areas to diversify representation. Medical doctors included general doctors, family medicine physicians, and hospital specialist doctors. Administrative or other healthcare professionals whose roles are not directly involved in the provision of diseases' prevention, diagnosis, or management were excluded. Demographic categories included gender, age, education, clinical experience, profession type, place/districts, region (urban or rural), and healthcare level (primary or secondary).

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 nurses or/and 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), and four emergency medical service companies (one public and three private). 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 is capable of admitting 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.

2.2. Ethical statement

The study was approved by the Ethics Committee of the University of Botswana, Ministry of Health and Wellness in Botswana (ref. HPDME: 13/18/1) and exempted by the Regional Ethics Committee, South East, section D (ref. 2017/2169), Norway.

2.3. Sampling and recruitment

We employed a purposively sampling technique to recruit at least 50% of respondents in each cadre in each healthcare facility. All study healthcare 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. All eligible participants willing to take part in the study were informed about the study and their written consent solicited before filling out the questionnaires.

2.4. Data collection instrument

The survey instruments were adapted from previous surveys [12,13] with some modifications. The instruments were anonymous, paper-based, standardized, structured questionnaires written and administered in English. Questions were mostly closed-ended in nature and categorized into sections. Questions were developed to reflect the American Heart Association/American Stroke Association (AHA/ASA) guidelines and European Stroke Organization guidelines [14,15].

We defined awareness based on recognition rates of individual modifiable stroke risk factors, while we defined knowledge score as the mean score of correct responses out of 8 stroke risk factors on the questionnaire. Awareness of each of the following eight modifiable stroke risk factors was determined: elevated total cholesterol, elevated low-density lipoprotein (LDL) cholesterol, obesity, hypertension, diabetes, smoking, excessive alcohol drinking, and physical inactivity (**Supplementary Fig. 1**). We included influenza as a detractor originally but only to find that influenza has been associated with stroke as a stroke risk factor in some studies [16–19]. This is perhaps not information that is commonly known among healthcare practitioners. Therefore, influenza was included as a false detractor to assess how many would recognize it as a risk factor. Each correct answer scored 1 point and each incorrect, unanswered, or unknown answer scored 0 points, giving a maximum score of 8 points. Recognizing each risk factor was considered being aware, otherwise unaware.

2.5. Statistical analysis

All statistical analyses were completed using SPSS 25 statistical software (SPSS Inc., Chicago, Illinois, USA). 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 returned the consented questionnaire was the denominator for all proportion calculations.

We used Chi-square tests to compare awareness rates. Independent-samples *t*-test and one-way ANOVA analyses were performed to test associations between stroke risk factors' knowledge and demographic

factors to determine predictors. Bonferroni corrections were applied to adjust for multiple comparisons. Two-sided *P*-values <0.05 were considered statistically significant.

3. Results

3.1. Participants' demographics

A total of 560 questionnaires were physically delivered to healthcare professionals in clinics and hospitals in greater Gaborone, Botswana from 20th July to 31st October 2018. The participants included 140 medical doctors (25.0%), 345 nurses (61.6%) and 75 paramedics (13.4%). Three hundred and forty-four (344) questionnaires were returned, for a valid response rate of 61.4%, with 60.0% for doctors, 65.8% for nurses and 44.0% for paramedics (**Supplementary Fig. 2**). One hundred and seventy-four respondents were excluded because they did not consent or participate for unknown reasons.

Of the 344 healthcare professionals, 218 were females (65.1%), and all respondents aged between 22 and 67 years, with a mean age of 37.0 ± 9.0 years. For more information on demographic characteristics, see **Table 1**.

3.2. Awareness of modifiable stroke risk factors

Awareness rate of all healthcare professionals (**Table 2**) was highest for hypertension (96.5%), followed by obesity (93.3%), smoking (91.9%), elevated total cholesterol (91.0%), physical inactivity (83.4%),

Table 1
Demographic factors of respondents.

	Doctors N = 84 N(%)	Nurses N = 227 N(%)	Paramedics N = 33 N(%)	Total N = 344 N(%)
Gender	(missing 4)	(missing 5)	(missing 9)	(missing 9)
Male	49(61.3)	50(22.5)	18(54.5)	117(34.9)
Female	31(38.8)	172(77.5)	15(45.5)	218(65.1)
Age (years)	(missing 16)	(missing 43)	(missing 4)	(missing 63)
20–35	30(44.1)	101(54.9)	18(62.1)	149(53.0)
Over 35	38(55.9)	83(45.1)	11(37.9)	132(47.0)
Region				
Rural	58(69.0)	183(80.6)	0(0.0)	241(70.1)
Urban	26(31.0)	44(19.4)	33(100.0)	103(29.9)
Education level				
Certificate	0(0.0)	1(0.4)	20(60.6)	21(6.1)
Diploma	0(0.0)	177(78.0)	9(27.3)	186(54.1)
Bachelor's degree	71(84.5)	45(19.8)	3(9.1)	119(34.6)
Master's degree	13(15.5)	4(1.8)	1(3.0)	18(5.2)
Clinical experience (years)	(missing 4)	(missing 12)	(missing 7)	(missing 23)
0–1.0	3(3.8)	11(5.1)	5(19.2)	19(5.9)
1.1–5.0	26(32.5)	41(19.1)	8(30.8)	75(23.4)
5.1–10.0	21(26.3)	52(24.2)	4(15.4)	77(24.0)
10.1–15.0	19(23.8)	43(20.0)	4(15.4)	66(20.6)
>15.0	11(13.8)	68(31.6)	5(19.2)	84(26.2)
Sector				
Government	74(88.1)	220(96.9)	10(30.3)	304(88.4)
Private	10(11.9)	7(3.1)	23(69.7)	40(11.6)
Care level				
Primary	40(47.6)	101(44.5)	33(100.0)	174(50.6)
Secondary	44(52.4)	126(55.5)	0(0.0)	170(49.4)
Place/ district				
Gaborone	12(14.3)	18(7.9)	33(100.0)	63(18.3)
Kgatlang	9(10.7)	13(5.7)	0(0.0)	22(6.4)
Southeast	20(23.8)	69(30.4)	0(0.0)	89(25.9)
Kweneng	16(19.0)	46(20.3)	0(0.0)	62(18.0)
Ngwaketse	19(22.6)	55(24.2)	0(0.0)	74(21.5)
Lobatse	8(9.5)	26(11.5)	0(0.0)	34(9.9)

Table 2
Awareness of modifiable stroke risk factors among respondents.

	Doctors N = 84 N(%)	Nurses N = 227 N(%)	Paramedics N = 33 N(%)	Total N = 344 N(%)	<i>p</i>
Elevated total cholesterol	75 (89.3)	211 (93.0)	27(81.8)	313 (91.0)	0.895
Elevated LDL cholesterol	70 (83.3)	187 (82.4)	22(66.7)	279 (81.1)	0.774
Obesity	81 (96.4)	211 (93.0)	29(87.9)	321 (93.3)	0.952
Diabetes	79 (94.0)	146 (64.3)	27(81.8)	252 (73.3)	0.162
Hypertension	81 (96.4)	221 (97.4)	30(90.9)	332 (96.5)	0.969
Physical inactivity	70 (83.3)	196 (86.3)	21(63.6)	287 (83.4)	0.609
Smoking	81 (96.4)	209 (92.1)	26(78.8)	316 (91.9)	0.809
Excessive alcohol drinking	60 (71.4)	185 (81.5)	20(60.6)	265 (77.0)	0.574
Influenza	16 (19.0)	48(21.1)	8(24.2)	72 (20.9)	0.924

elevated LDL cholesterol (81.1%), excessive alcohol drinking (77.0%), and lowest for diabetes (73.3%). There were no significant differences between healthcare professionals on awareness rates for any stroke risk factor. About 1 out of 5 healthcare professionals (20.9%) recognized influenza as a risk factor, and there were no significant differences between the groups.

3.3. Awareness of stroke risk factors by demographic factors

Demographic factors did not have any significant effects on awareness rates of individual stroke risk factors among the three healthcare professional groups (**Supplementary table 1–4**).

3.4. Demographic factors influence on stroke risk factors' knowledge scores

One hundred and fifty-two healthcare professionals (44.2%) correctly recognized all eight modifiable stroke risk factors, while 0.9% could not recognize any (**Figure 1**). There were significant differences in knowledge scores between all groups of healthcare professionals with doctors scoring highest, followed by nurses and paramedics lowest (7.11 vs 6.85 vs 6.06, *p* = 0.007), for sector category with government scoring higher than the private sector (6.96 vs 5.95, *p* < 0.001), mainly due to significant differences among doctors (7.22 vs 6.30, *p* = 0.011). There were also significant gender differences, with males scoring higher than females (7.11 vs 6.70, *p* = 0.037), and clinical experience differences, with 5.1–10 years' experience highest, followed by >15 years, 10.1–15 years, 1.1–5 years, and 0–1 year' experience lowest (7.14 vs 7.04 vs 6.76 vs 6.65 vs 5.89, *p* = 0.013) (**Table 3**).

4. Discussion

Our study adds to the scant previous literature on awareness of stroke risk factors either focusing only on doctors [12] or hospital workers [13]. Overall, only 44.2% of healthcare professionals recognized all 8 modifiable risk factors showing low knowledge of stroke among some healthcare professionals' subgroups such as female gender, certificate holders, 0–1 year' clinical experience and private sector. Only 20.9% of healthcare professionals recognized influenza as a stroke risk factor showing lack of awareness. An integral component of stroke prevention relies on an appropriately trained and resourced healthcare workforce. Given that healthcare professionals play important roles in stroke risk factors stratification and diagnosis, further post-graduate

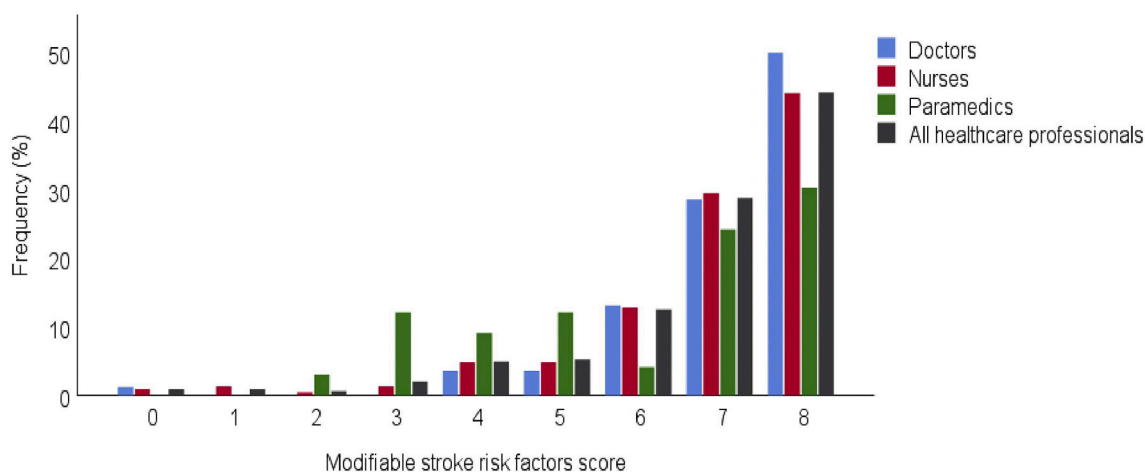


Fig. 1. Frequency of stroke risk factors recognized by respondents.

education, and improved training of healthcare professionals is required in stroke. Therefore, the results call for policy reforms on stroke care by health policymakers and other stakeholders so that these subgroups are targeted to improve their knowledge through continuous education programs.

To our knowledge, this is the first study comparing stroke knowledge among all-3 health professions. There were significant differences among the groups, with doctors scoring highest, followed by nurses and paramedics lowest. These can partly be attributed to the 2.9% variance in the knowledge that is explained by profession in this study, and different education levels with doctors having the highest education level, followed by nurses and lowest paramedics. Moreover, paramedics may not be aware of all the stroke risk factors due to different focus of their jobs (their work focuses on recognizing emergencies rather than identifying risk factors for those emergencies). Even though the mean knowledge scores by profession may be statistically significant different, they do not appear clinically or practically different. That is, for a maximum score of 8, an average score of 7.11 versus 6.85, for example, still means that both groups answered similarly, about 7 questions correct out of 8. For sector category, government scored better than private. An explanation for this may be that private institutions have less focus on continuous education compared to public ones. For gender, with males better than females, which could be partly attributed to the frequency distribution and medium effect size in the response rate in our study. For clinical experience, with 5.1–10 years' experience highest and 0–1 year' experience lowest. This is mainly due to lack of experience among those with 0–1 year' experience and the 3.9% variance in the knowledge that is explained by clinical experience in our study.

Second, to our knowledge, this is the first study to compare awareness of stroke risk factors among doctors, nurses, and paramedics. There were no significant differences in awareness of modifiable stroke risk factors among respondents. All-3 healthcare professionals and each individual profession showed the highest awareness rate for hypertension. This compares well to the Chinese study by Chen C et al. and the Nigerian study by Akinyemi RO et al. [12,13] that showed healthcare professionals had the highest awareness for hypertension. Doctors demonstrated awareness of more than 90% in 4 stroke risk factors (obesity, diabetes, hypertension, and smoking) and had the lowest awareness for excessive alcohol drinking (71.4%). This contrasts a study by Chen C et al., in which doctors demonstrated awareness of more than 90% in 7 risk factors and had the lowest awareness for limited physical activity (73.2%) [12]. These discrepancies can be explained by study population differences (number of respondents, time, and place of conducting the study).

Final, to our knowledge, this is the first study determining awareness of stroke risk factors by demographic factors among the three healthcare

professionals. There were no significant differences for stroke risk factors' awareness between any demographic factors among healthcare professionals. This contrasts with one study by Chen et al. [12], which showed education significantly influenced awareness of elevated total cholesterol, region influenced awareness of diabetes, and clinical experience influenced awareness of physical inactivity among doctors. This discrepancy can be explained by study population differences.

4.1. Limitations

There are some limitations to 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 risk factors included in this study should be weighted equally because some are easily identifiable and more common than others. Third, we did not include all risk factors e.g. atrial fibrillation and diet among others. Fourth, actual practice may not correlate with self-reported knowledge. Fifth, some subgroups were small in numbers (e.g. private sector) therefore reducing statistical power to show differences. Sixth, several detractors should have been added to the study, in case respondents crossed all answers correct for convenience. Seventh, because of the low numbers of healthcare professionals in the country, we did not specify their areas of specialization or departments for fear of recognition since the questionnaire were supposed to be anonymous. 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 61.4% was attained and therefore results represent current knowledge of healthcare professionals delivering healthcare to people with stroke/risk factors in greater Gaborone.

5. Conclusion

In summary, the survey results revealed high knowledge of stroke risk factors but gaps in knowledge among some healthcare professional subgroups. Doctors showed significantly highest knowledge, followed by nurses and paramedics lowest. Government employees were associated with high knowledge. Low knowledge was associated with female gender, paramedics, private sector, and 0–1 year' clinical experience. Healthcare professionals' subgroups with low knowledge need to be targeted for continuing education and training on ischemic stroke risk factors for better risk factors stratification and better management, since it can result in preventing stroke, and reducing stroke-related disability and mortality in Botswana.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ensci.2021.100365>.

Table 3
ANOVA analysis: Healthcare professionals' mean stroke risk factors knowledge scores by demographic factors.

	Doctors	Nurses	Paramedics	Total
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
Profession				
Doctors	NA	NA	NA	7.11 (6.83–7.39)
Nurses	NA	NA	NA	6.85 (6.65–7.06)
Paramedics	NA	NA	NA	6.06 (5.39–6.74)
p				0.007; 0.005#, 0.027 ϡ ηp2 = 0.029
Gender				
Male	7.24 (6.95–7.54)	7.24 (6.96–7.52)	6.39 (5.47–7.31)	7.11 (6.89–7.33)
Female	6.87 (6.25–7.49)	6.76 (6.51–7.01)	5.67 (4.59–6.75)	6.70 (6.47–6.93)
p	0.366	0.079	0.285	0.037; d = 0.24
Age group (years)				
20–35	7.20 (6.80–7.60)	6.80 (6.50–7.11)	5.78 (4.83–6.72)	6.76 (6.51–7.01)
>35	7.08 (6.58–7.58)	6.81 (6.45–7.17)	6.18 (4.72–7.65)	6.83 (6.55–7.12)
p	0.842	0.731	0.603	0.414
Region				
Rural/semi-urban	71.6 (6.79–7.52)	6.91 (6.71–7.12)	NA	6.97 (6.79–7.15)
Urban	7.00 (6.54–7.46)	6.61 (5.99–7.24)	6.06 (5.39–6.74)	6.76 (6.33–7.18)
p	0.393	0.810*	NA	0.623@
Education level				
Certificate	NA	7.00(NA)	6.05 (5.13–6.97)	6.10 (5.22–6.97)
Diploma	NA	6.84 (6.60–7.07)	5.78 (4.30–7.26)	6.78 (6.55–7.02)
Bachelor's degree	7.15 (6.90–7.41)	6.93 (6.48–7.38)	6.33 (1.16–11.50)	6.90 (6.45–7.34)
Master's degree	6.85 (5.54–8.15)	6.75 (3.74–9.76)	8.00(NA)	7.00 (4.85–9.15)
p	0.746	0.989	0.748	0.263ϡ
Clinical experience (years)				
0–1.0	6.33 (2.54–10.13)	6.55 (5.58–7.51)	4.20 (1.51–6.89)	5.89 (4.99–6.80)
>1–5.0	7.23 (6.78–7.68)	6.49 (5.90–7.08)	5.63 (4.08–7.17)	6.65 (6.26–7.04)
>5–10.0	7.19 (6.74–7.64)	7.13 (6.79–7.47)	7.00 (5.70–8.30)	7.14 (6.89–7.40)
>10–15.0	6.74 (5.82–7.66)	6.77 (6.31–7.23)	6.75 (3.74–9.76)	6.76 (6.36–7.16)
>15	7.45 (6.76–8.15)	7.04 (6.70–7.39)	6.00 (3.09–8.91)	7.04 (6.72–7.35)
p	0.415	0.145	0.229	0.013; 0.034φ, 0.022Ψ ηp2 = 0.039
Sector				
Government	7.22 (6.92–7.51)	6.88 (6.67–7.08)	6.80 (5.92–7.68)	6.96 (6.76–7.12)
Private	6.30 (5.40–7.20)	6.14 (4.69–7.60)	5.74 (4.84–6.64)	5.95 (5.38–6.52)
p	0.011; d = 0.85	0.156	0.079*	<0.001; d = 0.65
Care level				
Primary	6.98 (6.48–7.47)	6.82 (6.52–7.12)	6.06 (5.39–6.74)	6.87 (6.61–7.12)
Secondary	7.23 (6.92–7.53)	6.88 (6.60–7.16)	NA	6.97 (6.75–7.19)

Table 3 (continued)

	Doctors	Nurses	Paramedics	Total
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
p	0.518	0.610	NA	0.468@
Location				
Gaborone	6.67 (5.88–7.45)	7.11 (6.33–7.89)	6.06 (5.39–6.74)	6.93 (6.40–7.47)
Kgatlang	7.22 (6.15–8.29)	6.92 (6.05–7.79)	NA	7.05 (6.43–7.66)
Southeast	6.70 (5.88–7.52)	6.83 (6.45–7.20)	NA	6.80 (6.46–7.13)
Kweneng	7.19 (6.66–7.71)	7.04 (6.76–7.33)	NA	7.08 (6.84–7.33)
Ngwaketse	7.53 (7.06–7.99)	6.91 (6.50–7.32)	NA	7.07 (6.74–7.40)
Lobatse	7.50 (6.61–8.39)	6.27 (5.34–7.20)	NA	6.56 (5.81–7.30)
p	0.094	0.650	NA	0.705@

NA: not applicable, *: equal variances not assumed, @: between doctors and nurses, #: between doctors and paramedics, ϡ: between nurses and paramedics, ηp2: partial eta squared, d: Cohen's d, CI: confidence interval, φ: between 0 and 1.0 year and > 5–10.0 years, Ψ: between 0 and 1.0 year and > 15 years

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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.

Consent for publication

All authors have read and approved the manuscript for submission.

Author contributions

All authors contributed substantially in producing this manuscript.

Declaration of Competing Interest

None declared.

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