Kaddumukasa et al., *Cogent Medicine* (2017), 4: 1327129
https://doi.org/10.1080/2331205X.2017.1327129

cogent medicine

NEUROLOGY | RESEARCH ARTICLE

A cross-sectional population survey on stroke knowledge and attitudes in Greater Kampala, Uganda

Mark Kaddumukasa[1]*, James Kayima[1], Jane Nakibuuka[1], Leviticus Mugenyi[2], Edward Ddumba[3], Carol Blixen[4], Elisabeth Welter[4], Elly Katabira[1] and Martha Sajatovic[4]

Received: 11 November 2016
Accepted: 02 May 2017
First Published: 09 May 2017

*Corresponding author: Mark Kaddumukasa, Department of Medicine, School of Medicine, Makerere University College of Health Sciences, P.O. Box 7072, Kampala, Uganda
E-mail: kaddumark@yahoo.co.uk

Reviewing editor:
Omid Alizadehkhaiyat, Liverpool Hope University, UK

Additional information is available at the end of the article

Abstract: *Background*: Stroke is a neurological condition with rapidly increasing burden in many low- and middle income countries. Africa is particularly hard-hit due to rapid population growth, patterns of industrialization, adoption of harmful western diets, and increased prevalence of risk factors such as hypertension and obesity. Reducing stroke risk factors and teaching people to respond to stroke warning signs can prevent stroke and reduce burden. However, being able to address gaps in knowledge and improving both preventative and early-response care requires a clear understanding of practical and potentially modifiable topics. In this cross sectional study, we assessed the knowledge and attitudes among an urban population residing within the greater Kampala, Uganda. *Methods*: A population cross sectional survey was conducted in urban Mukono, district, central Uganda. Through the systematic sampling method, data were gathered from 440 adult participants who were interviewed about selected aspects of stroke knowledge, attitudes and perception using a pretested structured questionnaire. *Results*: A total of 440 study participants were enrolled. The leading risk factors for stroke identified by the participants were stress (75.7%) and hypertension (45.2%) respectively. Only two (0.5%) of the

ABOUT THE AUTHORS

Our research is focused on developing a better understanding of stroke burden reduction in urban areas in Uganda. This involves the adoption and development of culturally appropriate self-management interventions for the high risk populations. The research in this paper describes one of the study phases, where we try to understand the baseline knowledge and attitudes before designing appropriate interventions in adult populations living in urban areas. This is important because it is not clear what correct information these communities possess and what key areas should we emphasize when developing appropriate interventions for stroke prevention among high risk groups within urban areas in Uganda.

PUBLIC INTEREST STATEMENT

Stroke is a neurological condition, with a rapidly increasing burden in resource limited settings. Community attitudes and knowledge influence stroke prevention, including risk factor identification, management, community and individual response to stroke symptoms when they occur. The success of primary preventive measures and timely medical attention immediately following a stroke is influenced by the public's knowledge and perception of stroke and its risk risk factors. In this article, we describe the knowledge and attitudes of stroke in an adult, urban population in Uganda. We observed that stroke knowledge is poor while, stress and hypertension are the leading perceived risk factors in our settings. Increasing stroke knowledge and education is crucial for engagement in healthcare. Implementing a self-management program to support and motivate this high-risk group as well as adopting healthy life-styles may be a way to reduce stroke burden in Uganda.

study participants identified cigarette smoking as a stroke risk factor. Individuals with hypertension have poor knowledge regarding stroke in spite their high risk for stroke. *Conclusion*: Stroke knowledge is poor while, stress and hypertension are the leading perceived risk factors in our settings. While stress is contributing factor, hypertension is likely a more amenable and practical intervention target. Targeting individuals with stroke risk factors to increase stroke knowledge and education is crucial for engagement in healthcare. Implementing a self-management program to support and motivate this high-risk group as well as adopting healthy life-styles may be a way to reduce stroke burden in Uganda.

Subjects: General Medicine; Neurology; Stroke; Neurological Rehabilitation

Keywords: stroke; hypertension; global health; knowledge; risk factors; warning factors

1. Introduction

Stroke is the second most common cause of mortality worldwide and remains a leading cause of adult disability. Developing countries account for nearly 85% of global deaths from stroke (Feigin et al., 2013; Krishnamurthi et al., 2014; Mathers, Lopez, & Murray, 2006; Strong, Mathers, & Bonita, 2007). In Africa, stroke accounts for 15% of hospital admissions and is a major contributor to mortality in both rural and urban areas (Etyang & Scott, 2013). A systematic review showed that worldwide stroke incidence declined by 42% in high income countries over the 4 decades from 1970–1979 to 2000–2008 (Feigin, Lawes, Bennett, Barker-Collo, & Parag, 2009). During the same period, stroke incidence rose more than 100% in low- to middle-income countries (Feigin et al., 2009). Hypertension is the single most important modifiable stroke risk factor. In Africa, more than 90% of patients with hemorrhagic stroke and more than half with ischemic stroke have high blood pressure.

Community attitudes and knowledge influence stroke prevention, including risk factor identification and management, as well as community and individual response to stroke symptoms when they occur. The success of primary preventive measures and timely medical attention immediately following a stroke is influenced by the public's knowledge and perception of stroke and its risk factors (Akinyemi et al., 2009; Jones, Jenkinson, Leathley, & Watkins, 2010). However the awareness of stroke, and its risk factors and symptoms is low in community studies conducted in Africa (Cossi, Preux, Chabriat, Gobron, & Houinato, 2012; Wahab et al., 2008). In Uganda, public knowledge and attitudes have not been well studied. A study in Uganda's Mukono district found poor knowledge regarding stroke in the community population (Kaddumukasa et al., 2015). Another study found nearly 3/4 of study participants were unable to identify stroke risk factors and warning signs and did not recognize stroke as a brain disorder (Nakibuuka et al., 2014). Since understanding public knowledge gaps, attitudes, and perceptions of stroke is critical to inform the development of appropriate targeted primary and secondary stroke preventative interventions, this study objectives were, therefore, to assess the knowledge and attitudes of stroke in an urban population in Mukono district, central Uganda.

2. Materials and methods

Study design and population: Multi stage sampling at the sub-county, parish and village level in Mukono Municipality, Mukono district was used in this cross-sectional study of 440 participants. Mapping of the selected urban areas was based on the Uganda population and Housing Census where 17338 households were identified in Mukono TC. The sampling frame was all households in these areas. At the household level, one adult household member was randomly selected to participate. Face to face interviews were conducted between December and March 2016 in 6 urban villages. A resident of the village was defined as a person anticipated to be staying primarily within that location for the following 6 months. Each urban village contributed 75 households. The study team engaged the village local council leaders, municipal health team and the basic elements of informed consent: the purposes of the research, the potential benefits for and risks to the larger

Mukono municipality community, procedures for subject recruitment, inclusion and exclusion criteria, and the risks and benefits of participation were discussed. Once the protocol was explained, any questions were registered and appropriate responses were given. Community consent was sought before household screening for potential participants, and subsequently written informed consent was obtained from each participant before enrolment. The selected households were visited by the research team. One adult, randomly selected from each household was approached to participate in the study. If more than one eligible participant were found in a household, then a draw was conducted within that household. The randomly selected participant was informed about the research and the intended use of the information obtained.

The participants were interviewed in Luganda a local language, on selected aspects of stroke knowledge, and the participants' attitudes in the event of a stroke occurrence. The responses were collected using study paper questionnaires. The average length of the completed interviews was about 30 min. The inclusion criteria included; usual resident who is present in the sampled household on the night before the survey, aged 18 years or older (adult) and willingness to provide written informed consent. We excluded those who were physically unable to participate in interview. Once individuals agreed to enroll in the study and signed the consent form, the study coordinator/nurse completed the screening visit, including a brief questionnaire about demographics and knowledge about stroke and attitudes in the event of a stroke. The participants' blood pressure was measured and if their blood pressure equals or exceeded 140/90 mm Hg, the participants were be asked to go to the nearest designated clinic/health center the following morning or scheduled appointment, for additional assessments. To address potential sources of bias, a standardized questionnaire was used. Study interviewers' received training on standardized data collection to minimize inter-observer variability during data gathering and data entry.

2.1. Sample size determination

The sample size calculation for stroke knowledge and attitudes was based on the main study which determined the prevalence of hypertension which us an important risk factor for stroke in our setting.

The formula: $\left\{ n = \frac{Z_{\alpha}^{2}(pq)}{d^{2}} \right\} \times$ deff, was used to determine the sample size, where p = prevalence of hypertension, q = complement of the prevalence, margin of error is error = d, alpha = significance level and deff = design effect to account for clustering effect. Setting significance at 0.05, error margin at 5% and design effect at 1.5 based on education and age among respondents from the households, adjusted sample requirement for an assumed 10% level of non-response (nr = 10%) = N^*. Based on a meta-analysis of West African countries (Owolabi, Ugoya, & Platz, 2009) where hypertension prevalence was 22% and N^* = 439, we therefore recruited 440 participants.

3. Questionnaire and measurements

We used a modified standardized questionnaire that assessed knowledge towards stroke already used in the sub-Sahara African settings (Akinyemi et al., 2009; Droste, Safo, Metz, & Osada, 2014; Kaddumukasa et al., 2015; Nakibuuka et al., 2014) (See Additional file). The study questions in the questionnaire were closed. Participant's knowledge of stroke warning signs was categorized based on the numbers of stroke warning signs (Ayanniyi, Akande, & Mustapha, 2006; Sug Yoon, Heller, Levi, Wiggers, & Fitzgerald, 2001). Individuals with good knowledge could identify 5–10 stroke warning signs, fair knowledge 2–4 signs, and poor knowledge one stroke warning sign. *Anthropometric measurements:* Having completed the questionnaire, the survey team performed some simple measurements on the study participants. These were done at their homes as well as in the clinic using standardized protocols, calibrated equipment and recorded.

3.1. Height

Height was measured as a perpendicular distance between the top of the head and the bottom of the feet using a SECA 214 stadiometer.

3.2. Weight

A SECA 762 weighing scale was used to measure weight. The reading was taken to the nearest 0.1 kg.

3.3. Blood pressure measurement

Standard blood pressure assessment procedures were used. Blood pressure was measured with an Omron automated sphygmomanometer model HEM-907 whose accuracy has been validated (Gurpreet, Tee, & Karuthan, 2008). The blood pressure on the left arm after the participant has sat for at least five minutes, was taken in sitting position, legs uncrossed, the arm resting on the table and the ante cubital fossa at the level of the sternum. Two arm cuffs that fit arm circumferences 9–13 inches and 13–17 inches was used in the process. Three readings were taken three minutes apart and the closest two were used to describe the blood pressure of the patient. Hypertension was defined as a systolic blood pressure ≥140 mm Hg and/or a diastolic blood pressure of ≥90 mm Hg, or treatment with anti-hypertensive medication in accordance with the United States Seventh Joint national Committee on Detection, Evaluation and Treatment of Hypertension (JNC-VII) (Chobanian et al., 2003).

4. Ethical considerations

Ethical approval for the study was obtained from Makerere University College of Health Sciences' School of Medicine review board and ethics committee Ref number 2015-073 and UNCST Ref Number. HS 1858. Written informed consent was obtained before enrolling the participants into the study.

5. Data analysis

Descriptive statistics of mean, frequency, and percentages were used to summarize data on socio-demographic variables and stroke knowledge and attitudes. Chi-square or Fisher's exact tests were used, as appropriate, to assess associations between stroke knowledge and attitudes, demographic variables and self-reported risk factors. All tests of hypothesis were two tailed with a level of significance at 0.05. All statistical analysis was performed using STATA software version 12 (Stata Corporation, College Station, TX, USA).

6. Results

Four hundred and forty-eight subjects were screened and a total of 440 adult study participants in urban settings were enrolled into this study, (response rate of 98.2%). Among those not enrolled; 6 were excluded due to unavailability for the study activities and two for lack care partners. Seventy-three percent (321/440) of the study participants were women. The median age (Range) of the study participants was 45 (18–91) years. Other descriptions of the demographics are shown in Table 1. Out of 440 individuals screened in the greater Kampala area, 77 (17.5%) had hypertension.

6.1. Stroke knowledge and planned response to an event of stroke

A half of the study participants (228/440) were able to recognize that the brain is the organ involved in stroke. Over two-thirds of the participants (345/440) also reported that someone can have a stroke more than once. About 98.9% (434/440) expressed a willingness to participate in future stroke prevention strategies.

However, only 45.2% (199/440) of the study participants knew that hypertension causes stroke. The other known risk factors like bad diet, lack of exercise, diabetes mellitus, obesity, old age, hereditary factors and heart disease were reported in the following frequencies, 16.9, 8.2, 8, 3.1, 2.1, 1.2 and 0.9% respectively. Eight percent of the study participants reported other causes like bad luck, witch craft, punishment for bad deeds etc. About three fourths (333/440) reported stress to be the main contributing factor of stroke. Only 2.5% (11/440) did not know any cause of stroke, while 0.5% reported witchcraft as the cause.

Eighty-nine percent of the study participants (393/440) reported that they would go to hospital as a planned response to an event of stroke. Only three participants reported that they would visit

Table 1. Demographic of adult study participants screened in greater Kampala (*N* = 440)

Demographic characteristics	*N*	Percentage	Median (Min, Max)
Age in years			45 (18, 91)
<25 years	24	5.5	
25–34 years	68	15.5	
35–44 years	31	7.1	
>44 years	128	29.1	
Not known	189	42.9	
Gender			
Female	321	73.0	
Marital status			
Married	195	44.3	
Single-never married	58	13.2	
Cohabiting	75	17.1	
Divorced	5	1.1	
Separated	65	14.8	
Widowed	42	9.6	
Religion			
Catholic	133	30.2	
Protestant	185	42.1	
Muslim	69	15.7	
Pentecostal	43	9.8	
Other	10	2.3	
Highest level of education attained			
None	26	5.9	
Primary	137	31.1	
Secondary	226	51.4	
Tertiary	51	11.6	

alternative health care providers such as herbalist or traditional healers (see Table 2). Recognizing stroke as a disorder of the brain was not, however, associated with knowledge of stroke warning signs, $p = 0.250$.

6.2. Warning symptoms of stroke

Only 68 study participants (17.7%) knew three or more warning signs of stroke, while the majority knew one or two. However, there was no difference among those who knew warning signs and those who did not know any, $\chi^2 = 2.71$, $df = 2$, p-value of 0.145 (Table 3). We did not consider multivariable analysis because there were no factors associated with knowledge of warning signs at bi-variable analysis (see Table 3). Sixty-one percent (268/440) reported paralysis as the leading warning sign of stroke, followed by body weakness 25%, (110/440). The frequency of other reported warning signs of stroke such as weakness of the limbs, fever and sweating, dizziness, difficulty speaking, headache, double vision, palpitations, tiredness, shortness of breath, numbness and fainting was 25, 23, 18, 19, 15, 14, 8, 5 4, 1 and 1% respectively.

Table 2. Stroke knowledge among individuals in greater Kampala (*N* = 440)

Stroke knowledge	*N*	Percentage
Stroke caused by sudden attack of brain (Yes)	228	51.8
Stroke is preventable (Yes)	249	56.6
Someone can have stroke more than once (Yes)	345	78.4
Stroke has effect to daily activities like driving, use of toilet and having a job (Yes)	436	99.1
Knows any risk factor for stroke (Yes)	426	96.8
Knows any warning sign for stroke (Yes)	396	90.0
Would participate in stroke prevention strategies	434	98.9
What do you believe causes stroke?		
Hypertension	199	45.2
Stress	333	75.7
Bad diet	63	14.3
Fatty foods	62	14.1
High cholesterol	15	3.4
Obesity	14	3.2
Lack of exercise	33	7.5
Atherosclerosis	15	3.4
Alcohol	13	3.0
Inheritance	5	1.1
God's will	8	1.8
Cigarette smoking	2	0.5
Witch craft	2	0.5
Don't know	11	2.5
Planned response to an event of stroke		
Go to hospital	393	89.3
Call general practioner/doctor	29	6.6
Visit community health center	10	2.3
Visit alternative health care providers (e.g. herbalist, traditional healer)	3	0.7
Invite a physiotherapist	2	0.5
Ask family members or relatives to help	7	1.6
Ask friend or neighbours for help	4	0.9
Self-medication	4	0.9
Combination of hospital and traditional treatments	3	0.7

6.3. Differences in stroke knowledge among hypertensive and normotensive study participants

There were no significant differences in knowledge among study participants who were hypertensive and those who were normotensive except alcohol with $\chi^2 = 3.05$, $df = 2$, p-value 0.081. There was no difference in planned response to an event of a stroke. See Table 4.

Table 3. Factors associated with knowledge for warning signs of stroke among individuals in greater Kampala

		Knows 1 or more warning signs for stroke *N* (%)	Don't know any warning sign for stroke *N* (%)	*p*
Demographics				
Age in years	<25	17 (8.0)	7 (18.4)	0.276
	25–34	59 (27.7)	9 (23.7)	
	35–44	27 (12.7)	4 (10.5)	
	>45	110 (51.6)	18 (47.4)	
Gender	Female	286 (74.5)	35 (62.5)	0.059
	Male	98 (25.5)	21 (37.5)	
Marital status	Married	170 (44.3)	25 (44.6)	0.079
	Single	47 (12.2)	11 (19.6)	
	Cohabiting	71 (18.5)	2 (3.6)	
	Divorced	3 (0.8)	4 (7.1)	
	Separated	57 (14.8)	8 (14.3)	
	Widowed	36 (9.4)	6 (10.7)	
Religion	Catholic	114 (29.7)	19 (33.9)	0.081
	Protestant	168 (43.8)	17 (30.4)	
	Muslim	54 (14.1)	15 (26.8)	
	Pentecostal	38 (9.9)	5 (8.9)	
	Other	10 (2.6)	0 (0.0)	
Highest level of education attained	None	22 (5.7)	4 (7.1)	0.691
	Primary	120 (31.3)	17 (30.4)	
	Secondary	195 (50.8)	31 (55.4)	
	Tertiary	47 (12.2)	4 (7.1)	
Knowledge of stroke				
Knows Organ (brain) affected by Stroke	Yes	203 (52.9)	25 (44.6)	0.250
	No	181 (47.1)	31 (55.4)	
Stroke can be prevented if treated early	Yes	219 (57.0)	30 (53.6)	0.626
	No	165 (43.0)	26 (46.4)	
Person can have stroke more than once	Yes	303 (78.9)	42 (75.0)	0.507
	No	81 (21.1)	14 (25.0)	
Stroke has effect on daily activities	Yes	382 (99.5)	96.4	0.081
	No	2 (0.5)	2 (3.6)	
Knows risk factors for stroke	3 or more	68 (17.7)	6 (10.7)	0.145
	1 or 2	304 (79.2)	46 (82.1)	
	Don't know	12 (3.1)	4 (7.1)	

Table 4. Differences in stroke knowledge among individuals with hypertension vs. without hypertension

Stroke knowledge question	Individuals with normal blood pressure (*N* = 354)	Individuals with hypertension (*N* = 86)	Chi-square/fisher's exact test statistic (*p*-value)
Stroke caused by sudden attack of brain	184 (52.0)	44 (51.2)	0.02 (0.892)
Stroke in preventable	196 (55.4)	53 (61.6)	1.10 (0.293)
Someone can have stroke more than once	281 (79.4)	64 (74.4)	1.01 (0.316)
Stroke has effect on daily activities like driving, use of toilet and having a job	350 (98.9)	86 (100)	0.98 (>0.999)
What do you believe causes stroke?			
Hypertension	165 (46.6)	34 (39.5)	1.40 (0.237)
Stress	270 (76.3)	63 (73.3)	0.34 (0.559)
Bad diet	47 (13.3)	16 (18.6)	1.60 (0.206)
Fatty foods	48 (13.6)	14 (16.3)	0.42 (0.516)
High cholesterol	10 (2.8)	5 (5.8)	1.88 (0.171)
Obesity	9 (2.5)	5 (5.8)	2.40 (0.121)
Lack of exercise	27 (7.6)	6 (7.0)	0.04 (0.837)
Atherosclerosis	11 (3.1)	4 (4.7)	0.50 (0.507)
Alcohol	8 (2.3)	5 (5.8)	3.05 (0.081)
Inheritance	4 (1.1)	1 (1.3)	0.02 (>0.999)
Do not know	9 (2.5)	3 (3.9)	0.48 (0.448)
Other causes	94 (26.6)	21 (24.4)	0.16 (0.686)
Knows any risk factors for stroke			
Yes	343 (96.9)	83 (96.5)	0.35 (0.779)
Knows any warning signs for stroke			
Yes	317 (89.6)	79 (91.9)	0.41 (0.521)
Planned response to an event of stroke (most frequent)			
Go to hospital	314 (88.7)	79 (91.9)	0.72 (0.395)
Call general practitioner/ doctor	23 (6.5)	6 (7.0)	0.03 (0.872)
Ask family members or relatives to help	6 (1.7)	1 (1.2)	0.13 (>0.999)
Visit alternative health care providers (e.g. herbalist/ traditional healer)	1 (0.3)	2 (2.3)	4.27 (0.099)
Invite a physiotherapist	1 (0.3)	1 (1.3)	1.47 (0.225)
Other plans	81 (22.9)	24 (27.9)	0.96 (0.327)
Would you participate in stroke prevention strategies?			
Yes	349 (98.9)	85 (98.8)	0.00 (>0.999)

7. Discussion

Inadequate or incorrect knowledge of stroke risk factors and stroke warning signs contributes to the rising incidence of stroke amongst Africans (Akinyemi et al., 2009; Droste et al., 2014). While this survey of stroke knowledge and attitudes conducted in urban Uganda found that many individuals have limited knowledge of risk factors for stroke, knowledge levels seem greater that that seen in earlier studies conducted within the same area in Uganda (Kaddumukasa et al., 2015). Earlier studies found that only 47.2% individuals knew at least one of the known risk factors of stroke (Kaddumukasa et al., 2015) compared to 79.2% in this survey. While the cross-sectional design of the analysis does not permit a clear causal inference, it is possible that an apparent increase in public stroke knowledge is reflective of targeted community trainings and health. Alternatively, there may be other reasons for the apparent increase in stroke risk factors. There was a trend for women to have greater knowledge of stroke risk factors compared to men. This might be due to fact that women participate more in health activities and may be exposed to more knowledge during these engagments(Nabalamba, 2007; Verhaak, Heijmans, Peters, & Rijken, 2005).

The dissemination of accurate information regarding stroke risk factors and warning signs is important to prevent stroke morbidity and fatality within vulnerable communities. Increasing stroke knowledge among communities is known to result in a shorter time of presentation to the emergency department following stroke onset (Alberts, Perry, Dawson, & Bertels, 1992). In this survey the top reasons, by a large margin, for stroke risk perceived by urban Ugandans were stress and hypertension.

Consistent with our survey respondent's beliefs, stress is associated with cardiovascular disease and metabolic syndromes all which increase the risk of strokes (Everson-Rose & Lewis, 2005; Tsutsumi, Kayaba, Kario, & Ishikawa, 2009). Emotional or physical stress can cause such circulatory changes, mediated in part by catecholamine secretion. It has been proposed with Caplan's hypothesis that acute rises in blood pressure or cerebral blood flow may cause rupture of perforating cerebral vessels (Caplan, 1988, 1994). Stress was reported as a perceived leading cause of stroke in this sample. However, stress is not considered to be a "traditional" risk factor for stroke. Rather, it is usually considered as a contributing factor to more traditional risk factors like hypertension. Helping the urban populations understand stress, its role in stroke and stress coping measures. This is similar to earlier work where stress was attributed as a leading cause of stroke within residents of urban areas (Kreatsoulas & Anand, 2010). This is also similar to a study which has reported stress as a stroke risk factor in our settings (Ayanniyi et al., 2006). Identifying personal stressors and instituting appropriate self-management approaches or life skills is critical in reducing this risk in today's urban population. A study by Hoffman in Durban, South Africa reported low rates of stress and was conducted in young participants aged below 45 years (Hoffmann, 1998).

Hypertension, which ranked number 2 in perceived stroke risk factors in our sample, is one of the most important risk factors for stroke (Feinberg, 1996). Still, less than half of the study participants cited hypertension as a stroke risk factor. This is similar to other earlier studies which have reported higher proportions of 32–51% in the general public (Gill & Chow, 2010; Hux, Rogers, & Mongar, 2000; Potvin, Richard, & Edwards, 2000; Reeves, Hogan, & Rafferty, 2002; Schneider et al., 2003; Sug Yoon et al., 2001). Considering the intimate relationship between hypertension and stroke, communities need to be made aware and future stroke awareness campaigns and health education need to emphasize the significance of hypertension. In this survey many individuals with hypertension are largely unaware of their elevated risk for stroke and appear to be a highly vulnerable group.

Tailored stroke public health campaigns are essential for Ugandan urban adults to reduce their risk for stroke. Modifiable targets appear to be increasing knowledge regarding stroke symptomatology and risk factors. These tailored campaigns should include self-management training as it has been demonstrated that simply increasing knowledge regarding without appropriate motivational support does not lead to sustained changes in behavior (Forster et al., 2012; Rasura et al., 2014; Trobbiani et al., 2013). Finally, identifying high-risk sub-groups (for example, individuals with severe

and poorly controlled hypertension) and instituting appropriate measures might help mitigate the rising threats of stroke in Uganda and sub Saharan Africa.

8. Limitations

Our study is limited by the fact that it was cross-sectional, used close-ended questions, and was confined to a fairly limited geographic area. Because participants of this study were residents of urban areas, the findings of this paper are not likely to applicable to the whole nation or rural settings within Uganda.

The data collected from survey respondents was not adjusted to represent the population from which the sample was drawn.

The data used in this paper was extracted from a main study which was estimating prevalence of hypertension. Fortunately, the *post hoc* power calculation reveals that if the estimated proportion with knowledge that hypertension causes stroke (the 45.2%) is assumed to fall within 15% of the true proportion with 95% CI, a power of 82% was estimated when using a sample size of 440. Both relative precision of 15% and the estimated power of 82% are within the acceptable ranges, so precision was not compromised by using a sample of 440.

9. Conclusion

Future stroke awareness strategies should emphasize that stroke is a brain disease, that it is preventable, that individuals can manage their stroke risk factors. Considering the importance of prompt treatment in improving patient outcomes, we must continue to advise individuals and communities with regard to appropriate action during emergencies. Finally, an important implication of the present study is the need to focus on high risk individuals with poorly controlled hypertension, as a practical way to reduce population stroke burden in Uganda.

List of abbreviations

TC	Town council
UNCST	Uganda National Council of Science and Technology

Acknowledgments
We thank Levi Mugenyi for the guidance on the statistical analysis and Doreen Birungi for the support and guidance. We also thank our survey subjects for participating in this study.

Funding
This study was supported by a grant from the National Institute of Neurological Disorders and Stroke of the National Institute of Health R21NS094022-01 PIs: Martha Sajatovic and Elly Katabira.

Competing Interests
The authors declare no competing interest.

Author's contributions
MK, JN and JK and collected data during the survey; IM MS and EK performed data analyses; MS, CB, and EK designed the study; IM, MK, JK, and JN wrote the paper. MS, CB and EK revised the manuscript for important intellectual content. All authors discussed the results and commented on the manuscript. All authors read and approved the final manuscript.

Author details
Mark Kaddumukasa[1]
E-mail: kaddumark@yahoo.co.uk
James Kayima[1]
E-mail: jkkayima@gmail.com
Jane Nakibuuka[1]
E-mail: nakibuukajm@yahoo.com
Leviticus Mugenyi[2]
E-mail: lmugenyi005@gmail.com
Edward Ddumba[3]
E-mail: ddumbaentamuezala@gmail.com
Carol Blixen[4]
E-mail: cxb28@case.edu
Elisabeth Welter[4]
E-mail: emw@case.edu
Elly Katabira[1]
E-mail: katabira@imul.com
Martha Sajatovic[4]
E-mail: Martha.Sajatovic@UHhospitals.org
[1] Department of Medicine, School of Medicine, Makerere University College of Health Sciences, P.O. Box 7072, Kampala, Uganda.
[2] Infectious Diseases Research Collaboration, Mulago Hill Road, MUJHU3 Building. P.O. Box 7475, Kampala, Uganda.
[3] Department of Medicine, Nkozi University, St Raphael of St Francis Nsambya Hospital, P.O. Box 7146, Kampala, Uganda.
[4] Neurological and Behavioral Outcomes Center, University Hospitals Cleveland Medical Center, 11100 Euclid Avenue, Cleveland, OH 44106, USA.

Citation information
Cite this article as: A cross-sectional population survey on stroke knowledge and attitudes in Greater Kampala, Uganda, Mark Kaddumukasa, James Kayima, Jane Nakibuuka, Leviticus Mugenyi, Edward Ddumba, Carol Blixen, Elisabeth Welter, Elly Katabira & Martha Sajatovic, *Cogent Medicine* (2017), 4: 1327129.

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Cogent Medicine **(ISSN: 2331-205X) is published by Cogent OA, part of Taylor & Francis Group.**