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Development and Effectiveness Testing of a Mobile Health Education Package for Stroke Prevention among Stroke Survivors

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ABSTRACT

Background: Addressing limited stroke literacy among stroke survivors based on social cognitive theory, using trending Mobile Health (m-health) devices can be a valuable interventional approach to reduce secondary stroke risk. Objectives of this study were to develop and test effectiveness of m-health based educational package for stroke prevention among stroke survivors.

Method: This was a multimodal methodology involving content development and effectiveness testing using Delphi protocol and pre-test and post-test design respectively. Role shifting involved a physiotherapist administering stroke prevention education. Development comprised items selection, rating and retention; script writing, translation and recording into an audio and video educational packages. Effectiveness testing involved 30 consenting, consecutively assigned SSVs in each of audio (AIG) and video (VIG) intervention group. Stroke literacy was assessed at baseline, 2nd and 4th week post-intervention. Data was summarized using descriptive and inferential statistics at $p < 0.05$ Alpha value.

Results: Participants were majorly males (63.3%), over 60 years old (51.7%), hypertensive (83.3%) and had tertiary education (31.7%). Knowledge of stroke risk factors improved between AIG and VIG from baseline (11.23 ± 4.01 and 10.07 ± 3.24) to 2nd week (17.73 ± 0.78 and 15.30 ± 1.78) and 4th week (17.97 ± 0.18 and 16.77 ± 1.01) post-intervention respectively. There were significant differences between the two groups ($p < 0.01$).

Conclusion: Mobile health education based on social cognitive theory effectively improves stroke literacy among SSVs and should be tested among larger samples in the community.

Keywords: Stroke prevention; Recurrent stroke; Mobile health

INTRODUCTION

Stroke constitutes a major challenge to physicians and rehabilitation experts worldwide, with high incidence, mortality, disability rates, and costs. There were 25.7 million stroke survivors (SSVs), 6.5 million stroke deaths and 10.3 million first-ever strokes worldwide [1]. Low and middle-income countries (LMIC) bear the highest burden of stroke with 4.85 million deaths compared to 1.6 million in high-income countries (HIC) in 2013 [1]. Similarly, the number of disability adjusted

life years (DALYs) in LMIC was 91.4 million as opposed 21.5 million in HIC. In HIC, availability of good health services and effective strategies for stroke prevention and care are associated with better outcome compared with LMIC where resources for these strategies are limited [1]. SSVs have higher probability for unrecognized vascular risk factors, including hypertension and diabetes, than those with no previous history of stroke [2]. Consequently, compared with first time strokes, recurrent strokes are linked with greater morbidity and mortality [3].

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The risk of recurrence of up to 80% of vascular events after stroke may be prevented by modifying vascular risk factors through medical and behavioral interventions [4]. There is high rate of stroke recurrence and attendant physical and cognitive disabilities experienced by up to 50% of survivors, with serious economic and social consequences [5]. In spite of this, SSVs and their family members lack sufficient stroke education even after suffering a stroke [6,7]. Hence, prevention and health promotions action on stroke must take precedence, as fear of stroke recurrence is a serious concern for SSVs and their families [8]. SSVs are therefore an important population to target for educational interventions for stroke prevention. Stroke literacy, previously defined as knowledge of stroke symptoms and stroke risk factors, is an important component of reducing the risk of recurrent stroke, although improved stroke literacy alone is not sufficient to decrease secondary stroke risk [9,10].

Prevention is the overall goal in stroke education and 80% of the time, strokes can be prevented by providing proper education of the signs of stroke [11]. Consequently, guidelines for stroke management identify secondary prevention of stroke as one of the major goals of stroke care [12] while specific guidelines also exist for prevention of recurrent stroke [3]. Modifiable risk factors are often not effectively managed after a stroke or transient ischemic attack [1]. Evidence suggests that changes to healthcare services on patient education or behavior alone without changes to the organization of care delivery such as professional role revision and multidisciplinary team collaboration had no clinically significant changes in modifiable risk factors for stroke [13]. However, changes to the organization of healthcare services were associated with meaningful improvements in blood pressure and body mass index. Interventions based on social cognitive theory are more patient centered, focus on the demand side of health care and based on principles that can enlighten and encourage adoption of healthy habits.

Advancements in technology now provide new platform and direction to care for patients with chronic conditions such as stroke. Educational technologies such as printed materials, electronic materials, music, television and phone calls have been implemented to promote stroke awareness and prevention among the general population, patients, caregivers and health professionals with variable and inconsistent outcomes [14]. Cultural influence on educational intervention is also an important component [15]. Thus, the component, means and health professionals involved in delivering educational intervention is important to achieving a favorable outcome [13,16]. Sophisticated technologies such as image based technologies, sensor based technologies and virtual reality based tele-rehabilitation systems are far from the reach of many people living in LMICs like Nigeria [17]. However, the use of smart phone software provides a novel approach to encouraging home and on the go health intervention in the form of mobile health (mHealth) [18,19].

Mobile health interventions specifically suited for LMICs have been researched among Nigerian health professionals and patients in recent years with evidence of good uptake, especially in urban cities [18-21]. Specifically, video based educational interventions have been shown to be more effective than written materials for education and behavioural changes for other chronic diseases [22]. However, this has been sparsely explored

for stroke education in this context. For obvious reasons, stroke interventions should not only be effective but practical and sustainable in terms of affordability, availability, accessibility and acceptability, the criteria that audio-visual packages possess [23,24]. Therefore, for SSVs who have access to smartphones, the use of audio-visual educational packages on stroke becomes an important interventional tool which may be effective for improving stroke literacy. This study adopted the theory of changes to the organizational interventions of healthcare services through recommended professional role revision and multidisciplinary team collaboration [13]. The multidisciplinary team was involved and professional role revised in which physiotherapists took the lead stroke prevention role in this study, which was aimed at development and effectiveness testing of audio-visual based m-health (AVm Health) educational package for stroke prevention among SSVs.

MATERIALS AND METHODS

This was a multimodal methodology involving two phases of content development and effectiveness testing using Delphi protocol and pre-test and post-test design respectively.

Development Phase

Desk review of available methods and guidelines in previous studies on stroke education in literature were studied and items were selected from relevant ones [23,25] based on what is applicable to Nigerian context. Thirteen domains and 78 topics were selected to develop the content of the educational package. The domains are medical knowledge, risk factors, treatment with medication, treatment with surgery, treatment with herbal or alternative medicine, rehabilitation, promotion of healthy lifestyle, dietary habits, prevention strategy, special problems, coping, other topics and importance of outpatient clinic follow-up. Five experts in stroke rehabilitation were thereafter invited to partake in the content validity survey. They included two neurologists, two physiotherapists, and one occupational therapist. The recommended number of experts to review an instrument varies from 2 to 20 individuals. At least 5 people are suggested to review the instrument to have sufficient control over chance agreement [26].

A cover letter was included with the content validity survey, explaining why experts were invited to participate, along with clear and concise instructions on how to rate each item. Each item was rated for selection or exclusion from the educational package by rating based on degree of agreement with relevance of each item. A 4 point Likert scale was used and responses included: 1=not relevant, 2=somewhat relevant, 3=quite relevant and 4=very relevant. Ratings of 1 and 2 are considered content invalid while ratings of 3 and 4 are considered content valid [26]. Very relevant items were chosen for this study. Item Content Validation Index (I-CVI) is computed as the number of experts giving a rating of "very relevant" for each item divided by the total number of experts. Values range from 0 to 1 where I-CVI>0.79, the item is relevant, between 0.70 and 0.79 the item needs revisions, and if the value is below 0.70 the item is eliminated [26]. After consulting the five experts, the result of the content validity survey was assessed. Items with values 0.8 and above were selected for the contents of this educational package. Out of the 78 topics and 13 domains that were select-

ed initially, 59 items and 11 domains were rated very relevant and were included in the content of the educational package at the development stage, while 19 items were rated not relevant and were discarded (Table 1). Contents of two out of the 13 domains were rated irrelevant, the domains were therefore excluded (Table 1). These domains were: Treatment with surgery and Treatment with Herbal or Alternative medicine.

Selected items of the educational package were written into a script in English language and translated to Yoruba, the indigenous language of the southwestern Nigeria, the target

population for this study. The translation was done by a Yoruba language teacher at the Secondary school level and was validated by a stroke rehabilitation expert who is proficient in both Yoruba and English languages. After the development of the script, it was then made into a speech by an orator and recorded by an audio technician into a 14 minutes audio package in English and Yoruba languages. The educational audios were then merged with pictures relevant to the content to produce an audio visual package (Figure 1), made available in video MP4 format, playable on mobile phones, laptops, televisions and other MP4 compatible devices.





Figure 1: Pictorial representation of some contents of audio-visual m-health educational package (a) Definition of stroke; (b) Types of stroke; (c) Signs and symptoms of stroke; (d) Risk factors of stroke; (e) Non-modifiable risk factor of stroke; (f) Modifiable risk factor of stroke; (g) Complications of stroke; (h) Prevention of stroke; (i) Prevention of stroke

Table 1: Critical appraisal of the checklist of educational package for prevention of recurrent stroke

Domain 1: Medical Knowledge	
How relevant is this item?	How representative is this item?
1. Parts of the brain	
2. Right and left hemisphere differences	
3. Location of blood vessels	
4. Definition of stroke	
5. Types of stroke	
6. Difference between stroke and TIA	
7. Diagnosis of stroke	
8. Signs/symptoms of stroke	
9. Effect of family history	
10. Emergency treatment	
11. Effects of stroke	
12. Complications	
13. Co-morbidities	

14. Recurrence

Domain 2: Risk Factors

How relevant is this item?

How representative is this item?

15. High blood pressure

16. Heart disease

17. Diabetes

18. Smoking

19. Alcohol

20. Cholesterol

21. Obesity

22. Exercise

23. Stress

Domain 3: Treatment With Medication

How relevant is this item?

How representative is this item?

24. Blood thinners/antiplatelets

25. Side effects

26. Success of medication

27. Dose

28. Reason for medication

29. Duration of medication

Domain 4: Treatment with Surgery

How relevant is this item?

How representative is this item?

30. Deciding surgery

31. Diagnostic method

32. Recovery

33. Cost

34. Complications

Domain 5: Treatment With Herbal or Alternative Medicine

How relevant is this item?

How representative is this item?

35. Difference between Western and African medicine

36. Combine herbal medicine and surgery

37. Acupuncture

38. Diagnostic method

Domain 6: Rehabilitation

How relevant is this item?

How representative is this item?

39. General rehabilitation (Physiotherapy, Occupational therapy and Speech therapy)

40. Care for bedsores

41. Depression

42. Anger management

43. Behavioural issues

44. Sexual activity

Domain 7: Promotion of healthy lifestyle

How relevant is this item?

How representative is this item?

45. Leisure activities

46. Physical fitness

47. Adaptive activities

48. Fatigue

49. Rest and sleeping patterns

50. Engaging in activities of daily living

Domain 8: Dietary Habits

	How relevant is this item?	How representative is this item?
51. Meat intake		
52. Fatty food intake		
53. Fish intake		
54. Vegetable and fruit intake		
55. Bean intake		
56. Milk intake		
57. Salt intake		

Domain 9: Prevention strategy

	How relevant is this item?	How representative is this item?
58. Reduce risk		
59. Recognize stroke signs		
60. Respond by calling a doctor		
61. Respond by going to the hospital		

Domain 10: Special problems

	How relevant is this item?	How representative is this item?
62. Cognition		
63. Aphasia		
64. Bladder/bowel function		
65. Dysphagia		
66. Facial paralysis		

Domain 11: Coping

	How relevant is this item?	How representative is this item?
67. Problem solving		
68. Relaxation exercises		
69. Support system		
70. Time management		
71. Coping strategies		

Domain 12: Other Topics

	How relevant is this item?	How representative is this item?
72. Ability to use extremities		
73. Ability to work		
74. Ability to drive		
75. What people think		
76. How you will look		

Domain 13: Importance of outpatient clinic follow-up

	How relevant is this item?				How representative is this item?		
How relevant is this item?	Pictorial	Pictorial	Pictorial	Pictorial	Pictorial	Pictorial	Pictorial
Pictorial	Pictorial	Pictorial	Pictorial	Pictorial	Pictorial	Pictorial	Pictorial
Relevant Scale: 1=Not relevant; 2=Somewhat relevant; 3=Quite relevant; 4=Very relevant Representative Scale: 1=Not Representative; 2=Useful but not Representative; 3=Representative							

Effectiveness Testing Phase

Pilot testing of the AVm Health educational package was conducted over a period of 4 weeks in three phases viz: the pre-intervention phase, the initial post-intervention phase and the final post-intervention phase.

Participants

Participants in this study were stroke (SSVs) who were purposively recruited from the Physiotherapy and Neurology outpatient clinics of Obafemi Awolowo University Teaching Hospital

(OAUTH), Ile-Ife, Uniosun Teaching Hospital (UTH), Osogbo, and State Hospital Asubiaro (SHA), Osogbo all in Osun state, Nigeria. Stroke survivors with no cognitive impairment (scores of 2 or less on the Short Portable Mental Status questionnaire (SPMSQ)), who can read and/or understand stroke literacy questionnaire and SPMSQ were included in the study; while SSVs with scores of >2 on the SPMSQ, those on hospital admission or those with active psychiatric disease or dementia were excluded from the study. Participants were divided into two groups viz: audio intervention group (AIG) and video intervention group (VIG).

Sample Size Calculation

The sample size was determined using a general rule of thumb for the large enough sample condition which is $n \geq 30$, where n is the sample size. This is based on central limit theorem which states that if a sample size is large enough, the distribution will be approximately normal. The general rule of $n \geq 30$ occurs [27]. The recommended number of 30 stroke survivors was recruited for each of AIG and VIG group.

Instrument

- **Short Portable Mental Status Questionnaire (SPMSQ):** This is a 10 item questionnaire used to assess the participants' level of cognitive impairment. Interpretation of the scores is based on the number of errors, with 0-2 errors having normal mental functioning, 3-4 errors having mild cognitive impairment, 5-7 errors having moderate cognitive impairment and 8 or more errors having severe cognitive impairment [28]. It has been found reliable and valid in distinguishing individuals with dementia from cognitively intact individuals with sensitivity and specificity of 0.74 and 0.79 for the telephone test and 0.74 and 0.91 for the face to face test, respectively. Both test versions correlated significantly with the Mini-Mental State Examination [28].
- Stroke literacy questionnaire for stroke survivors [10,29]. It is a four section questionnaire that contained socio-demographic and clinical data; general stroke knowledge questions; signs, symptoms and risk factors of stroke and actions to be taken in event of stroke.
- Audio-visual mobile health educational package containing evidence based stroke education.

Procedure

Ethical approval was obtained before the commencement of the study. Permission to conduct the study was also obtained from the heads of each clinic where the participants were recruited. A verbal explanation of the purpose and details of the study were given to the participants. The verbal informed consent of each SSV was obtained followed by screening for cognitive impairment with the SPSMQ. At the Pre-intervention phase, stroke survivors with scores of 2 or less on the SPSMQ were included in the pilot testing. Eligible SSVs were subsequently assessed for baseline stroke literacy using the stroke literacy questionnaire (SLQ). The educational package was shared to each SSV in each of AIG and VIG group via their mobile phones at the various clinics. Participants were instructed to use the AVm Health educational package for at least three times a week and were further informed about the subsequent re-assessment on stroke literacy that took place 2nd and 4th week post intervention. After the first meeting, the researcher called each SSV on phones twice a week for two weeks to follow up and remind them to use the AVm Health package. At the initial post-intervention phase SLQ was re-administered on participants after two weeks of intervention at their various clinics or through phone calls. The SSVs were encouraged to continue the use of AVm Health educational package at least thrice in a week for another two weeks. The final post-intervention phase involved administering SLQ on the SSVs after the 4th week at their various clinics or through phone calls.

Data Analysis

Descriptive statistics was used to characterize demographics and clinical characteristics using mean, standard deviation, frequency and percentages. Repeated measure ANOVA was used to compare stroke literacy within group at baseline, two weeks and four weeks post intervention; while mixed method ANOVA was used for between group comparisons. Alpha value was set at $P < 0.05$. The data analysis was carried out using Statistical Package for Social Sciences (SPSS) software version 22.

RESULTS

Development of the Educational Package

Following the Delphi guidelines, a process that involved item selection, retention, rejection using consensus from experts in stroke rehabilitation, the contents of the educational for stroke prevention among stroke survivors (SSVs) was successfully developed. Out of the 78 topics and 13 domains that were selected initially, 59 items and 11 domains were retained to produce the educational package (Table 1).

Effectiveness-Testing of the Educational Package

Socio-demographic characteristics of participants: A total of 60 SSVs, consecutively and equally assigned into AIG and VIG participated in the effectiveness-testing of this educational package. Majority were male (63.3%), over 60 years of age (51.7%) and had tertiary level education (31.7). The details of socio-demographic and clinical characteristics of the participants are presented in Table 2.

Table 2: Socio-demographic and Clinical Variables of stroke survivors

Variables	Frequency	Percentage (%)
Gender		
Male	38	63.3
Female	22	36.7
Age category (Years)		
41-50	11	18.3
51-60	18	30
Over 60	31	51.7
Level of Education		
No /Primary Education	11	18.3
Secondary Education	15	25
Post-secondary (OND/NCE)	12	20
Tertiary HND/Bachelor's	19	31.7
Post-graduate	3	5
Smoking status		
Past Smoker		
No	54	90
Yes	6	10
Current Smoker		
No	60	100

Yes	0	0
Hypertensive		
No	10	16.7
Yes	50	83.3
Prior Stroke		
No	8	13.3
Yes	52	86.7

Comparison of within group differences of participants: Results of within group stroke literacy are presented in **Table 3** (VIG) and **Table 4** (AIG). The VIG participants' stroke literacy at baseline, 2 weeks and 4 weeks post intervention by age group are presented in **Table 5**. There was a general increase in mean scores of participants with age groups <40 having the highest mean score in stroke knowledge at 2nd and 4th week and age

group 41-50 having the highest mean score in knowledge of risk factors and symptoms at 2nd week and 4th week. All age group recorded almost perfect scores in the knowledge of actions to be taken at baseline, 2nd and 4th week post-intervention. There was no significant increase in stroke knowledge among the SSVs between age categories. **Table 3** shows the results of within group comparison of AIG participants' scores on stroke literacy at baseline, 2 weeks and 4 weeks by level of education. Participants with post graduate education have the highest mean score at baseline, 2 weeks and 4 weeks post intervention. There is no significant difference in stroke literacy among the SSVs except in stroke knowledge at 4th week post intervention ($F=2.824$ $p=0.038$). Post hoc analysis further revealed significance difference between primary and secondary levels of education and also between the primary and the post-secondary levels of education.

Table 3: Comparison of within group scores for VIG participants by age group

Variables	≤ 40	41-50	51-60	>60	F-Value	P Value
	X ± SD (n=2)	X ± SD (n=4)	X ± SD (n=9)	X ± SD (n=15)		
Stroke Knowledge						
Baseline	2.50 ± 0.707	1.00 ± 0.817	1.11 ± 0.782	1.40 ± 0.737	2.127	0.121
2 weeks	4.00 ± 0.000	2.75 ± 0.500	2.89 ± 0.782	2.93 ± 0.594	1.963	0.144
4 weeks	4.00 ± 0.000	3.50 ± 0.577	3.22 ± 0.667	2.97 ± 0.594	1.076	0.377
Signs, Symptoms and Risk factors of stroke						
Baseline	8.50 ± 0.707	10.50 ± 1.732	10.56 ± 4.391	9.87 ± 3.067	0.247	0.863
2 weeks	15.50 ± 0.707	15.75 ± 2.217	15.44 ± 2.128	15.07 ± 1.668	0.182	0.908
4 weeks	16.50 ± 0.707	17.00 ± 1.414	16.78 ± 0.972	16.73 ± 1.033	0.113	0.952
Actions taken						
Baseline	7.00 ± 0.000	6.75 ± 0.500	6.89 ± 0.333	6.93 ± 0.258	0.431	0.733
2 weeks later	7.00 ± 0.000	6.75 ± 0.500	6.89 ± 0.333	6.93 ± 0.258	0.431	0.733
4 weeks later	7.00 ± 0.000	6.75 ± 0.500	6.88 ± 0.354	6.90 ± 0.316	0.21	0.888

Table 4: Comparison of within group scores for Audio Intervention Group at baseline, 2 weeks and 4 weeks by level of education

Variables	Primary Education	Secondary Education	Post-Secondary	Tertiary Education	F-Value	P- Value
	X ± SD (n=5)	X ± SD (n=10)	X ± SD (n=6)	X ± SD (n=9)		
Stroke Knowledge						
Baseline	1.50 ± 1.00	1.30 ± 0.484	1.50 ± 0.837	1.33 ± 1.000	0.778	0.55
2 weeks later	2.75 ± 0.50	3.20 ± 0.632	3.00 ± 0.894	2.89 ± 0.601	0.961	0.446
4 weeks later	3.25 ± 0.50	3.50 ± 0.527	3.17 ± 0.753	3.44 ± 0.527	1.777	0.165
Warning signs and risk factors						
Baseline	8.75 ± 1.708	8.80 ± 3.615	11.0 ± 2.280	10.56 ± 2.698	2.769	0.049
2 weeks	13.75 ± 0.50	14.70 ± 1.829	15.00 ± 1.789	16.56 ± 1.130	3.858	0.014*
4 weeks	16.50 ± 1.29	16.30 ± 0.949	16.83 ± 1.169	17.22 ± 0.667	1.564	0.215
Actions taken						
Baseline	7.00 ± 00.00	6.90 ± 3.160	7.00 ± 00.00	7.00 ± 00.00	0.372	0.774
2 weeks	7.00 ± 00.00	6.90 ± 3.160	7.00 ± 00.00	7.00 ± 00.00	0.372	0.774
4 weeks	7.00 ± 00.00	6.90 ± 3.160	7.00 ± 00.00	7.00 ± 00.00	0.372	0.774

Comparison of between group differences of participants: There are equal numbers of participants (30) in the audio and VIGs with equal gender distribution (19 males and 11 females). The AIG and VIG are not significantly different in terms of socio-demographic variables (**Table 4**). Similarly, there are no significant associations between the AIG or VIG and the gender,

age or level of education ($p>0.05$). **Table 6** presents comparison of scores of AIG and VIG on stroke literacy at baseline, 2 weeks and 4 weeks post intervention. There is a steady increase in scores at all levels between the two groups, with significant difference between the AIG and VIGs on knowledge of stroke risk factors and warning signs ($p<0.01$).

Comparison of mean scores of AIG and VIGs: Figure 2 shows a steady increase in knowledge of stroke between both AIG and VIGs. Knowledge of stroke risk factors and warning signs for the AIG and VIGs are represented in Figure 3. The mean score of the AIG is higher with the highest difference in the scores at the 2nd week. Action to be taken in the event of stroke by each of AIG and VIG is represented in Figure 4. The mean score is constant from baseline, 2nd week and 4th week for the two groups.

Table 5: Comparison between Socio-demographic Variables of Audio Intervention Group and Video Intervention Group

Variables	AIG N=30	VIG N=30	X ²	Z	p
Gender					
Male	19	19	0	0.000*	1.000**
Female	11	11			
Age category (Years)					
41-50	04	7	1.073	-0.552*	0.585**
51-60	10	8			
Over 60	16	15			
Level of Education					
No /Primary Education	6	5	4.81	-1.038 ^{ww}	0.307**
Secondary Education	5	10			
Post-secondary (OND/NCE)	6	6			
Tertiary HND/Bachelor's	10	9			
Post-graduate	3	0			

AIG- Audio Intervention Group; VIG- Video Intervention Group; OND- Ordinary National Diploma; NCE- National Certificate of Education; HND- Higher National Diploma.

*Indicates no significant difference (p>0.05) for Mann-Whitney U test;

**Indicates no significant association (p>0.05) for Chi square test

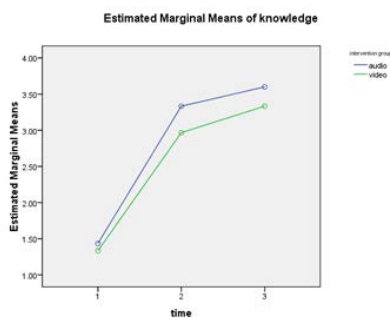


Figure 2: Mean scores on knowledge of stroke between audio and video group at baseline, 2nd and 4th week post intervention

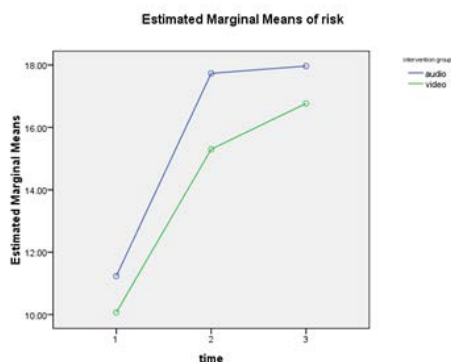


Figure 3: Mean scores of stroke risk factors and warning signs between

audio and video group at baseline, 2nd and 4th week post intervention

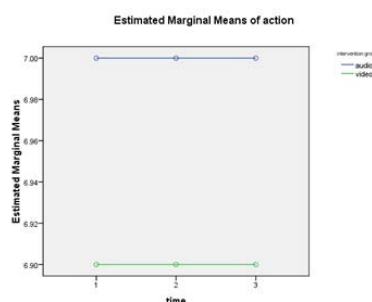


Figure 4: Mean scores on action to be taken between audio and video group at baseline, 2nd and 4th week post intervention

DISCUSSION

Health professionals need to be aware of the importance of meeting the educational needs of stroke survivors and provide information about all aspects of stroke. SSVs and their caregivers need to be educated via various means of information dissemination such as videos, handbooks, and modern technology [23]. In this study, an audio-visual based mobile health (AVm Health) educational package was developed for stroke prevention among stroke survivors. Knowledge of stroke risk factors is expected to substantially contribute to secondary stroke prevention by improving stroke literacy among this population, especially in Nigeria and other LMICs where stroke survivors lack knowledge of stroke, its risk factors and warning signs [7,30,31].

The contents of this educational tool are in line with the themes featured in the study of Maniva et al., [14]. The tool was validated by stroke rehabilitation experts, consistent with previous studies in which a new tool was developed and the items were assessed for content validation [32,33]. The development of AV mHealth educational package in this study was conceptualized and initiated by a physiotherapist and involved a multidisciplinary team. This corroborates the recommendation of professional role revision and multidisciplinary team collaboration emphasized by Joel et al., [13] with documented evidence of meaningful outcome. It was a form of engaging material delivered via mobile phones which is more convenient for participants. The intervention was based on social cognitive theory which is more patient centered and provided information that enlightened and encouraged stroke survivors to adopt healthy habits. The choice of mobile phones as an easy means of information delivery is supported by similar reports of no difficulty with operating the exercise package on the mobile device or at home [31,34].

The educational tool in this study was of 14 minutes duration, in contrast to a stroke literacy video of 5 minutes duration by Denny et al., [10] and a 30 minutes video home based exercise for SSVs by Odetunde et al., [31]. The varied duration was to address the study objectives and accommodate the contents of each of the videos. This study revealed that the AV mHealth stroke education was associated with improved stroke literacy at the 2nd and 4th week post intervention, consistent with previous studies on stroke education [10,35]. In the AIG, stroke education were associated with improved stroke knowledge

and recognition of stroke risk factors and warning signs at the 2nd and 4th week post intervention. The knowledge improved significantly across age group in stroke risk factors and warning signs as well as across level of education in stroke knowledge. In the VIG however, the increase in stroke knowledge is not statistically significant across age group and between genders. Only the levels of education showed significant increase with

identification of stroke risk factors and warning signs, between the primary and the tertiary levels of education 2nd week post-intervention. These findings are consistent with previous studies on stroke education of Denny et al., and Maisarah et al., [35]. Earlier studies, have reported increase in stroke knowledge across education levels, with the largest effect on those with at least college education [36,37].

Table 6: Comparison of Audio Intervention Group and Video Intervention Group scores on stroke literacy Questionnaire at baseline, 2 weeks and 4 weeks post intervention

Variables	AIG N=30			VIG N=30			F-value	P-value	Partial Eta2
	Baseline	2-weeks	4-weeks	Baseline	2-weeks	4-weeks			
	X ± SD	X ± SD	X ± SD	X ± SD	X ± SD	X ± SD			
Stroke Knowledge	1.43 (0.94)	3.33 (0.71)	3.60 (0.50)	1.33 (0.80)	2.97 (0.67)	3.33 (0.61)	0.771	0.593	0.05
Stroke risk factors and warning signs	11.23 (4.01)	17.73 (0.78)	17.97 (0.18)	10.07 (3.24)	15.30 (1.78)	16.77 (1.01)	12.652	0.001	0.22
Action taken	7.00 (0.00)	7.00 (0.00)	7.00(0.00)	6.90 (0.31)	6.90 (0.31)	6.90 (0.31)	-	-	-

AIG- Audio Intervention Group, VIG- Video Intervention Group

The results of higher mean scores of the AIG than the VIG in all aspects of stroke literacy assessed and at all points is surprising, as naturally the VIG with added advantage of visual feedback is expected to score higher. This finding is supported by earlier reports of many advantages of information dissemination through media such as radio and mobile phones including easy availability to a large population which offer health promoters many advantages over other means [38]. Access to health information is an important way to reduce the social and economic impact of preventable and non-preventable diseases and illnesses [39]. Availability and accessibility of audio may explain why the use of audio material is common in this environment in the form of music, spiritual messages and public information via radios and pre-recorded audio packages. The AV mhealth based educational package for this study was developed as a form of an engaging material and was delivered via mobile phones. This is in agreement with submission of Angola and Dlodlo, that mobile devices have become the most dominant tools to disseminate information worldwide nowadays and that a large number of people will benefit whether they attend clinics or not, once they have smart phones. Considering the peculiar situation of LMICs, challenges of poor internet facility and erratic power supply that limits the uptake of mHealth via the use of mobile telephone and other advanced technological devices was bypassed in the AV m-Health educational package employed in this study. This allows for possibility of uptake of this tool among rural and urban poor population of Nigeria and other LMICs. Another positive implication from this study is that video technology can be used as a substitute for conventional education to improve stroke literacy among SSVs. Finally, video based educational intervention on stroke in indigenous Nigerian language is novel approach in clinical practice in Nigeria. The fact that the positive outcomes obtained in this study corroborate similar studies serves as a stimulus for wider use of video based technology in the dissemination of educational intervention materials among SSVs.

CONCLUSION

Audiovisual based mhealth educational package in indigenous Yoruba language was produced. The tool is useful, understandable, effective in improving stroke literacy among stroke survivors; and may be effective for secondary stroke prevention. The tool should be tested among larger sample in different settings in the community.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Ethics and Research Committee of Obafemi Awolowo Teaching Hospitals, Ile-Ife, with number, ERC/2021/06/45.

COMPETING INTERESTS/FUNDING

The authors report there are no competing interests to declare. No funding from any source

AUTHORS' CONTRIBUTION

M.O conceptualized the study, conducted the research, prepared the manuscript and took part in data analysis and interpretation. S.O and G.T were involved in conceptualization of the study, data collection, analysis and interpretation. A.C was involved in the research design and proofread the manuscript for intellectual contribution. C.E was involved in research design, data analysis and interpretation and proof-reading of the manuscript for intellectual contribution; M.A was involved in research design and proof reading. All authors read and approved the final manuscript.

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DATA AVAILABILITY STATEMENT

Data generated from this study are available on reasonable request from the corresponding author

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