Revista del Nacional (Itauguá)
ISSN 2072-8174 versión impresa *Rev. Nac. (Itauguá). 2023;15(2):078-088*
ISSN 2307-3640 version online http://dx.doi.org/10.18004/rdn2023.dic.02.078.088

Original Article/Artículo Original

Development validation and evaluation of the knowledge test on cardiopulmonary resuscitation and correct use of the automated external defibrillator in Asunción 2023

Desarrollo validación y evaluación de la prueba de conocimientos sobre reanimación cardiopulmonar y uso correcto del desfibrilador externo automático en Asunción 2023

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Article received: *September 22, 2023.* ***Article approved:*** *December 18, 2023.*

How to cite this article: *Rolón Ruíz Díaz A, González-Ríos C, Ortellado Maidana J, González G, Rolón Ruíz Díaz L, González-Ríos D. Development validation and evaluation of the knowledge test on cardiopulmonary resuscitation and correct use of the automated external defibrillator in Asunción 2023. Rev. Nac. (Itauguá). 2023;15(2):078-088.*

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ABSTRACT

Introduction: in out-of-hospital cardiac arrest, early and efficient intervention through cardiopulmonary resuscitation (CPR) maneuvers and the use of the automated external defibrillator (AED) are the cornerstone for survival. Instruments that improve education would increase the responsiveness of lay personnel.

Objectives: to develop, validate and evaluate a knowledge test on cardiopulmonary resuscitation and correct use of the automated external defibrillator in Asunción during 2023.

Methodology: observational cross-sectional study, non-probabilistic sample for convenience of lay personnel users of mass attendance centers in Asunción. An exclusive questionnaire was developed on knowledge in cardiopulmonary resuscitation and the use of the automated external defibrillator (KOR-AED) based on the chain of survival in out-of-hospital cardiac arrest. Content, construct, and internal consistency were validated using expert opinion, factor analysis and Cronbach's alpha.

Results: a total of 200 lay people participated, mostly shopping mall customers, with a predominance of men (63.5 %) (127), between 25-29 years old 28.5% (57). 61.5 % (123) had a university education, 75.5 % (151) had not related to health, 52 % (104) had prior knowledge of CPR, but 81.5 % (163) did not. The test showed reliability and suitability for factor analysis (Cronbach's alpha 0.75, Kaiser-Meyers-Olkin; 0.78, Bartlett $p<0.05$). The questions covered the first three links in the chain of survival, with items of medium to high difficulty. Women performed significantly better ($p=0.04$).

Conclusion: the KOR-AED test is a valid and reliable instrument to improve the education of the layperson in CPR and use of the AED based on the chain of survival.

Key words: cardiopulmonary resuscitation, cardiac arrest, survival.

RESUMEN

Introducción: en la parada cardíaca extrahospitalaria la actuación precoz y eficiente mediante maniobras de reanimación cardiopulmonar (RCP) y uso del desfibrilador externo automático (DEA) constituyen la piedra angular para la supervivencia. Instrumentos que mejoren la educación aumentarían la respuesta del personal lego.

Objetivos: desarrollar, validar y evaluar una prueba de conocimientos sobre reanimación cardiopulmonar y uso correcto del desfibrilador externo automático en Asunción durante el 2023.

Metodología: estudio observacional corte transversal, muestro no probabilístico por conveniencia de personal lego usuarios de centros de concurrencia masiva de Asunción. Se desarrolló un cuestionario exclusivo sobre conocimientos en reanimación cardiopulmonar y uso del desfibrilador externo automático (COR-DEA) basado en la cadena de supervivencia en parada cardíaca extrahospitalaria. Se validó el contenido, el constructo y la consistencia interna mediante la opinión de experto, análisis de factores y el alfa de Cronbach.

Resultados: participaron 200 legos mayormente clientes de shoppings, predominando hombres 63,5 % (127) entre 25-29 años 28,5 % (57). Con educación universitaria 61,5 % (123), no relacionados con la salud 75,5 % (151), con conocimientos previos en RCP 52 % (104), pero no en DEA 81,5 % (163). El test mostró fiabilidad y adecuación para análisis factorial (Alfa de Cronbach 0.75, Kaiser-Meyers-Olkin; 0.78, Bartlett $p<0.05$). Las preguntas abarcarón los tres primeros eslabones de la cadena de supervivencia, con ítems de dificultad media a alta. Las mujeres tuvieron significativamente mejor desempeñó ($p=0.04$).

Conclusión: la prueba COR-DEA es un instrumento válido y fiable para mejorar la educación del lego en RCP y uso del DEA basado en la cadena de supervivencia.

Palabras clave: reanimación cardiopulmonar, paro cardíaco, supervivencia.

INTRODUCTION

The success of the intervention in an out-of-hospital cardiac arrest (OOHCA) is based on the urgency with which two key actions are fundamentally implemented: basic cardiopulmonary resuscitation (CPR) and cardiac defibrillation, which can reach success rates of 70 % of survival[(1)].

CPR maneuvers and early cardiac defibrillation in a OOHCA bring with it two inherent obstacles, which are: the performance of technically correct CPR and the efficient use of the automated external defibrillator (AED), with the education of lay personnel[2,3] being an essential intervention to achieve accessibility of CPR maneuvers and correct use of the AED for the general population[4,5].

In Paraguay, Law 5578 has been in force since 2016; Mandatory use of AED in places of public and private access of mass attendance[6]. In Paraguay there is no developed and validated questionnaire that evaluates knowledge about basic CPR maneuvers and correct use of the AED in the lay population, considering the links in the chain of survival in OOHCA(7).

The present research aims to; to develop, validate and evaluate a knowledge test on cardiopulmonary resuscitation and correct use of the automated external defibrillator in Asunción during 2023.

METHODOLOGY

An observational, descriptive cross-sectional study was carried out in a lay population of Asunción, with non-probabilistic sampling of consecutive cases during the months of March to June 2023, the participants were included through an invitation to the Directorate of Occupational Health and Hygiene (SHO) and/or human resources office of different private mass concurrence centers (MCC) in the neighborhoods; Mburicao, Bernardino Caballero, Villa Morra, Mburukuya, San Cristobal, Santo Domingo, Manorá, Bella Vista, Las Mercedes, Los Laureles in the city of Asunción and for its intermediation with users (clients, employees) of eight types of MCC; Social clubs, sports clubs, gyms, shopping malls, restaurants, supermarkets, universities, car dealership. An online link to Google forms containing the closed-ended questions of the questionnaire was sent. The calculation of the sample size was based on an expected Cronbach's alpha of 0.7 for 10 items of the KOR-AED, a power of 80 % with a $\alpha < 0.05$, and a percentage of participant losses due to incomplete data of 15 %, a total of 101 laypeople from the city of Asunción were required in the study period.

The inclusion criteria were citizens over 18 years of age, of both sexes, residing in Asunción, who are users (clients, employees) of any of the eight types of MCC and who have agreed to participate in the study by signing an informed consent.

For data collection, an instrument designed by the researchers called the "Knowledge Questionnaire on Basic Cardiopulmonary Resuscitation and Correct Use of the Automated External Defibrillator" (KOR-AED) was developed, which was divided into two parts. The first; the general variables (age, sex, education, profession, previous training in CPR and AED) and the second part; The variables on

knowledge about basic CPR and correct use of the AED in lay citizens based on the first three stages of the survival chain[7], 10 questions with 5 answers in multiple choices, only one of them as correct. The chain of survival in OOHCA consists of six links; first link; verify if the victim responds and activate the emergency system, second link; initiating high-quality chest compressions, third link; early use of the AED, fourth link; advanced life support, fifth link; post-cardiac arrest care, sixth link; rehabilitation and recovery. Of the 10 items of the KOR-AED, 6 should be answered correctly to have adequate knowledge.

Qualitative validation was performed by five independent research experts (three cardiologists and two emergentologists), using the Delphi method.

The reliability of the instrument was assessed by calculating the scale's Cronbach's alpha to measure internal consistency. A Cronbach's alpha value equal to or greater than 0.7 indicates good reliability. Factor validity was assessed by performing an exploratory factor analysis (EFA) and then a confirmatory factor analysis (CFA). EFA was performed using principal component analysis with varimax rotation. All factors with an eigenvalue equal to or greater than 1 were extracted, and elements with a load factor equal to or greater than 5 after rotation remained in the factor.

The item's difficulty index was calculated as a percentage of the total number of correct answers to the test item and ranged from 0 to 1: less than 0.20 is too difficult; 0.40 to 0.60 excellent; and more than 0.90 being too easy. Discriminatory indices were used to determine the sensitivity of the items and the test as a whole was used to measure unit capacity. The sample was divided into thirds. The index was then calculated by subtracting the difficulty ratings of the appropriate test items from the bottom third from the difficulty index of the test item from the top third. The higher the coefficient, the more discriminative the item will be: if the value of the discriminative index is ≥0.40, then the item is working satisfactorily; if it is between 0.30 and 0.39, then little or no revision is required; if it is between 0.20 and 0.29, then the item is marginal and needs revision; and if it is equal to or less than 0.19, then the item should be eliminated or completely revised

The research was approved by the Ethics Committee of the National University of Caaguazú with opinion number: 018/2023. STATA v.16 software was used for univariate and bivariate data management and descriptive analysis.

RESULTS

A total of 200 citizens participated in the study, most of them 51.5 % (103) customers of shopping malls, 63.5 % (127) were male, 28.5 % (57) were between 25 and 29 years old. 61.5 % (123) had a university education, 75.5 % (151) were non-health related laymen, 52 % (104) received some previous training in CPR, and 81.5 % (163) never received previous training in the use of AED (Table 1).

Table 1: Distribution of the general characteristics of the trained lay population. Asunción, Paraguay 2023. (n = 200)

Sex	n	%
Male	127	63.5
Female	73	36.5
MCC		
Shoppings (clients)	103	51.5
Other	97	48.5
Age		
20 - 24	55	27.5
25 - 29	57	28.5
30 - 34	19	9.5
35 - 39	20	10
40 - 44	13	6.5
≥45	36	18
Schooling		
Primary	3	1.5
High school	74	37
University	123	61.5
Profession		
Health-related (non-medical)	49	24.5
Non-health	151	75.5
Pre-CPR Training		
Yes	104	52
No	96	48
AED Pre-Training		
Yes	37	18.5
No	163	81.5

Questions 1 and 2 correspond to the first link in the chain of survival, questions 3,4,5,8 to the second link in the chain of survival and questions 6,7,9 and 10 to the third link in the chain of survival. Cronbach's alpha was 0.75, the Kaiser-Meyers-Olkin (KMO) measure for sampling adequacy was 0.78, and the Bartlett scale sphericity test was significant ($p<0.05$), demonstrating the suitability of the data for factor analysis. (Table 2)

Table 2: Factor loads of the exploratory factor analysis of the KOR-AED questionnaire

Elements	Factor Load
1. What's the first thing you should do if you see someone collapse and they're not responding?	0.78
2. If a person on the ground doesn't respond, what number should I dial right away?	0.84
3. How often should chest compressions be performed in cardiopulmonary resuscitation (CPR)?	0.79
4. What's the first thing you should do after you've called for help?	0.78
5. Where in the chest should you perform compressions?	0.72
6. If you're using an AED and the device indicates that a flush isn't necessary, what should you do?	0.73
7. When should an AED be used during CPR?	0.7
8. If two people are present during an emergency, how should they act to perform CPR?	0.73
9. If you see an AED nearby when you're helping someone who isn't responding, what should you do?	0.75
10. What does the acronym AED mean in the context of cardiopulmonary resuscitation?	0.7

The questions were ordered according to the proportion of correct answers. Items 4, 7, 6 and 2 had a medium difficulty, while items 8 and 10 had a difficult discriminatory index (Table 3).

Table 3: Analysis of the knowledge test of the COR-DEA questionnaire.

Question	% Correct	Difficulty Index	Discrimination Index
4. What's the first thing you should do after you've called for help?	50	0.33	0.44
7. When should an AED be used during CPR?	60	0.31	0.36
6. If you're using an AED and the device indicates that a flush isn't necessary, what should you do?	68.5	0.43	0.79
3. How often should chest compressions be performed in cardiopulmonary resuscitation (CPR)?	65	0.49	0.59
1. What's the first thing you should do if you see someone collapse and they're not responding?	81	0.84	0.31
2. If a person on the ground doesn't respond, what number should I dial right away?	84	0.65	0.55
9. If you see an AED nearby when you're helping someone who isn't responding, what should you do?	84	0.69	0.44
5. Where in the chest should you perform compressions?	94	0.56	0.49
8. If two people are present during an emergency, how should they act to perform CPR?	94	0.84	0.21
10. What does the acronym AED mean in the context of cardiopulmonary resuscitation?	92.5	0.99	0.22

The average score was 7.89 ± 0.21, with women obtaining significantly better scores than men (8.11± 0.15 vs 7.67± 0.1 p= 0.04). Questions related to the third link in the chain of survival in OOHCA; Early use of the AED were the most frequently answered by laypeople 76 % (152) incorrectly.

DISCUSSION

The development and validation of our KOR-AED questionnaire had a significant participation of the lay population, being mostly young people with university education, although most often the participants had received previous training in CPR, a significant proportion had not been trained in

the use of AED. These results are consistent with the findings of Borovnik Lesjak, who based his focus on a purely student population in Slovenia, where it was also observed that only a minority of students had received previous training in CPR and AED use[8].

Despite previous training in CPR, the results highlight a knowledge gap in the use of AED, suggesting the need to strengthen this last aspect with educational workshops on a massive scale for the lay population. Although Law 5578/2016 on the mandatory use of AEDs in public and private mass circulation centers has been regulated at the time of completion of this investigation, through Decree 9619/2023[6], we believe that the functional application of this law will allow the dissemination of mass training by the Ministry of Public Health and Social Welfare[9], and the access of lay citizens to intervene with CPR and AED in the face of a OOHCA, so that the KOR-AED questionnaire can be implemented as an educational strategy in citizens with different levels of education at different levels of education and act as multiplying agents, as was the case with the Girona Project in Spain[10] which, after changes in Spanish legislation, were able to carry out massive campaigns of CPR and use of the AED in OOHCA, being The main focus is on educational institutions.

The difficulty of the KOR-AED items varied, with certain items showing a medium level of difficulty, especially the questions related to the use of the AED and others a higher discriminatory index, In addition, Cronbach's alpha of 0.75 indicates an acceptable internal consistency of the KOR-AED test, however other studies of development and validation of questionnaires in CPR and AED use showed a Cronbach's alpha of 0.84[11] and 0.9[12] attributable to social contexts and familiarity with the use of the AED other than our own.

The KOR-AED test revealed that females scored significantly better compared to males. This result is interesting and could reflect differences in learning approaches or possibly in motivation between genders, which suggests an area for future research, regardless of this, the KOR-AED test can serve for a first approach to the level of knowledge of the lay population in CPR maneuvers and use of the AED and massively disseminate in society the knowledge of both maneuvers in line with the recommendations of international associations[5,13].

In terms of limitations, it is important to recognize that the study was conducted in an urban setting with participants who might not be representative of the general population of Asunción. In addition to the inherent limitations of the cross-sectional design, the self-selection of participants could introduce bias. Increased involvement of public MCCs highlights the need for larger longitudinal studies to expand our findings.

CONCLUSION

The KOR-AED test is a valid and reliable instrument to contribute to the critical need for CPR and AED training, by implementing more effective training strategies, with a particular focus on the first three links in the chain of survival, improving the public's preparedness to respond to out-of-hospital cardiac arrest.

Conflict of Interest

The authors declare no conflicts of interest.

Financing

None

Author contribution statement:

Ríos-González C and Rolón A: contributed with the research question, design, recruitment of variables, analysis, and discussion of the results.

Rolón L and Ríos D with variable recruitment. Ortellado J and González G with the analysis of the results.

The authors are fully aware of the final content of the manuscript and authorize its publication.

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