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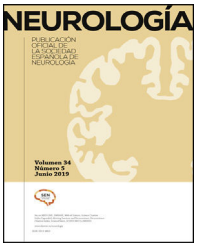

ORIGINAL ARTICLE

Effectiveness of a digital application to improve stroke knowledge for kids

A.P. Moreno[a], L. Camargo[b,*], G. Gaitán[a], E.E. Castillo[c], S.A. Pabón[d], S. Shelach[e], P. Gargiulo[f], N. Caldichoury[g], N. López[h]

[a] *Residencia Neurología, Escuela de Medicina, Universidad del Sinú, Cartagena, Colombia*
[b] *Profesorado Neurología, Universidad del Sinú y Universidad de Cartagena, Cartagena, Colombia*
[c] *Profesorado Neurología, Universidad del Sinú, Cartagena, Colombia*
[d] *Educación médica, Estrategia pedagógica en ACV, Colombia*
[e] *Laboratorio de Neurociencias, Universidad Católica San Pablo, Arequipa, Perú*
[f] *Laboratorio de Neurociencias y Psicología Experimental, Universidad Nacional de Cuyo, Mendoza, Argentina*
[g] *Universidad de Los Lagos, Osorno, Chile*
[h] *Departamento de Ciencias Sociales, Universidad de la Costa, Barranquilla, Colombia*

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KEYWORDS
ICT;
Stroke;
Mobile app;
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Education

Abstract
Introduction: Stroke is highly prevalent in Latin America and one of the leading causes of morbidity and mortality in the world. Educating children about stroke has been established as an effective method to detect symptoms early, reduce hospital visits, and raise awareness among adults.
Objective: To analyze the effectiveness of a mobile application to improve knowledge and understanding of stroke among children.
Method: We conducted a focus group session including 12 children in order to analyze the behavior of 6 questions previously validated by expert neurologists. Subsequently, 105 primary school students between the ages of 7 and 12 completed a questionnaire on stroke symptoms and how to contact the emergency services before and after using an application on stroke symptoms. Qualitative analyses and the Student *t* test were used to verify the existence of differences between pre- and post-intervention test results.
Results: After a single 40-min working session with the application, between 50% and 67% of the children were able to identify the signs of stroke, and 96.2% knew the national emergency services telephone number. Statistical analysis revealed statistically significant differences before and after the intervention with the digital application ($t = 19.54$; $p < 0.001$) and intragroup differences in the post-intervention test results ($t = 40.71$; $p < 0.001$).

* Corresponding author.
E-mail address: loida.camargo@hotmail.com (L. Camargo).

Conclusion: Primary school children who used our digital application increased their knowledge, understanding, and learning of stroke symptoms.

PALABRAS CLAVE
TIC;
Ictus;
App;
Aplicación;
Educación

Efectividad de una aplicación móvil para mejorar el conocimiento sobre los síntomas de ictus en una población pediátrica de Colombia

Resumen
Introducción: El ictus es muy prevalente en Latinoamérica y constituye una de las principales causas de morbimortalidad a nivel mundial. Se ha sugerido que enseñar a los niños a reconocer los primeros síntomas de ictus puede ayudar a reducir el número de ingresos por esta enfermedad y a concienciar a la población adulta.
Objetivo: Analizar la efectividad de una aplicación móvil para aumentar el conocimiento del ictus en los niños.
Método: Llevamos a cabo una sesión con un grupo focal de 12 niños para analizar el comportamiento de 6 preguntas previamente validadas por un grupo de neurólogos expertos. Posteriormente, administramos un cuestionario sobre síntomas de ictus y servicios de emergencias a 105 niños de entre 7 y 12 años en dos momentos diferentes: antes y después de usar la aplicación sobre síntomas de ictus. Se realizaron análisis cualitativos y se aplicó la prueba t de Student para confirmar la presencia de diferencias en las respuestas al cuestionario antes y después de la intervención.
Resultados: Tras una única sesión de 40 minutos con la aplicación, entre el 50% y el 67% de los niños eran capaces de identificar los síntomas de ictus y el 96,2% se sabían el número de teléfono de emergencias. El análisis estadístico reveló diferencias estadísticamente significativas entre los resultados del cuestionario antes y después de la intervención ($t = 19{,}54$; $P < 0{,}001$), así como diferencias intragrupo en los resultados postintervención ($t = 40{,}71$; $P < 0{,}001$).
Conclusión: Los niños que utilizaron nuestra aplicación acabaron sabiendo más sobre los síntomas de ictus y cómo actuar.

Introduction

Stroke is one of the leading causes of death and disability worldwide, with substantial economic costs of care and treatment.[1] Shortening the time from the onset of stroke symptoms to arrival at the hospital is associated with favorable outcomes. However, only 25% of patients reach the hospital in three hours.[2] Furthermore, considering that many of the strokes occur at home, where a minor is usually present, developing educational programs is an efficient alternative to reduce the intervention gap in the preclinical phase of stroke.

Teaching about stroke in schools can be effective in helping children learn to identify risk factors and signs that lead to the development of stroke. Incorporate the information and communications technology (ICT) in child neuroeducation, associated with knowledge, detection and decision-making in the face of stroke, can be an excellent tool to save lives. Likewise, a resource for educational innovation and health promotion. Therefore, it is a necessity to integrate these learning, through ICTs in classrooms.[3]

One of the reasons children need to be educated about strokes is because they may be the only ones present during a stroke, in a unique position to influence decision making. They can call the emergency line, guide the adult, inform third parties or help transfer the patient to a hospital.[4,5] However, there is little evidence about which is the best method of teaching about stroke, for the purposes of knowledge and prevention in the school population. Additionally, in the general population there is little knowledge about the signs of a stroke and the first actions to be taken.[6]

The evidence indicates that the prognosis of stroke is more favorable in people with better educational and socioeconomic levels, as well as more information on care and decisions regarding stroke, than in subjects with less schooling and older age.[7] For the latter, the lack of knowledge about the disease may represent a delay in seeking immediate medical attention[8] or worsening of symptoms.[9] Therefore, medical education for these purposes can be beneficial.[10]

In the present study, we analyzed the effectiveness of a learning program on stroke symptoms, through a cell phone application, in a child school population in Colombia. To our knowledge, there is no history of studies of this type from Colombia or South America.

Table 1 Stroke questionnaire with pre- and post-intervention responses.

Item	Answers	Before		After	
		F	%	*F*	%
1. A person quickly begins to have difficulty speaking. What could be happening to him?	Vocal problems	32	30.5	3	2.8
	He is aphonic	14	13.3	3	2.8
	Brain development problems	14	13.3	38	36.1
	Dental problems	0	0.0	0	0
	Vocal cord problems	44	41.9	7	6.6
	Other (No stroke)	1	0.9	2	1.9
	Other (Yes stroke)	—	—	52	49.6
2. What do you think of when a person has sudden arm or leg weakness or a crooked face?	He is tired	16	15.2	2	1.9
	He fell	8	7.6	2	1.9
	He was hot and took a bath	46	43.8	22	20.9
	He was born sick	32	30.5	3	2.86
	Vocal cord problems	0	0.0	1	0.9
	Other (No stroke)	3	2.8	5	4.7
	Other (Yes stroke)	—	—	70	66.7
3. A person suddenly begins to have difficulty seeing. What could be happening to him?	Something fell in his eye	17	16.1	1	1.9
	He has inflammation in the eye	7	6.6	7	6.6
	Need glasses	45	42.8	12	11.4
	Eye infection	30	28.5	13	12.3
	He hit his eye	4	3.8	4	3.8
	Other (No stroke)	2	1.9	6	5.7
	Other (Yes stroke)	—	—	63	60.0
4. Suddenly a person cannot or has difficulty walking. That could be happening?	He had an accident	38	36.1	12	11.4
	He was born sick	12	11.4	13	2.8
	He made a lot of effort	10	9.5	8	7.6
	He fell	2	1.9	7	6.6
	He broke his spine	41	39.0	5	4.7
	Other (No stroke)	2	1.9	10	9.5
	Other (Yes stroke)	—	—	60	57.1
5. From one moment to the next a person has a great headache. Which may be?	It may be from a lot of noise	22	20.9	3	2.86
	He had a rage or fight	5	4.7	6	5.7
	He is stressed	26	24.7	12	11.4
	He is tired	48	45.7	16	15.2
	He was born sick	3	2.8	0	0
	Other (No stroke)	1	0.9	4	3.8
	Other (Yes stroke)	—	—	64	61
6. What is the emergency number?	He knows the emergency number	8	7.6	101	96.2
	He doesn't know the emergency number	97	92.3	4	3.8

Method

The present investigation is a descriptive observational study, with a qualitative and quantitative approach, with questions designed and validated with a Delphi-type method by neurologists.[11] 105 children were included, between 7 and 12 years old, who were studying initial basic education in a school in eastern Colombia.

Procedure

At first, 6 questions about stroke were constructed that were validated by neurologists who are experts in this pathology. Then, a focus group was conducted with 12 children, with age and schooling similar to that of the intervention group, with whom the stroke questions were analyzed. All the responses from the recording were transcribed and synthesized to form a questionnaire. The first 5 questions were multiple-choice and a sixth question had two response options (Table 1). Subsequently, at school, an online questionnaire was applied to 105 children of the initial level of training (3—5 years of education). After the evaluation (test), the children were trained in the use of the mobile application, following the guidelines of the Colombian Ministry of Education for the use of ICT in a school context. The use of the application lasted 40 min and was monitored by the educational community and main researcher. When they finished using the application, the subjects completed the online questionnaire (post-test) again. The intervention, together with the respective measurements, was carried out in a 1-h session.

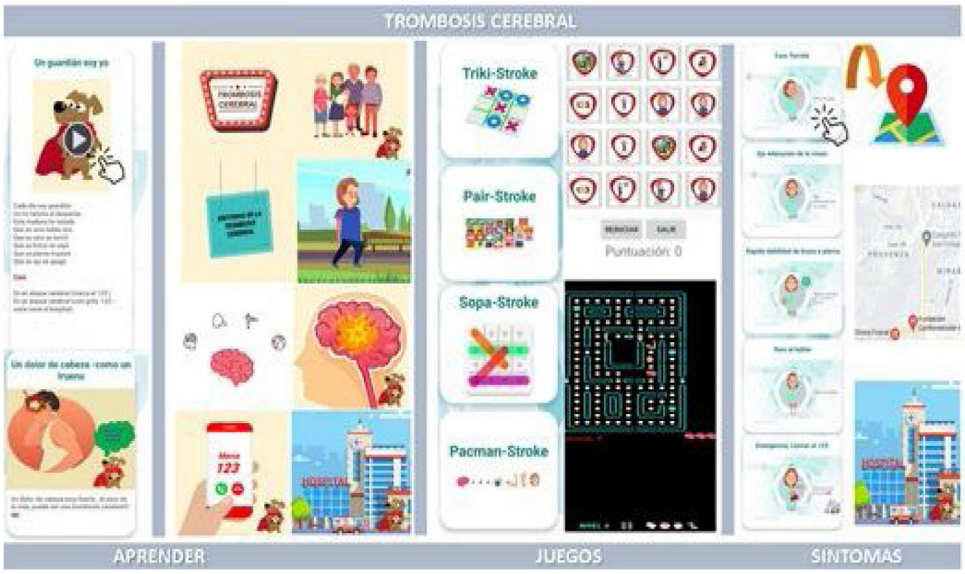

Figure 1 App thrombosis cerebral.

Mobile app

The App ''Cerebral Thrombosis'' was created by FASTROKE (Fig. 1). It is available on the Google play digital platform. It contains animated videos, songs, images, triki-stroke games, word search, find the couple card, Pacman-stroke allusive to ACV and a mnemonic based on an acronym in Spanish, which means ''CORRE/FAST'' (''C: cara torcida'', face crooked; ''O: ojo con vision alterada'', eye vision alteration; ''R: rápida debilidad de un brazo o pierna'', rapid weakness of an arm or leg; ''R: raro al hablar'', rare when speaking; and ''E: emergency call 123'' Taken from Luis Roa W. Vascular neurology. Colombian association of neurology.) which when activating geolocates to the hospital that has the closest cerebrovascular unit). The APP has a classification suitable for all ages (L) according to the country where it is downloaded.

Statistical analysis and formal aspects

Categorical analyses were performed for the focus group. In addition, student's *t*-test was carried out to analyze the differences in the performance of the children in the questionnaire on knowledge of the stroke, before and after the use of the mobile application. Intragroup analysis was also done in the post-intervention. All the children participated freely and voluntarily with the prior informed consent of their relatives and educational institution.

Results

Of the total sample ($n = 105$), 44.8% are men and 55.2% are women. 28 children were in the 3rd year of initial education (Average age: 7.71; SD: 0.61), 19 fourth year (mean years: 9.42; SD: 0.69) and 48 fifth year (Mean years: 10.23; SD: 0.75). In the focus group, the responses to the first

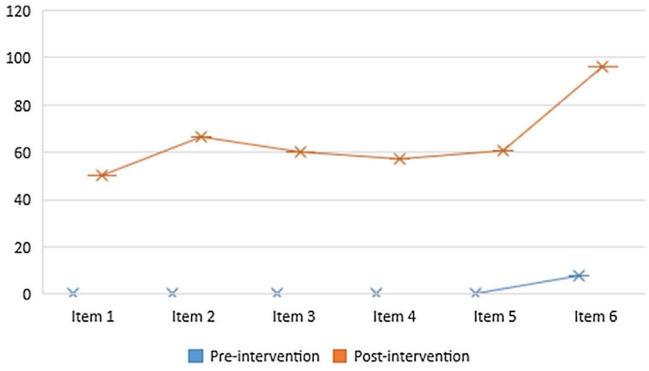

Figure 2 Before and after the stroke app.

five questions of the questionnaire were categorized into 5 options. Two remaining options included other incorrect answer options (Other: No CVA), in addition to the correct answer (Other: Yes CVA).

Regarding the quantitative analysis, in the initial measurement, the percentage of students with correct answers for the symptoms of stroke was very low; except in question 1, where only 13.3% chose an answer associated with the brain. In question 6, only 7.6% identified the national emergency number. However, after the intervention with the mobile application, statistically significant differences were found ($t = 19.54$, $p < 0.001$) in the identification of stroke signs, by correcting the 6 questions of the questionnaire. As can be seen in Fig. 2, in the post-test, between 50% and 67% of the children identified the signs of stroke; and 96.2% got the national emergency number right.

Finally, an intragroup analysis was carried out with the results of the questionnaire in the post-intervention. Significant differences were found between those who answered correctly vs those who erred ($t = 40.71$, $p < 0.001$). As can be seen in Fig. 3, over 60% of the children were able to identify the clinical signs of stroke, except for item 1, where the

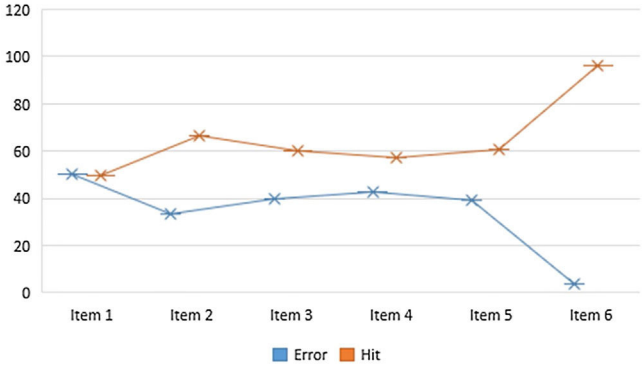

Figure 3 Intragroup comparison with the stroke app.

correctness was 49.6%. The 96% of the subjects identified the national emergency number.

Discussion

Our study is the basis of an educational training program for children, destined to improve the knowledge and identification of the most common symptoms of stroke in the adult population. It sought to qualitatively and quantitatively evaluate the child's knowledge of the symptoms that comprise stroke.

From a qualitative point of view, our results were novel because they aim to position the perception of the severity of stroke. This makes children a vehicle for promoting health within families and promoters of changes in adult lifestyles. In this regard, the available evidence has consistently shown that targeting the younger population through stroke education programs is an effective way of transmitting educational information to parents and other family members. In this way, awareness of stroke is created and maintained.[12—14]

However, we were struck by the fact that in the initial measurement 49.5% of the children selected 911 as the emergency number. The emergency number in Colombia is 123. We consider that this may be associated with the media and audiovisual content that children culturally consume; affecting the perception of the emergency number. However, in the country there are no studies evaluating this phenomenon.

On the other hand, the results showed that there was a significant lack of knowledge in the children prior to the intervention. But, after the implementation of our stroke education program, through the digital application, knowledge and learning about stroke improved.

With just one session of educational intervention, the children demonstrated significant improvement in their knowledge of stroke and the national emergency number. The children were able to recall the common symptoms of strokes, the need for urgent medical attention, and the best course of action in such a scenario. This was seen in all age groups, including the youngest children who were in third grade.

These results are consistent with other studies that have shown the benefits of training children to identify the signs of stroke and act quickly.[15,16] The available evidence shows that improving children's knowledge about stroke can generate knowledge transfer and behavior changes among adults.[17] This makes it possible to reduce the delay in arrival at the hospital due to stroke.[4]

Our research has some limitations. First of all, it is not a randomized controlled study. Second, follow-up studies, with a larger sample, are necessary to analyze the learning potential, together with the phenomenon of interference and the levels of consolidation of children's knowledge. Third, the questionnaire would have to be adjusted to avoid ambiguities in the answers and to carry out analysis of psychometric properties to the items. Finally, the tasks of the ''cerebral thrombosis'' application should be validated for the detection of stroke symptoms.

Conclusions

The elementary school children who used our digital application significantly improved their knowledge, understanding and learning about stroke signs and symptoms. Therefore, incorporating ICT and digital applications for the teaching of stroke in children can be beneficial. They could help detect and report symptoms and reduce delay in arrival at the hospital for stroke. In this sense, a greater awareness and transfer of knowledge and healthy behaviors should be generated among adults. Considering that the burden of stroke in Latin America is high.

Conflict of interest

The authors declare that they have no conflict of interest.

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