Original Article

Acquisition of knowledge and skills on cardiopulmonary resuscitation and use of the automated external defibrillator after a training process by Galician schoolteachers

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ABSTRACT

The aim of this research was to evaluate the knowledge that Galician schoolteachers from kindergarten, primary and secondary schools had on cardiopulmonary resuscitation (CPR) and automated external defibrillator (AED) after a training process comparing oblivion after one week (G1), after a month (G2) and after two months (G3). The sample was made up by 144 schoolteachers between 23 and 64 years old (M = 42.46 SD = 10.03), 100 (69.4%) women, and 44 (30.6%) men. For data collection an ad hoc questionnaire was used, also a mannequin QCPR Laerdal® and a Philips AED. The results show statistical significative differences between the average of correct answers on the first questionnaire, and the last one (p < .001) among all the studied dimensions and groups (G1, G2 and G3). Regarding the ability to carry out a CPR, only statistical significative differences were found regarding average depth (men vs women; p < .001). Regarding AED time of use there were not found statistical significative differences regarding the time to apply an effective discharge on different groups (p > .005; G1 = 61.98 seconds; G2 = 54.69 seconds; G3 = 56.68 seconds). After the formative programme about BLS, there is an increase of theoretical knowledge among the schoolteachers and it remains 2 months after the programme is given. Also, it happened the same regarding CPR skills and AED use program.
Keywords: Schoolteachers; Training programme; Basic life support; Cardiopulmonary resuscitation; Automated external defibrillator; Mandatory education.

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INTRODUCTION

Education must be the engine for the welfare of a country, in this way the Educational System must give the possibility to teach new contents and methods in order to satisfy the student's needs, which have evolved, as the society did (Organic Law 8, 2013).

Basic Life Support (BLS), is one of these contents, and there are different legal references regarding first aids and safety performance, and also, claims from Kindergarten (Royal Ordinance 1630, 2006), Primary (Royal Ordinance, 126, 2014), Secondary school and baccalaureate (Royal Ordinance 126, 2014), and others suggested by the World Health Organization (WHO) in collaboration with the American Heart Association (AHA, 2001), and the European Resuscitation Council (ERC) (Nolan, et al., 2010), in order to teach CPR at school (Perkins, et al., 2015) through the initiative «Hands that help-Training children is training for life» (Böttiger, et al., 2016).

In order to teach these contents at school, schoolteachers had to also learn about them, because, due to their abilities (Böttiger, et al., 2016; Lukas, et al., 2016; Semeraro, et al., 2017) and also because they are an available population to learn about BLS and AED, and also because their knowledge could be multiplied (Lesjak, Šorgo, & Strnad, 2019), they were the right subjects to teach these techniques and so contribute to the formation of CPR at the schools (Böttiger et al., 2016).

Actually, future schoolteachers (Navarro, Penelas, & Basanta, 2016), and also active schoolteachers (Gainzta & Velasco, 2020; Navarro-Patón, et al., 2020) are not qualified enough into these contents, so they cannot contribute to the kids save lives initiative (Böttiger, et al., 2016). In addition, one of the most controversial aspects regarding CPR training is the teaching method which would allow to teach a large group of people in a short period of time avoiding the "*oblivion curve*", because in order to the Project to be effective, a large group of people must be taught and what they learn should be forgotten as late as possible (García del Aguila, et al., 2019).

Even though there are many BLS teacher trainings regarding CPR and the use of AED (Lago-Ballesteros et al., 2018; Navarro et al., 2020), and their effectiveness has been proved (Basanta-Camiño, et al, 2018; Navarro-Patón, et al., 2018; 2020; Pavón-Prieto, et al., 2016), the research regarding the use of these training methods for schoolteachers in our country is limited.

Due to this fact and following the advice of the European Resuscitation Council (Olasveengen, et al., 2020), BLS practices, scene safety, consciousness assessment, respiratory assessment, emergency calls, CPR and the use of an automated external defibrillator (AED) (Olasveengen, et al., 2020), should be included on the teacher training. In this way, all schoolteachers could be trained and the group to be formed will be large.

For all these reasons, our objective has been to analyse the effect of a short traditional training program following the ERC recommendations (Perkins, et al., 2015) on the theoretical knowledge and practical skills on basic life support acquired by active Galician schoolteachers, of Galician public schools, one week after the training, one month after the training, and also two months after the training. This way it can be proven how many times these knowledges remain and we can also come up with a guide to avoid the grade of oblivion.

METHOD

Research design
A quasi experimental research was carried out, without a control group, tracing it after one week, one month and two months of the training given.

Participants
Two hundred and fifty seven Kindergarten, Primary and Secondary Education schoolteachers were contacted. All these schoolteachers from Galician public schools. One hundred and sixty-six attended the briefing were the objective, the confidentiality statement, the design and the procedure of the research were explained. They were also informed about the voluntary aspect of this research and the free decision to leave it anytime they wanted. Finally, one hundred and forty-four schoolteachers participated in each part of the research and gave the consent for their data treatment.

Procedure
Before the formation was given, the personal data of the participants was collected (age, gender, educative stage in which they taught and previous knowledge regarding BLS). Also, they were given a questionnaire about previous knowledge regarding cardiopulmonary resuscitation (CPR) on adults, performance of the automated external defibrillator (AED) and emergency calls. After the formation, the schoolteachers were randomly separated into three groups G1 (evaluation one week after the formation), G2 (evaluation one month after the formation) and G3 (evaluation after one month of the formation) and their theory knowledge through the questionnaire, the CPR abilities and the sequence of use of the AED were again evaluated.

During their participation in this research the subjects were treated regarding the Helsinki Statement.

Study variables
The dependent variables of this research were those derived from the questionnaire on the theoretical part (compression/ventilation knowledge rate; Compressions per minute, and depth of the CPR on an adult; sequence of performance for the use of an AED and knowledge of the emergency phone number), those derived from the ability to perform CPR (% correct compression, % correct re-expansion, total number of compressions and average depth) and the use of AED (high quality, high effectiveness, safety and errors committed and time to perform an effective discharge).

Tools
Questionnaire
To obtain the data of this investigation, a 12 question questionnaire was used as before in research carried out by Navarro, et al. (2016) or Navarro-Patón, et al., (2020). The questions were established according to 6 dimensions: sociodemographic (4) (gender, age, educational stage in which he or she teaches, years of experience); training in first aid and CPR given (2) [training received (dichotomous, yes-no), knowledge of first aid (Likert scale from 1-5 from no to excellent); specific knowledge of CPR in adults (4), [dichotomous (yes-no) and 3 open]; AED sequence performance (1) (open) and emergency phone (1) (open).

Basic Life Support (BLS)
The didactic material used was a guide from the European Resuscitation Council (ERC) on BLS, a Little Anne Laerdal® mannequin for every two students, a QCPR Laerdal® and training AED for every 6 students.

Check list for the use of AED
The following variables were collected in the checklist for the use of AED: time to apply an effective discharge; safety during the performance (if the schoolteacher was not in contact with the mannequin during discharge); correct performance order (1. Turn on, 2. Place patch, 3. Insert the connectors into the patches, 4. Follow the instructions, 5. Discharge); non changing objective mistake (for example exchange the places in which the patches are placed); Accomplishment of effective discharge objective (do not make mistakes which could change the objective); Quality objective (no mistakes, safe execution, and correct order).

Formative process
The participants received a theoretical-practical course, with guided formation on BLS and AED in groups of 10. In this training, it was highlighted the importance of carrying out the CPR only with compressions and without interruptions. In the practical part, in which there was an investigator for every two schoolteachers, the participants performed external cardiac compressions on a manikin without feedback, exchanging themselves every 2 minutes, during a total time of 6 minutes of compressions per participant. Once the procedure was completed, each group was given an AED in order to simulate the performance sequence for its application.

Statistical analysis
In order to analyse the data, quantitative variables were used and expressed through central trend measures. To study the relation between categorical variables the Pearson χ^2 was used with a contingency coefficient for the comparison of the variables related to knowledge about CPR in adults, AED use and emergency phone, regarding the variables of time [1 week (G1) vs 1 month (G2) vs 2 months (G3)]. Afterwards, a t-test was used to compare de average answers before and after the formation for the CPR and AED factor, and also for the emergency phone. Also, a bifactorial variance analysis (*ANOVA*) was carried out for every studied variable regarding the execution abilities to carry out hands only CPR, and make an effective discharge with the AED, being the first factor the time (1 week (G1); 1 month (G2); 2 months (G3)) and the second one the gender variable (men-women). The main effects were studied and also the interaction between variables, using the *Bonferroni* statistical to evaluate signification. For all these reasons, the IBM SPSS Statistics v. 25.0 statistical package was used, and the confidence interval was established on 95%.

RESULTS

A total of 144 schoolteachers participated in this research. 100 of them were women (69.4%) and 44 men (30.6%). Their average age was 42.46 (10.03) years old. The schoolteachers in Kindergarten (32; 22.2%), Primary Education (46; 32.0%) and Secondary Education (66; 45.8%) with an average of 14.95 (9.8) years of experience. Even though 48 of them had previous formation regarding first aid and BLS, only 4 (8%) indicated their knowledge was good enough.

Table 1 shows the correct and incorrect answers to the knowledge acquired before and after every question. Before training, there were no differences in the knowledge of the three groups (*p* > .005). The percentage of correct questions after the training was significantly higher, which is why learning was acquired with this training method.

After the implementation of the training program, it should be highlighted that a statistical significative association was found between the three periods of time in which the knowledge of the schoolteachers was evaluated (χ^2 (2) = 8.909; *p* = .012; contingency coefficient = 0.241; *p* = .012). When the oblivion grade is evaluated, differences were only found on theoretical knowledge regarding compressions per minute (χ^2 (2)

= 7.439; *p* = .024 contingency coefficient = 0.222; *p* = .024). The trend is that, after training, the number of correct answers remains stable over time.

Table 1. Sample data before and after the training regarding CPR on adults, use of AED and emergency phone number for the three groups.

Adult CPR		G1 (n = 57)		G2 (n = 39)		G3 (n = 48)	
		Yes	No	Yes	No	Yes	No
I would now how to perform a CPR to an adult	Pre	9 (34.6%)	48 (40.7%)	9 (34.6%)	30 (25.4%)	8 (30.8%)	40 (33.9%)
	Post	49 (47.1%)	8 (20.0%)	25 (24.0%)	14 (35.0%)	30 (28.8%)	18 (45.0%)
		Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Compression-ventilation rate	Pre	8 (34.8%)	49 (40.5%)	8 (34.8%)	31 (25.6%)	7 (30.4%)	41 (33.9%)
	Post	28 (40.6%)	29 (38.7%)	24 (34.8%)	15 (20.0%)	17 (24.6%)	31 (41.3%)
Compressions per minute	Pre	2 (33.3%)	55 (39.9%)	3 (50.0%)	36 (26.1%)	1 (16.7%)	47 (34.1%)
	Post	34 (50.7%)	23 (29.9%)	17 (25.4%)	22 (28.6%)	16 (23.9%)	32 (41.5%)
Depth	Pre	3 (37.5%)	54 (39.7%)	4 (50.0%)	35 (25.7%)	1 (12.5%)	47 (34.6%)
	Post	32 (48.5%)	25 (32.1%)	18 (27.3%)	21 (26.9%)	16 (24.2%)	32 (41%)
AED and emergency phone number							
		Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Sequence and use of AED	Pre	0 (0.0%)	57 (39.6%)	0 (0.0%)	39 (27.1%)	0 (0.0%)	48 (33.3%)
	Post	0 (0.0%)	57 (39.6%)	0 (0.0%)	39 (27.1%)	0 (0.0%)	48 (33.3%)
Emergency phone number	Pre	41 (39.0%)	16 (41.0%)	26 (24.8%)	13 (33.3%)	38 (36.2%)	10 (25.6%)
	Post	56 (40.9%)	1 (14.3%)	38 (27.7%)	1 (14.3%)	43 (31.3%)	5 (71.4%)

Note: G1 = Retest Group- 1 week; G2 = Retest Group-1 month; G3 = Retest Group-2 months.

Figure 1 shows the global average score of the schoolteachers regarding the correct answers before and after the training (M = 0.98; SE = 0.07 vs M = 2.35; SE = 0.10; t (143) = -12.959, *p* < .001, r = 0.20). Also, for groups of dimensions, the following results were obtained: CPR for adults (M = 0.26; SE = 0.05 vs M = 1.40; SE = 0.09; t (143) = -11.931, *p* < .001, r = 0.20) and sequence of AED use and knowledge of the emergency phone number (M = 0.72; SE = 0.04 vs M = 0.95; SE = 0.02; t (143) = -5.560, *p* < .001, r = 0.18).

The same way, the ANOVA performed, only showed significative statistical differences between groups in terms of correct answers globally *(F* (2, 141) = 5.113; *p* = .007, *η2* = 0.08), decreasing these averages as the time went on. The same happened with the parameters of CPR for adults knowledge (*F* (2, 141) = 4.196; *p* = .017, *η2* = 0.06), but this did not happen regarding the knowledge of the sequence on the use of an AED

and the knowledge of the emergency phone number (p = .090). A decrease in the correct answers is observed as the time passes in all the factors studied.
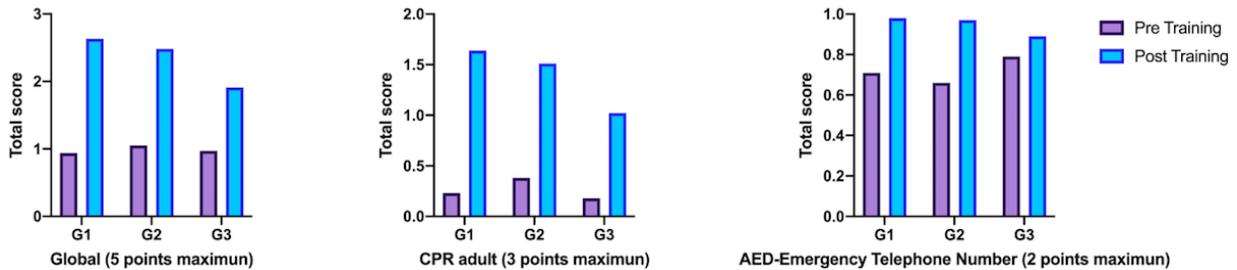

Figure 1. Number of correct responses in the questionnaire before-after training, (G1: 1 week; G2: 1 month; G3: 2 months).

Skills regarding the CPR quality

Table 2 shows measures and standard deviations for the parameters collected for the post-program mannequin skills reporter with respect to the type of training program, globally and by gender.

Table 2. Descriptive data of the analysed variables. Mean, Standard Deviation regarding gender and re-test group.

Variable	Group	Men		Women		Total	
		M	*SD*	*M*	*SD*	*M*	*SD*
CoD (mm)	G1	39.25	7.62	31.97	7.17	34.50	8.05
	G2	34.50	6.61	29.70	7.51	31.18	7.50
	G3	36.92	4.42	32.69	5.87	33.77	5.80
CReP (%)	G1	37.19	33.63	56.50	41.43	49.78	39.62
	G2	41.25	32.96	58.70	38.22	53.33	37.16
	G3	50.58	30.95	51.58	34.98	51.49	33.67
TNCo (2 min)	G1	259.56	44.20	209.13	66.18	226.67	63.75
	G2	221.08	91.07	211.37	95.45	214.36	93.03
	G3	243.08	68.56	230.63	70.72	233.81	69.65
CCo (%)	G1	55.87	34.27	36.86	39.19	43.64	38.24
	G2	37.36	32.96	28.42	36.72	31.08	35.43
	G3	32.83	33.72	40.42	34.19	38.40	33.85

Note. M: Average; SD: Standard Deviation; CoD: Average Compressions Depth; CReP: correct re-expansion percentage; TNCo: Total number of Compressions CCo: Correct compressions percentage. G1 = Retest Group- 1 week; G2 = Retest Group-1 month; G3 = Retest Group-2 months.

The results of the ANOVA factorials indicated that there was a main and significative effect of gender in the mean depth (F = 17.926, p < .001; η2 = 0.125) being higher form men than women. No significant main effect of the group factor was found (p = .087). Furthermore, there was no significant interaction between gender and group factors (p = .632). Regarding the rest of the analysed factors, no significant statistical differences were found between gender, group or the interaction of both.

Skills regarding use and sequence of the AED

Table 3 shows averages and standard deviations of the times dedicated to applying an effective discharge after the training program, after one week, one month and two months, globally and separately by gender, of the schoolteachers who achieved the objective.

Table 3. Descriptive data of AED application time. Group, gender and global of schoolteachers who participated in the research.

		Men		Women		Total	
Variable	Group	Mean	SD	Mean	SD	Mean	SD
	G1	63.19	50.69	61.33	22.33	61.98	34.33
Application time(S)	G2	54.50	14.38	54.50	20.77	54.69	18.84
	G3	52.83	10.72	58.00	16.59	56.68	16.59

Note. S.: Seconds. SD: Standard Deviation.

The results of the ANOVA factorials indicated that there was no significant effect of the group factor (p = .339), neither gender factor (p = .803) nor a significant interaction between both (p = .823).

DISCUSSION

The objective of this research was to evaluate the effect of a CPR and use of AED training on Kindergarten, Primary School and Secondary Education schoolteachers. At global level, in terms of the results obtained, it should be highlighted that before the training, schoolteachers did not have enough knowledge about BLS in order to perform during a school emergency, and neither they have it to teach about these topics during their daily lessons according to international organisms such as ERC (Böttiger, et al., 2016; Lukas, et al., 2016; Semeraro et al., 2017), as happened in research carried out by Navarro et. al., (2016), on future schoolteachers of Primary Education, and in research carried out by Gainzta and Velasco (2020), on Kindergarten and Primary Education schoolteachers, and also in that of Navarro-Patón et al. (2020) about Kindergarten, Primary and Secondary School. This shows that in our country, there is actually a room for improvement regarding teaching BLS to schoolteachers. After the theoretical-practical training of 40 minutes, the participants improved their knowledge on CPR for adults and the performance sequence of AED, and also regarding the emergency phone number, showing that a brief training can improve this knowledge (Aqel, et al., 2014; Hernández-Padilla, et al., 2015).

However, the results obtained after the training program, indicate that a brief theoretical training, using a slide presentation and the ability practice afterwards, is enough to increase knowledge regarding CPR and AED, and also the knowledge of the emergency phone number. These results are similar to those obtained by Mendez-Martínez, et al. (2019) on health science students and Navarro-Patón et al. (2016; 2018) on Primary Education degree students, and Navarro-Patón et al. (2021) on Physical Education schoolteachers.

Regarding the basic skills to perform basic CPR, if we compare the criteria indicated by the ERC guidelines (Perkins et al., 2015) which says that quality chest compressions of the victim at a depth of 5 or 6 cm allowing the thorax to totally re-expand in every compression, with a frequency per minute of 100 to 12 compressions, we should indicate that the schoolteachers of our research do not reach the quality parameters in terms of depth, and there are closer to these parameters means results than women's results (Méndez-Martinez, et al., 2019). They are also better a week after training than after one month or two. The same occurs with the percentage of re-expansion and the percentage of correct compressions, which reach 50% one week after the training and decreases as the time goes by. These data are different than the results obtained on research

like Gonzalez-Salvado, et al., (2016) Navarro-Patón et al., (2020) and Navarro-Patón et al. (2018). However, it should be highlighted that schoolteachers are able to perform a correct frequency in the three different periods of time.

The results obtained should not discourage training with these tools because only a few people, such as training students (Navarro et al., 2018), or even professionals working on medical emergencies, are capable of exceeding and achieving these parameters (Gonzalez-Salvado et al., 2016) that indicates the ERC (Perkins et al, 2015).

In our research, the average retain time (1-2 months), did not vary, so that for this training time it was enough to improve knowledge and skills among the schoolteachers who participated, unlike what happened with the BLS training (Baldi, et al., 2017; Cortegiani, et al, 2017, Navarro-Patón et al, 2018; Nishiyama et al., 2015). This indicates that these programmes, even though they are brief, do not require extra technical aspects or organisation, and the results are even better than if a citizen is guided by an emergency centre (Navarro-Patón, et al., 2017).

Regarding the use of AED, the training was efficient, 100% of the participants obtained the objective of applying discharge, such as research like Méndez-Martínez et al., (2019) with nursing students or physiotherapy students, or the one carried out by Basanta-Camiño et al. (2017) or Navarro-Patón et al. (2018) with students of the Primary Education degree. The deterioration of the skills is less than basic CPR, which is why it is recommended to include this type of training in all BLS courses, so that a larger amount of people can learn about it, since it is a main element in terms of baseline CPR survival by control.

Regarding the emergency phone number, it should be said that it is the most known by the schoolteachers, maybe due to the campaigns on communication media. Furthermore, this knowledge increased with the formative process.

As limitations on this research, the sample size should be highlighted, because it is not representative, but this should not detract from the discoveries made. Also, basic RCP skills, such as the use of the AED, were performed by a simulation, so we are not able to know how the participants would behave in a real situation. On the other hand, although participation was free, the motivation of some of the participants may have influenced the development of the study.

CONCLUSSION

The conclusions of this research are that schoolteachers did not have enough knowledge regarding BLS (CPR and AED), but they did have enough knowledge about the emergency phone number before the training, although they indicated having previous knowledge about these topics.

After the low-cost training program on BLS, an increase in theoretical knowledge is shown among the schoolteachers, and it is maintained for at least 2 months after training.

Regarding the CPR basic abilities, the training program produces an increase in skills but only reaches the recommended parameters of the rate of compressions. Even so, the skills learned remain for at least two months after training. Regarding the use of AED, a significant improvement is registered and it is maintained after two months, as well as the knowledge about the emergency phone number. Because all of this, this type of training program, can be feasible for teaching BLS to active schoolteachers and should stimulate the

start of training programs in other areas of our country in order to reach the necessary training for all schoolteachers.

AUTHOR CONTRIBUTIONS

All authors have participated in all parts of the research work and in the preparation of the article (in the conception and design of the study, in the acquisition of data, in the analysis and interpretation of the data, as well as in the draft of the article, the critical review of the intellectual content, and the final approval of this document).

SUPPORTING AGENCIES

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

ACKNOWLEDGMENT

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