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Knowledge, attitudes and practices of West Africans on genetic studies of stroke: Evidence from the SIREN Study

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Abstract

Background: It is crucial to assess genomic literacy related to stroke among Africans in preparation for the ethical, legal and societal implications of the genetic revolution which has begun in Africa.

Objective: To assess the knowledge, attitudes and practices (KAP) of West Africans about stroke genetic studies.

Methods: A comparative cross-sectional study was conducted among stroke patients and stroke-free controls recruited across 15 sites in Ghana and Nigeria. Participants' knowledge of heritability of stroke, willingness to undergo genetic testing and perception of the potential benefits of stroke genetic research were assessed using interviewer-administered questionnaire. Descriptive, frequency distribution and multiple regression analyses were performed.

Results: Only 49% of 2029 stroke patients and 57% of 2603 stroke-free individuals knew that stroke was a heritable disorder. Among those who knew, 90% were willing to undergo genetic testing. Knowledge of stroke heritability was associated with having at least post-secondary education (OR 1.51, 1.25–1.81) and a family history of stroke (OR 1.20, 1.03–1.39) while Islamic religion (OR=0.82, CI: 0.72–0.94), being currently unmarried (OR=0.81, CI: 0.70–0.92), and alcohol use (OR=0.78, CI: 0.67–0.91) were associated with lower odds of awareness of stroke as a heritable disorder. Willingness to undergo genetic testing for stroke was associated with having a family history of stroke (OR 1.34, 1.03–1.74) but inversely associated with a medical history of high blood pressure (OR=0.79, 0.65–0.96).

Conclusion: To further improve knowledge of stroke heritability and willingness to embrace genetic testing for stroke, individuals with less formal education, history of high blood pressure and no family history of stroke require targeted interventions.

Keywords

African; chronic disease; developing countries; genetic disorders; stroke; Sub-Saharan Africa

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Authors' contribution

MOO, BO and ROA designed the study and planned analyses. ROA and FS wrote the first draft of the report. JA performed the statistical analyses. All authors contributed to the collection of data, discussions and interpretation of the data, and to the writing and review of the manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Introduction

Genetic testing is becoming increasingly popular and available for detecting the heritability risk of diseases for better prediction, early detection, personalized and targeted treatment as well as tailored preventive strategies.[1] However, effective uptake of genomics-driven personalized medicine will require sufficient knowledge about the disease, appropriate attitude and ethically acceptable practices which are not at variance with the core beliefs and value systems of the recipient population. There are recent efforts to enhance the involvement of Africans and African investigators in genomic research to shed more light on the complex interplay between genetic and non-genetic factors in the causation and natural history of communicable and non-communicable diseases including stroke.[2,3] Stroke is the clinically relevant outcome of several complex biological processes and pathways that involve metabolic, behavioural, environmental and genetic factors. Individuals of African ancestry are at higher risk of, and experience poorer outcomes from stroke than most other racial groups in the world.[4]

Recent studies in a sample of individuals of African ancestry in the UK have demonstrated a higher genetic heritability of stroke compared with individuals of European ancestry.[5] Thus, inherited genetic variations offer a possible explanation for the observed peculiarities of stroke in populations of African ancestry, as well as the proportion of risk that remains unexplained by lifestyle, cardiometabolic and socioeconomic factors such as inadequate access to health care.[6] Therefore, studying the genetics of stroke in African ancestry populations may elucidate genetic mechanisms that could not be otherwise revealed in studies of non-African populations.

Previous studies in Africa have highlighted the inadequate knowledge of stroke among the general population, stroke survivors, individuals at risk and even hospital workers[7,8] as well as attitudes and practices that are influenced by cultural and religious beliefs.[9] Although the concept of heritability is well known, the level of comprehension of genetics and genomic risk of diseases is quite uncertain among Africans.[10] Facilitating the translatability of stroke genetic research findings for personalized medicine in Africa will require overcoming the barriers posed by poor health literacy and practices influenced by factors including religious and cultural beliefs. The Stroke Investigative Research and Education Network (SIREN) study[11] is a case-control study exploring the genetic and non-genetic factors involved in stroke among West Africans using multiple approaches.

We previously reported an association of genetic polymorphisms of IL-6, CDKN2A-CDKN2B with ischemic stroke among indigenous West Africans.[12] Furthermore, we have investigated the association of APOL1 G1 variants, with the occurrence of small vessel disease (SVD) ischemic stroke among indigenous West Africans and found that Apolipoprotein L1 (APOL1) rs73885319, rs2383207 in CDKN2A/CDKN2B, and rs2107595 and rs28688791 in HDAC9 gene were significantly associated with symptomatic cerebral small vessel disease.[13]

We report, in this article, the knowledge, attitude and practices (KAP) of West African individuals about genetic studies of stroke and participation in stroke genetic research studies.

Methods

Study design

Study population, patient enrollment and data acquisition.—The rationale and design of the SIREN study has been described elsewhere.[11] Essentially, the SIREN study is a multi-center case-control study involving several sites in Nigeria and Ghana which was initiated in August 2014. The ethnographic characteristics of the study population are as previously described.[14] The ethnic groups include predominantly the Yoruba (Ibadan, Abeokuta, Ile-Ife, Ogbomoso, Owo and Ilorin sites in southern and north central Nigeria), the Hausa/Fulani (Kano and Zaria in northern Nigeria), the Akan, Ewe and Ga/Adangbe (Accra and Kumasi, southern and northern Ghana).[14] Ethical approval was obtained for all study sites and informed consent was obtained from all subjects. Cases included consecutively recruited consenting adults (aged 18 years or older) with first clinical stroke within eight days of current symptom onset or 'last seen without deficit' with confirmatory cranial CT or MRI scan performed within 10 days of symptom onset. Stroke-free status of controls was ascertained using a modified locally validated version of the Questionnaire for Verifying Stroke-Free Status (QVSFS) with a modification to include pictograms of stroke symptoms with improved sensitivity and specificity.[15,16] Individuals with impairment of consciousness, communication difficulties (aphasia) and significant cognitive impairment (Community Screening Instrument for Dementia (CSID) score < 20)[17] following stroke were excluded from the questionnaire survey but sometimes proxies (close family members) assisted the subjects.

Using a comparative cross-sectional design and an interviewer-administered questionnaire for the current study, data were collected on basic demographic and lifestyle variables including ethnicity and native language of the subjects and their parents, socioeconomic status, cigarette smoking and alcohol use. Information on level of education, religious belief and self-reported medical history were also obtained. We obtained information on the participants' knowledge of heritability of physical traits such as facial appearance, height, complexion as well as knowledge of heritability of disorders and illnesses including stroke, hypertension, diabetes mellitus, obesity, albinism, sickle cell disease, cancer, HIV/AIDS, liver cirrhosis and asthma. We further evaluated participants' willingness to undergo genetic testing for assessment of stroke risk and their perception of the potential benefits of genetic testing to the understanding, treatment and control of stroke.

Data management and statistical analysis

Data entry, descriptive and comparative statistical analysis were performed using Stata MP version 14. Thirty-eight (0.8%) participants with missing data for basic demographic variables were excluded from analysis. Chi-square test was used to investigate the association between substrates of stroke genomic literacy and socio-demographic characteristics. Logistic regression analysis was used to identify factors associated with

knowledge of heritability of stroke and willingness to undertake stroke genetics study. Using univariate analysis, crude odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for age, sex, education level, occupation, family medical history, personal medical history, current lifestyle behaviours and awareness of heritability of stroke, hypertension, diabetes mellitus and obesity. Adjusted ORs (95% CI) were then obtained, adjusting for variables that were significantly related in the univariate analyses. Collinearity was assessed using variance inflation factor while the Hosmer-Lemeshow test was applied to assess model fitness. Level of statistical significance was set at $p < 0.05$.

Results

Participants' characteristics

The socio-demographic characteristics of the 2029 stroke patients and 2603 stroke-free individuals are presented in Table 1. Mean age was 57.9±15.1 years and 56.4±15.0 years, respectively. The proportion of women was lower among stroke patients (44.9%) than in stroke-free participants (54.4%). Distribution of educational attainment showed that 33.7% of stroke patients and 26.1% of stroke-free controls had post-secondary education. The predominant religious affiliations were Christianity (stroke patients—67.2%; stroke-free controls—70.7%) and Islam (stroke-patients—31.8%; stroke-free controls—27.8%). History of high blood pressure and diabetes mellitus was much higher among stroke patients than controls (Table 1). The effect of a proxy as informant did not significantly influence participants' knowledge of stroke as a heritable disorder; adjusted OR (95% CI):1.09 (0.89–1.33), p=0.416. In this study, 11.9% and 88.1% of controls and 9.8% and 90.2%, respectively, of the cases lived in rural and urban areas. Living in an urban environment made no significant difference to participants' knowledge of stroke as a heritable disorder adjusted OR (95% CI): 1.05 (0.85–1.28), p=0.668

Knowledge of stroke heritability

Among stroke patients and stroke-free control subjects, 48.7% and 57.0%, respectively, were aware of stroke as a heritable disorder. Comparison of awareness of heritability of other common medical disorders between cases and controls is shown in Table 2. Table 3 shows the crude and adjusted Odds Ratio from a logistic regression model fitted to identify the factors independently associated with knowledge of stroke heritability among stroke subjects. Post-secondary education and family history of stroke were associated with awareness of stroke as a heritable condition. In contrast, Islamic religion, being currently unmarried, and alcohol use were associated with lower odds of awareness of stroke as a heritable disorder (Table 3). Further stratified analysis by country showed that Nigerian respondents older than 45 years of age were less likely to be aware of the heritability of stroke while Ghanaian respondents older than 45 years of age were more likely to be aware of the heritability of stroke (Table S1). Furthermore, the association with Islamic religion and marital status was limited to Nigerian participants only.

Willingness to participate in stroke genetic testing

Survey participants were asked whether they would participate in a research program on stroke genetic testing. Overall 89.1% (stroke patients—85.2%; controls—92.0%) expressed

willingness to participate. Table 4 shows that a family history of stroke was significantly associated with willingness to participate in stroke genetic testing while a personal medical history of hypertension and Islamic religion were inversely associated. Further stratified analysis by country showed that Nigerian respondents who had post-secondary education were willing to participate in genetic testing (Table S2).

Perception about benefit of genetic research

Survey participants also responded to a Likert scale question—"the outcome of genetic test will help scientist to better understand a disease like stroke". Those who agreed or strongly agreed were categorized as having a positive perception about the benefit of stroke genetic test. In total, 89.9% of survey participants (stroke patients—86.6%, controls—92.4%) gave a positive response to the question item. Factors significantly associated include: history of alcohol use, and a family history of stroke whereas age ≥45 years and Islamic religion were inversely associated. Overall, stroke patients were less knowledgeable on stroke heritability, less willing to undergo stroke genetic testing and were less likely to believe that stroke genetic research had any potential benefit (Table 5). Adjusted comparison showed that cases were less likely to have knowledge of stroke heritability, express willingness for stroke genetic testing and have positive perception about benefits of stroke genetic research. These patterns were consistent for all participants and among Nigerians and Ghanaians (Table 6, Table S3).

Discussion

The substantial genomic heterogeneity of African populations offers a unique opportunity to identify novel genes and molecular pathways which contribute to stroke with a potential to pave way for personalized stroke care in people of African ancestry and possibly other global populations.[1,2,5] However, there is paucity of information on stroke genomic literacy in Africa where the burden of stroke is high and escalating.[6] This study assessed knowledge, attitudes and practices on the heritability of stroke among a large population of stroke subjects compared with stroke-free controls encountered in Nigeria and Ghana as a first important step in deciphering areas needing intervention in order to improve stroke genomic literacy. Our major finding is that approximately 50% of West Africans were aware of the heritability of stroke, with stroke patients significantly less aware of the heritable basis for their illness compared with community-based controls. Better awareness of heritability of stroke was strongly associated with higher educational attainment and a family history of stroke whilst single marital status, use of alcohol, a personal medical history of high blood pressure and Islamic religion were associated with lower awareness. However, among study subjects who were aware of the genetic contributions to stroke occurrence, 90% were willing to undergo genetic testing for stroke while 92% believed that genetic testing would enhance better understanding of stroke.

In this study, majority of both cases and controls were urban dwellers but living in an urban environment made no significant difference to participants' knowledge of stroke as a heritable disorder. The finding in this study that stroke genomic literacy was better among the stroke-free controls compared to cases suggests that people who are at higher risk of

stroke and fail to control blood pressure, cholesterol, eat unhealthy food and exercise less have less knowledge about stroke than the stroke-free population.

A pragmatic approach to addressing the high and escalating stroke burden in the SSA region is necessary given its contextually unique setting with socioeconomic obstacles, cultural barriers, lower educational levels, supernatural beliefs, under diagnosis and poor health literacy. Promoting stroke genomic literacy is thus likely to be challenged in such a milieu. For instance, although educational status was significantly higher among stroke patients compared with controls in this study, stroke genomic literacy was significantly lower among stroke cases compared with controls which may probably be a reflection of lower functional health literacy overall among stroke patients in West Africa. Indeed, we have previously shown among the general population, high CVD risk population, stroke survivors, and even among health workers in West Africa,[7–9] a general and pervasively low literacy on cardiovascular disease risk factors and stroke[18–24] which is further highlighted in the present study assessing knowledge on genetic predispositions to stroke. The socio-cultural factors associated with stroke genomic literacy identified in our study represents potential strategic targets for effective educational efforts towards improving public awareness of stroke genetics.[25]

We are eagerly expectant that large scale studies aiming to uncover the genetic underpinnings of stroke among Africans will yield promising findings that might help elucidate the high burden of stroke in the population. A hint from the present study to support our expectations for further genetic discoveries was the observed association between a family history of stroke and stroke occurrence among cases compared with controls.

Ethical, legal and societal implications

The foregoing shows that stroke genomic studies are sprouting in Africa and it is anticipated that this will improve further, especially as findings from other NIH-funded Human Heredity and Health in Africa (H3Africa) cardiometabolic genomic studies are being published. However, although a high percentage of the participants in the current study have a positive perception about the benefit of stroke genetic test, this may not necessarily translate to a good understanding of the interaction between genetic and environmental factors in the etiology, manifestation and prognosis of stroke. This finding is hardly limited to SSA as similar experience has been documented in many communities experiencing health disparity and low education.[25] Nakamura et al. have also documented an inverse relationship between genomic literacy and risk of hypertension in a Japanese community.[26] Our findings also provide a basis for targeted health and genomic literacy intervention for those who have a history of high blood pressure, are above the age of 45 years and adherents of Islamic faith in order to improve cultural, societal and religious understanding of stroke genomics. The latter is particularly important to facilitate the translatability of genetic research findings for personalized medicine and precision public health relevant to Africa and other resource limited settings.[1,2] As stroke genomics discoveries in SSA begin to unravel, and Africans become more technologically savvy and media exposed, there is a need to identify, document, and develop evidence-based approaches to address all potential ELSI issues

related to genetic and genomic stroke research in the region.[2,6] This is a contextually significant issue in the light of the finding from the present study where 90% were willing to undergo genetic testing for stroke, >90% believed that genetic testing would enhance better understanding of stroke juxtaposed with the high frequency of stroke-related stigma,[27] post-stroke vascular cognitive impairment,[28–30] post-stroke depression and anxiety[31–33] and high early and late post-stroke mortality reported in the region.[6,34] The importance of educating genetic research participants using lay language and culturally proficient community-based participatory approaches in underserved populations has been previously emphasized.[35]

Strengths, limitations and future directions

Although we have sampled a fairly large population across 15 sites in Nigeria and Ghana making our findings more generalizable, stroke patients were recruited mainly from hospitals while the stroke-free individuals were recruited largely from the community. We minimized referral bias for the stroke patients through community outreaches from the catchment populations of the hospitals to encourage rapid referral to SIREN hospitals. Furthermore, due to the cross-sectional design of the study, associations observed between clinical indicators and stroke genomic literacy are not causal. Also, qualitative approaches were not used in the current study. However, this study, to our knowledge, is the largest to date in Africa to report on the knowledge, attitudes and practices of West Africans towards heritability of stroke, a prototypical non-communicable disease with strong genetic underpinnings. Further studies are required to explore the sociocultural issues and impact on individuals and communities in West Africa.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Socio-demographic characteristics of participants

Characteristic	Cases (*n*=2029)	Controls (*n*=2603)	Test Statistic	*P* value
Age (mean + SD) years	57.9 ± 15.1	56.4 ± 15.0	3.205[a]	0.001
Gender (% female)	44.9	54.4	40.829	<0.001
Education (%)				
None	18.3	18.0		<0.001
Elementary	18.5	28.0		
Secondary	29.4	27.9		
Post-secondary	33.7	26.1	66.443	
Religion (%)				0.005
Christianity	67.2	70.7		
Islam	31.8	27.8		
Others	1.0	1.5	10.797	
Marital Status				<0.001
Not married	23.1	30.3		
Married	76.9	69.7	30.274	
Residence				
Rural	11.9	9.8		
Non-rural	88.1	90.2	4.584	0.032
Personal medical history				
Hypertension (%)	69.3	37.8	451.713	<0.001
Diabetes mellitus (%)	15.5	8.7	51.093	<0.001
Heart disease	2.2	2.6	139.636	0.43
Obesity	3.4	3.8	0.613	0.45
			26.83	
Family medical history				
Stroke	23.1	15.3	45.887	<0.001
Current lifestyle/behaviour				
Smoking	6.4	6.2	0.058	0.81
Alcohol use	18.8	22.4	9.064	0.003

Test Statistic:

[a]Compared by student' *t* test; all others chi-square test.

Table 2.

Knowledge of heritable disorders.

Heritable disorder	Controls: *n* (%)	Cases: *n* (%)	Test statistic	*P* value
Stroke	1484 (57.0)	988(48.7)	31.7	$p < 0.001$ *
Hypertension	1482 (56.9)	1200 (59.1)	2.3	0.131
Diabetes mellitus	1546 (59.4)	1222 (60.2)	0.3	0.566
Albinism	1614 (62.0)	1232 (60.7)	0.8	0.372
Cancers	1074 (41.3)	751 (37.0)	8.6	0.003
Heart disease	1043 (40.1)	719 (35.4)	10.4	0.001
Kidney disease	856 (32.9)	551 (27.2)	17.7	$p < 0.001$ *
Asthma	1541 (59.2)	1127 (55.5)	6.2	0.012
HIV/AIDS	866 (33.3)	674 (33.2)	0.0	0.971
Tuberculosis	1100 (42.3)	723 (35.6)	21.0	$p < 0.001$ *
Liver cirrhosis	810 (31.1)	459 (22.6)	41.4	$p < 0.001$ *

Test Statistic: compared by student's *t*-test.

*Significant variables ($p < 0.05$)

Table 3.

Demographic and clinical characteristics associated with awareness of heritability of stroke among stroke patients.

Characteristic	Aware (*n*, %)	Crude OR (95% CI)	Adjusted OR (95% CI)
Age			
<45 years	557 (56.4)	1.00	1.00
>45 years	1915 (52.6)	0.86 (0.74–0.99)	0.91 (0.78–1.05)
Gender			
Male	1,239 (53.7)	1.00	–
Female	1,233 (53.0)	0.97 (0.87–1.09)	
Education			
None	408 (48.5)	1.00	1.00
Elementary	536 (48.6)	0.99 (0.84–1.19)	0.95 (0.79–1.14)
Secondary	692 (52.3)	1.16 (0.98–1.38)	1.06 (0.89–1.28)
Post-secondary	836 (61.3)	**1.68 (1.42–2.02)**	**1.51 (1.25–1.81)** *
Religion			
Christianity	1,761 (55.0)	1.00	1.00
Islam	683 (49.9)	**0.82 (0.72–0.93)**	**0.82 (0.72–0.94)** *
Others	28 (47.5)	0.74 (0.44–1.23)	0.89 (0.53–1.50)
Marital Status			
Married	1,856 (55.0)	1.00	1.00
Not Married	616 (49.0)	**0.79 (0.69–0.89)**	**0.81 (0.70–0.92)** *
Personal medical history			
Hypertension	1,272 (53.2)	0.99 (0.88–1.11)	
Diabetes mellitus	275 (50.9)	0.89 (0.75–1.07)	
Heart disease	59 (52.7)	0.97 (0.67–1.42)	
Obesity	91 (54.8)	1.06 (0.78–1.45)	
Family history of stroke	492 (56.8)	**1.18 (1.01–1.37)**	**1.20 (1.03–1.39)** *
Current lifestyle/behaviour			
Smoking	139 (47.9)	0.79 (0.62–1.01)	0.88 (0.68–1.13)
Alcohol use	475 (49.3)	**0.81 (0.71–0.94)**	**0.78 (0.67–0.91)** *

Note: Only variables with *p*-value<0.1 from crude OR were included to obtain adjusted ORs using logit model.

* Significant variables ($p < 0.05$). Significant variables are in bold.

Table 4.

Demographic and clinical characteristics associated with willingness to undergo stroke genetics testing among stroke patients

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)
Age		
<45 years	1.00	1.00
>45 years	0.82 (0.65–1.04)	0.92 (0.72–1.18)
Gender		
Male	1.00	
Female	1.01 (0.84–1.22)	
Education		
None	1.00	1.00
Elementary	1.42 (1.08–1.87)	1.24 (0.94–1.65)
Secondary	1.43 (1.01–1.87)	1.22 (0.93–1.61)
Post-secondary	1.38 (1.06–1.79)	1.19 (0.91–1.57)
Religion		
Christianity	1.00	1.00
Islam	0.72 (0.59–0.87)	**0.79 (0.65–0.97)** *
Others	0.82 (0.37–1.82)	0.75 (0.34–1.68)
Marital Status		
Married	1.00	
Not Married	0.89 (0.73–1.09)	
Personal medical history		
Hypertension	**0.78 (0.64–0.94)** *	**0.79 (0.65–0.96)** *
Diabetes mellitus	1.02 (0.77–1.37)	
Heart disease	0.86 (0.49–1.51)	
Obesity	1.59 (0.88–2.89)	1.52 (0.84–2.77)
Family history of stroke	1.42 (1.09–1.84)	**1.34 (1.03–1.74)** *
Current lifestyle/behaviuor		
Smoking	1.16 (0.78–1.73)	
Alcohol use	1.41 (1.10–1.81)	1.25 (0.97–1.61)

Note: Only variables with *p*-values < 0.1 from crude OR were included to obtain adjusted ORs using logit model.

* Significant variables ($p < 0.05$). Significant variables are in bold.

Table 5.

Factors associated with belief that genetic research will enhance better understanding of stroke.

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)
Age		
<45 years	1.00	1.00
>45 years	0.67 (0.51–0.86)	**0.74 (0.56–0.97)** *
Gender		
Male	1.00	
Female	0.99 (0.81–1.19)	
Education		
None	1.00	1.00
Elementary	1.57 (1.19–2.08)	1.32 (0.99–1.75)
Secondary	1.67 (1.27–2.19)	**1.33 (1.00–1.76)** *
Post-secondary	1.56 (1.20–2.04)	1.26 (0.95–1.66)
Religion		
Christianity	1.00	1.00
Islam	0.64 (0.53–0.79)	**0.73 (0.59–0.89)** *
Others	0.72 (0.32–1.59)	0.67 (0.30–1.51)
Marital Status		
Married	1.00	
Not Married	1.02 (0.82–1.26)	
Personal medical history		
Hypertension	0.79 (0.65–0.96)	0.84 (0.68–1.02)
Diabetes mellitus	0.97 (0.72–1.30)	
Heart disease	0.67 (0.39–1.14)	
Obesity	1.79 (0.94–3.41)	1.62 (0.85–3.12)
Family history of stroke	1.54 (1.17–2.03)	**1.41 (1.07–1.87)** *
Current lifestyle/behaviuor		
Smoking	1.33 (0.86–2.06)	
Alcohol use	1.56 (1.19–2.03)	**1.35 (1.02–1.77)** *

Note: Only variables with *p*-value<0.1 from crude OR were included to obtain adjusted ORs using logit model.

* Significant variables ($p < 0.05$). Significant variables are in bold.

Table 6.

Adjusted comparison of knowledge, attitude and perception about stroke genetic studies between stroke patients and stroke-free controls

	All participants Adjusted OR (95% CI)	Nigerian subjects Adjusted OR (95% CI)	Ghanaian subjects Adjusted OR (95% CI)
Knowledge of stroke heritability	0.65 (0.58–0.74)	0.72 (0.62–0.84)	0.52 (0.42–0.64)
Willingness to undergo stroke genetic testing	0.49 (0.40–0.59)	0.55 (0.44–0.69)	0.51 (0.34–0.75)
Perception about benefit of stroke genetic research	0.52 (0.42–0.65)	0.55 (0.43–0.72)	0.64 (0.42–0.99)