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Effect of 3 basic life support training programs in future primary school teachers. A quasi-experimental design☆

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KEYWORDS
Laypersons;
Basic life support;
Cardiopulmonary resuscitation;
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Abstract
Aim: To evaluate the learning of basic life support (BLS) measures on the part of laypersons after 3 different teaching programs.
Design: A quasi-experimental before–after study involving a non-probabilistic sample without a control group was carried out.
Scope: Primary school teacher students from the University of Santiago (Spain).
Participants: A total of 124 students (68.8% women and 31.2% men) aged 20–39 years (M = 22.23; SD = 3.79), with no previous knowledge of BLS, were studied.
Interventions: Three teaching programs were used: a traditional course, an audio-visual approach and feedback devices.
Main variables of interest: Chest compressions as sole cardiopulmonary resuscitation skill evaluation: average compression depth, compression rate, chest recoil percentage and percentage of correct compressions. Automated external defibrillator: time needed to apply a shock before and after the course.

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Results: There were significant differences in the results obtained after 2 min of chest compressions, depending on the training program received, with feedback devices having a clear advantage referred to average compression depth ($p < 0.001$), compression rate ($p < 0.001$), chest recoil percentage ($p < 0.001$) and percentage of correct compressions ($p < 0.001$). Regarding automated external defibrillator, statistically significant differences were found in T_{after} ($p = 0.025$).
Conclusions: The teaching course using feedback devices obtained the best results in terms of the quality of chest compressions, followed by the traditional course and audio-visual approach. These favorable results were present in both men and women. All 3 teaching methods reached the goal of reducing defibrillation time.

PALABRAS CLAVE
Personal lego;
Soporte vital básico;
Resucitación cardiopulmonar;
Desfibrilador externo semiautomático

Efecto de 3 métodos de enseñanza en soporte vital básico en futuros maestros de Educación Primaria. Un diseño cuasiexperimental

Resumen
Objetivo: Evaluar el aprendizaje en soporte vital básico (SVB) en personal lego tras 3 experiencias formativas diferentes.
Diseño: Se trata de un estudio cuasiexperimental antes-después de muestreo no probabilístico, sin grupo control.
Ámbito: Estudiantes de formación de profesorado de educación primaria de la Universidad de Santiago de Compostela.
Participantes: Un total de 124 estudiantes (68,8% mujeres y 31,2% hombres) de entre 20 y 39 años (M = 22,23; DE = 3,79), cuyo criterio de inclusión fue el no tener conocimientos previos sobre SVB.
Intervenciones: Se aplicaron 3 programas formativos sobre SVB a estudiantes universitarios: curso tradicional, métodos audiovisuales y dispositivos de retroalimentación.
Variables de interés principales: En masaje continuo: profundidad media de la compresión, porcentaje de reexpansión correcta, ratio de compresiones por minuto, porcentaje de compresiones correctas. Con el desfibrilador externo semiautomático: tiempo empleado en aplicar una descarga antes y después de la formación.
Resultados: Existen diferencias significativas en los resultados obtenidos tras 2 min de masaje continuo en función de los programas formativos recibidos, favorables al método de retroalimentación: ratio de compresiones por minuto ($p < 0,001$), profundidad media de la compresión ($p < 0,001$), porcentaje de compresiones correctas ($p < 0,001$) y porcentaje de reexpansión correcta ($p < 0,001$). En cuanto al desfibrilador externo semiautomático, se encontraron diferencias estadísticamente significativas en el $T_{después}$ ($p = 0,025$).
Conclusiones: El programa de formación con dispositivos de retroalimentación obtuvo los mejores resultados de calidad de compresiones cardíacas, seguido del curso tradicional y del método audiovisual. Sus superiores resultados se manifestaron tanto en hombres como en mujeres. Los 3 métodos formativos lograron el objetivo de reducir los tiempos de desfibrilación.

Introduction

Sudden cardiac death (SCD) is one of the leading causes of death in industrialized countries, and more than 90% happen outside the hospital setting.[1] In Europe, it is estimated that the average incidence rate of cardiorespiratory arrests (CRA) is 84% for every 100,000 inhabitants per year,[2] with an average survival rate after hospital discharged of 10.3%. In Spain, back in the year 2013, there were 115,752 cases of acute coronary syndrome, of which 100,000 suffered from an acute myocardial infarction, 33% of which died before arriving to a health center.[3] It is estimated that by 2021 this figure will remain stable until reaching 109,772 cases, of which 81% will be due to acute myocardial infarctions.[3] On the other hand, the average response time of the emergency medical teams (EMT) is between 7 and 20 min,[4] based on the resources and location of the victim. According to a study conducted in the Balearic Islands, Spain, the average response time in Spain since the basic life support (BLS) is initiated by these EMTs[5] is 8.3 min, which is why starting the BLS maneuvers by whoever witnesses the CRA is of paramount importance here. All citizens should have some sort of basic training on how to perform cardiopulmonary resuscitation (CPR) maneuvers since they are usually the first witnesses and responders to an out-of hospital cardiac arrest (OHCA). Thus, the measures established by international ogranizations[6,7] to increase the survival rates of OHCA should be observed. These measures should be oriented toward the early activation of the EMT, the performance of CPR maneuvers by first responders, early defibrillation, and further care by the advance life support team. This is even more important if we take into consideration that most OHCAs happen at the victim's own house and in public places,[8–10] where the first responders can be the family members or acquaintances. This is why it is crucial that everybody knows how to initiate BLS maneuvers immediately after witnessing an OHCA, since it is of vital importance for the victim's survival.[6,7,11,12] However, there is a lack of information and training when it comes to reacting to this urgent situation, and a small percentage of the population knows how to perform CPR maneuvers.[13,14] Due to how difficult it is to guarantee the training of the entire population, back in the year 2015, the World Health Organization together with other international societies published a series of recommendations to teach CPR maneuvers to kids—the Hands that help-Training children is training for life initiative[15] in an attempt to increase the percentage of CPR performed by witnesses—taking as an example the high rates of CPR performed by witnesses of Scandinavian countries. The initiative recommended two (2) hours of mandatory CPR training a year starting at 12 years old in schools everywhere.[15]

The manifest states that both healthcare professionals and teachers trained in CPR maneuvers can teach these techniques to school children, meaning that in order to meet the requirements of official BLS training in schools, teachers should be the providers of information. It is estimated that even scholars trained in CPR maneuvers[15] could teach these skills to their families and friends,[16] the basic skills needed to perform external chest compressions and use an automated external defibrillator (AED). This school training proposal is motivated by the fact that, at one time or another in a person's lifetime, schools are visited by nearly 100% of the population.[17]

So, teachers, the cornerstone of experience, should be trained, prepared, and motivated to be able to perform this task. This is why college training can increase the ratio of witnesses capable of performing CPR maneuvers.[18] However, according to several reports and studies, these days, CPR is not part of the teachers' curricula,[19] which is why they do not teach CPR maneuvers to their students, because they do not have enough information on this topic, or they are not ready to deal with CPR in their classes.[20,21]

Due to how important it is to guarantee the best teachers' training in BLS who, by the way should be the providers of this experience, and knowing the actual time constraints and limited resources to put it into practice, the goal of this study is to compare the degree of acquisition of the 2 fundamental skills needed to provide BLS: chest compressions, and use of AED[22] in future teachers through the implementation of three (3) different short-term training methods (<1 h): one traditional course; multimedia devices; and CPR feedback devices.

Material and methods

Sample

A total of 124 college students from the Faculty of Teacher Training at the Universidad de Santiago de Compostela, Spain without any prior experience or training in BLS participated in this study. Those students with BLS training (CPR and use of AED) were excluded. Participation in the study was voluntary and prior written informed consent was obtained from the participants for the transfer of data and use in research. The study was approved by the bioethics committee from the Universidad de Santiago de Compostela, in full compliance with the Helsinki Convention.

Study design

The three (3) training experiences had to meet the following requirements: be designed based on the actual guidelines on the performance of CPR, last less than 60 min, be a unique experience in order to avoid the possibility of confounding factors from any possible voluntary trainers, and share the same duration of limited training on a phantom to a total of 6 min for every participant in shifts of continuous chest compressions of 2 min each.

Once the participants had been informed and after accepting the conditions required by the research, the two factors—age and sex were recorded. After this, the participants were allocated to one (1) of three (3) study groups using the following non-randomized criterion: natural groups of class attendance. Three (3) different groups were built: one first training group using a traditional course ($TG_{traditional}$) ($n = 40$); one second training group using multimedia resources ($TG_{multimedia}$) ($n = 44$); and a third group ($TG_{feedback}$) ($n = 40$) of training using one immediate feedback device for external chest compressions, plus a short explanation (<60 s) on the use of AEDs.[23,24]

These were the training processes used:

The $TG_{traditional}$ received a 40 min-theory-practice course with instructor-led training in BLS and AED in groups of ten (10) people during which the importance of performing CPR maneuvers with uninterrupted chest compressions only was stressed out. On the practical side of the course, and with a ratio of one (1) instructor for every two (2) students, the participants performed external chest compression on a phantom to get used to the phantom, and with no feedback at all, and switched roles every 2 min, for a total 6 min-time of chest compressions per participant.

The $TG_{multimedia}$ was shown two (2) short videos: one first video on external cardiac massage of chest compressions only, of 3 min-and-20 s duration, and a second video on how to use the AED, of 3 min-and-57 s duration, where an indoor soccer player suffers from a cardiac arrest and is assisted by his coach following the steps of the chain of survival. At the end of each video, one expert summarizes the key aspects of CPR for first responders. The videos are available through the following links: external cardiac massage at https://www.youtube.com/watch?v=ZQdwoRf-TLg; AED at https://www.youtube.com/watch?v=6W4zbqWWDs.[20] After watching the videos, and same as it happened in the group with traditional training, the participants performed external cardiac compressions, in pairs, on a phantom and switched roles every 2 min for a total 6 min-time of chest compressions per participant.

The third group, $TG_{feedback}$, received a brief one-minute explanation on how to place the hands on the cardiac massage area on the feedback phantom, followed by recommendations on how to achieve the correct frequency and compression depth, while taking into consideration the teacher's indications, and the feedback from the phantom. When it comes to the AED, they received a less-than-60-s-brief explanation on how to use this device.[23,24] Same as it happened with the aforementioned two training groups, the participants performed external cardiac compressions, in pairs, on a phantom and switched roles every 2 min for a total 6 min-time of chest compressions per participant.

After completing the training, each student was taken to a private room with a simulation including the Leardal Resusci Anne Q-CPR phantom programmed in compression mode only. Each participant was asked to perform external cardiac compressions of 2 min-duration, and the results from the different parameters of the phantom program were recorded. After the two-minute massage, they were asked to use the AED on the uncovered chest of the phantom, and the time elapsed until one discharge was administered following the AED indications was recorded. The time elapsed from the moment the AED was handed out, until the students pressed the discharge button was measured, and the mistakes made while placing the patches were assessed.

Tools

One ad hoc questionnaire was handed out in order to collect the sociodemographic data (age and sex), and prior knowledge on BLS, and those who knew or had been trained on how to perform CPR chest compressions were excluded.

One of the tools used to collect information on external cardiac compressions was the Laerdal Resusci Anne phantom using the Laerdal Skill Reporter software version 2.4. This model records the compressions and distinguishes whether they have been performed right or wrong. This whole process was conducted following the recommendations from the actual guidelines on cardiopulmonary resuscitation established by the European Resuscitation Council.[7]

Variables

The following variables were collected: sex; age; average compression depth (ACD); correct reexpansion rate (CRR); compression rate per minute (CRM); and correct compressions rate (CCR). The time elapsed while applying the defibrillation with the AED before and after the training process was recorded too.

Statistical analysis

Quantitative variables are expressed as mean and standard deviation (SD). Group mean analyses (ANOVA) were conducted in order to analyze any prior differences between groups in the measures of each of the variables studied. Also, bifactorial analyses of variance (ANOVA) were conducted for each of the variables studied: the group with 3 levels (traditional, multimedia, and feedback) was the first factor, while the sex variable (man–woman) was the second one. The main effects and interaction between the different variables were studied using the Bonferroni Correction to estimate significance. The statistical software IBM SPSS

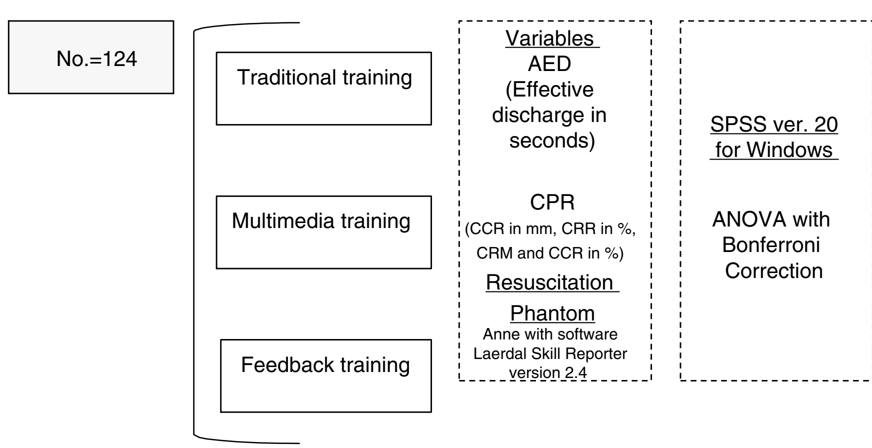

Figure 1 Research flow chart. CCR: correct compressions rate; ACD (mm): average compression depth (mm); CRR: correct re-expansion rate; CRM: compression rate per minute.

Statistics v. 20.0 was used. A 95% confidence interval was established (Fig. 1).

Results

Sociodemographic data

One hundred and twenty-four (124) individuals were studied (average age: between 20 and 39 years (M = 22.23; SD = 3.79), all of them third-year students of the Degree in Primary Education from the Faculty of Teacher Training at the Universidad de Santiago de Compostela, Spain. The traditional groups included 12 men and 28 women; the multimedia group included 12 men and 32 women, and the immediate feedback group included 14 men and 26 women. Twenty-two (22) students were excluded whether because they had former training, or some knowledge on BLS.

Times elapsed using the automated external defibrillator

Table 1 shows the means and standard deviations of the times elapsed when applying the DEA discharge before and after the training program—both overall-based, and sex-based.

The results from the factorial ANOVA analyses conducted showed that there is a significant main effect in the training program factor $F(2.118) = 10.219$, $p < 0.001$, $Eta^2 = 0.148$ in the time elapsed using the AED after the training period. We have not found the existence of a significant main effect in the sex factor ($p = 0.618$), or a significant interaction between the program factor and the sex factor ($p = 0.751$).

When it comes to paired comparisons, there is a 6.41 s-difference in the application of the AED discharge ($p = 0.022$) between women from the feedback training group, and those from the traditional training group—a tendency that can also be observed in men, with a 6.31 s-difference ($p < 0.001$). Similarly, there is a 3.90 s-difference ($p = 0.032$) between women from the multimedia training group, and those from the traditional training group. When drawing comparisons on the improvement effect—understood as the differences reported when applying a discharge between T_{after} and T_{before}, no statistically significant differences among the 3 training programs were found ($p = 0.556$): this means that this improvement is the same in the three (3) training programs, regardless of the differences seen in the times elapsed after the test.

CPR parameters recorded

Table 2 shows the means the standard deviations of the parameters recorded by the skill reporter phantom after the training program, based on the training program – both overall-based, and sex-based.

The results from the factorial ANOVA analyses conducted on the CRM showed that there is a significant main effect of the program factor $F(2.118) = 31.974$, $p < 0.001$, $Eta^2 = 0.351$ in the number of compression rate per minute performed on the phantom test. We have not found a significant main effect in the sex factor ($p = 0.098$), or a significant interaction between the program factor, and the sex factor ($p = 0.855$).

On the method of paired comparisons, we can say that both the traditional and the multimedia groups compressed the chest at an inadequate rhythm (above 120 chest compressions per minute). In the analysis conducted between men and women within each and every one of the training groups, we did not find any statistically significant differences on this regard.

The results from the factorial ANOVA analyses conducted on the ACD showed that there is a significant main effect of the program factor $F(2.118) = 32.204$, $p < 0.001$, $Eta^2 = 0.214$ in the average compression depth on the phantom test. We found a significant main effect in the sex factor $F(1.118) = 17.934$, $p < 0.001$, $Eta^2 = 0.233$, and, also, a significant interaction between the program factor, and the sex factor $F(2.118) = 3.284$, $p < 0.041$, $Eta^2 = 0.053$.

On the method of paired comparisons, both men and women from the feedback training group achieve deeper depths than the other two (2) training programs. With the data obtained we can say that there is a statistically significant difference between men and women, regardless of the training program they took, on the average depth achieved ($p < 0.001$). In the comparison drawn between men and women within the same group, we found statistically significant differences in all of them: traditional

Table 1 Descriptive statistical analysis: variable *Time* in the use of AED based on sex, and overall college students.

Variable		Men		Women		Total		Anova (Bonferroni)
Time (s)	Program	Mean	SD	Mean	SD	Mean	SD	A vs B; A vs C; B vs C
	Traditional	63.661	9.861	69.897	16.404	68.027	14.775	0.099;
T_{before}	Multimedia	61.092	11.132	62.667	8.574	62.207	9.165	0.061;
	Feedback	64.967	13.003	60.530	7.245	62.083	9.553	1.000
	Traditional	49.420	8.359	50.632	7.861	50.268	7.810	0.028;
T_{after}	Multimedia	47.331	2.977	46.910	4.272	47.032	4.502	<0.001;
	Feedback	43.104	6.327	44.222	4.272	43.831	4.946	0.053

A: traditional program: B: multimedia program; C: feedback program; SD: typical or standard deviation; s: seconds; T_{before}: time measured without training; T_{after}: time measured after training based on the training program taken.

Table 2 Descriptive data from the variables analyzed based on chest compressions.

Variable	Program	Men		Women		Total		Anova (Bonferroni)
		M	SD	M	SD	M	SD	A vs B; A vs C; B vs C
ACD (mm)	Traditional	49.66	5.71	43.21	7.06	45.15	7.26	<0.001;
	Multimedia	45.00	5.32	30.93	7.84	35.40	9.69	0.775;
	Feedback	51.00	4.22	45.53	11.52	47.45	9.89	<0.001
CRR (%)	Traditional	98.16	2.03	98.07	3.68	98.10	3.24	0.025;
	Multimedia	99.42	0.75	99.33	0.80	99.36	0.78	1.000;
	Feedback	98.71	1.72	98.38	1.81	98.80	1.62	0.206
CRM	Traditional	135.50	8.23	138.67	12.19	137.72	11.14	1.000;
	Multimedia	134.85	9.34	140.36	14.34	138.62	13.10	<0.001;
	Feedback	116.92	7.86	119.57	12.05	118.61	10.74	<0.001
CCR (%)	Traditional	46.16	33.86	25.57	32.00	31.75	33.52	0.007;
	Multimedia	29.00	26.13	4.53	10.31	12.31	20.27	0.001;
	Feedback	64.42	24.89	51.69	34.16	56.15	31.50	<0.001

Mean, typical or standard deviation, based on sex and the training program taken.
A: traditional program: B: multimedia program; C: feedback program; SD: typical or standard deviation; M: mean; CCR: correct compressions rate; ACD (mm): average compression depth (mm); CRR: correct re-expansion rate; CRM: compression rate per minute.

group ($p = 0.020$); multimedia group ($p < 0.001$), and feedback group ($p = 0.040$).

The results from the factorial ANOVA analyses conducted on the CCR showed that there is a significant main effect of the program factor $F(2.118) = 20.968$, $p < 0.001$, $Eta^2 = 0.262$, in the correct compressions rate on the 2-min test on the phantom. We found a significant main effect in the sex factor $F(1.118) = 13.202$, $p < 0.001$, $Eta^2 = 0.101$, but no significant interaction between the program factor, and the sex factor ($p = 0.648$).

On the method of paired comparisons, the participants from the feedback group achieved a higher correct compressions rate than the traditional ($p = 0.003$) and the multimedia groups did ($p < 0.001$). On the inter-group analysis, we found statistically significant differences between men and women from the traditional group ($p = 0.032$), and those from the multimedia group ($p = 0.007$).

The results from the factorial ANOVA analyses conducted on the CRR showed that there is a significant main effect of the program factor $F(2.118) = 3.154$, $p < 0.046$, $Eta^2 = 0.051$, in the correct compressions rate on the 2-min test on the phantom. We did not find a significant main effect in the sex factor ($p = 0.680$), or a significant interaction between the program factor, and the sex factor ($p = 0.966$).

When it comes to the method of paired comparisons, no statistically significant differences were found within the groups when comparing men vs women.

Discussion

The goal of this article was to verify the different training/educational methods of the BLS skill set.

The study was designed to assess three (3) teaching methods as part of one pilot experience in BLS training, and focused on eliminating confounding factors after the course, such as the material hand-out to participants, or the training that each participant could have carried out individually with such material. The organization chosen—the Faculty of Teacher Training at the Universidad de Santiago de Compostela, Spain was the target population (the future teachers) who, according to the European Resuscitation Council, should be the leading force in the teaching of CPR.[15] Age differences may be a determinant factor when it comes to learning and performing CPR maneuvers; this study sample has one homogeneous average, which is why no age analysis was conducted. The three (3) training activities were conducted by personnel from the aforementioned Faculty of Teacher Training following recommendations from the ''kids save lives'' initiative,[15] that states what the most important moment is for the acquisition of this skill set, which is why the Faculty of Teacher Training was chosen as the ideal place for the consolidation of prior skills in BLS of future teachers, or if they already had such skills, to initiate them, and guarantee training.

When it comes to defibrillation, all three (3) training methods achieved the goal of reducing the AED defibrillation times.

Out of the three (3) short-term training methods under comparison, the CPR training program with feedback devices was the one that score the best when it comes to quality of the 2-min continuous chest compressions; results that remained in the groups of both men and women. The multimedia group scored the worst when it comes to quality in the parameters analyzed during the 2-min chest compression period. In a study based on a short training of laypersons with feedback devices, González-Salvado et al., confirmed that these people scored quality ratios that were similar to those of healthcare personnel when performing chest compressions.[25]

With respect to other studies on this issue when it comes to teacher training few experiences have been published to date. In one of them, teachers-in-training who do not have any BLS training scored worse results in the quality of chest compression than groups from this study when they performed CPR only with chest compressions on a phantom with real time guidance from an emergency call center.[26]

When it comes to researches from other groups, the results obtained in our study are similar to other studies that showed that 30-min CPR seminars and courses on a personal phantom using DVDs are almost as effective as the classic 4-h courses.[27] We should mention here that, in our case, this training lasted less than an hour, and the results were somehow better in the traditional training group than in the multimedia one. Thus, 1-h long trainings allow students to acquire the CPR hand skills needed,[28] something that can be easily be taught at the classes.

When it comes to the multimedia training group, the results obtained were not consistent with the results coming from the actual studies that say that the results obtained in self-educational courses are the same as the ones obtained in traditional courses,[29] or even help train special populations.[30] We should mention here that in the actual study, we used a unique training experience under controlled training time, the same for everyone, which means that we never saw the advantages of self-educational courses, or continuous training and reinforcements, given the availability of material at the trainee's house. We share the idea that watching multimedia materials and then practicing on a phantom is the cheapest training available and allows acquiring skills similar to the skills acquired with traditional courses[29] and, also, mass train young people.[31,32] With this alternative, it is possible to educate populations on CPR training with a personal kit in just 30 min.[33]

When it comes to feedback devices, the actual guidelines[34] recommend that their clinical use should only be taken into consideration as a part of a wider healthcare system, that should include CPR training, since it has been confirmed that they significantly improve the ratios of spontaneous circulation in in-hospital CRAs when used in combination with a system to improve CPR through weekly training and debriefing sessions of those cases where the resuscitation maneuvers took place,[35] which is consistent with what the actual study says, that they are an important piece of the puzzle in the learning of CPR skill sets.

The actual study is the first case of an educational/training plan developed in the Faculty of Teacher Training at the Universidad de Santiago de Compostela, Spain in an attempt to guarantee the training of future teachers as key participants in the training of BLS contents.[15]

After confirming the validity of the three (3) initial experiences and their training possibilities as a unique experience, now the strategy will be focused on new studies that will assess both the ''forgetting effect'' of initial experience, and the most appropriate type (self-training vs scheduled vs combined) and frequency of experience reinforcements. The goal here is to guarantee quality training for a population that is essential spreading BLS knowledge, and contribute to the implementation of the motto established by the European Resuscitation Council ''community response saves lives''.[36]

As some of our study limitations, we should mention here that no randomization was ever conducted; nevertheless, the fact that the prior state was not knowing anything on BLS, and that the results in the most important parameters of compressions (CRA, HR, CCR) were maintained when isolating the groups into men and women, could be a plus that would be favoring homogeneous distribution. Also, it was a study conducted on a phantom, meaning that it cannot be completely generalized to the medical practice with real patients. Although the assessment of the skill set was conducted using the same conditions and times in the three (3) groups, it was an immediate post-course measure, and it was not part of the study to assess the quality of compressions after the ''forgetting period'',[37] which is why we do not know if, eventually, this aspect could modify long-term results. On the other hand, we should mention as well that no official materials were used to train CPR as established by the European Resuscitation Council that recommends an annual 2-hour training starting at 12 years old. Time constraints have conditioned the use of adapted materials with less training time.

Conclusions

The training program with feedback devices scored the best quality results in the item of chest compressions, followed by the traditional course, and the multimedia method ranking last. Results that were reported in both men and women.

The three (3) training programs achieved the goal of reducing fibrillation times.

Authors' collaboration

All authors have participated in all sections of this research and, also, in the preparation of this paper including the study idea and design, data mining, the statistical analysis, the interpretation of data, the writing of the draft, the critical review of the intellectual content, and the approval of the final version of this document.

Conflict of interest

The authors declare no conflict of interests associated with this article whatsoever, and that they have received no funding while conducting this study.

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References

1. Vigo-Ramos J. Muerte súbita y urgencias cardiovasculares: Problemática actual. Emergencias. 2008;25:233–6.
2. Gräsner JT, Lefering R, Koster RW, Masterson S, Böttiger BW, Herlitz J, et al. A prospective one month analysis of out-of-hospital cardiac arrest outcomes in 27 countries in Europe. Resuscitation. 2016;105:188–95.
3. Degano IR, Elosua R, Marrugat J. Epidemiología del síndrome coronario agudo en España: estimación del número de casos y la tendencia de 2005 a 2049. Rev Esp Cardiol. 2013;66:472–81.

4. Claesson A, Svensson L, Silfverstolpe J, Herlitz J. Characteristics and outcome among patients suffering out-of-hospital cardiac arrest due to drowning. Resuscitation. 2008;76:381–7.
5. Socias Crespí L, Ceniceros Rozalén MI, Rubio Rocab P, Martínez Cuellar N, García Sáncheza A, Ripoll Vera T. Características epidemiológicas de las paradas cardiorrespiratorias extrahospitalarias registradas por el sistema de urgencias 061 (SAMU) de la Comunidad Autónoma de las Islas Baleares (2009-2012). Med Intensiva. 2015;39:199–206.
6. Monsieurs KG, Nolan JP, Bossaert LL, Greif R, Maconochie IK, Nikolaou NI, et al. European Resuscitation Council Guidelines for Resuscitation 2015 Section 1. Executive summary. Resuscitation. 2015;95:1–80.
7. Anthony J, Handley AJ, Koster RW, Castrén M, Smyth MA, Olasveengen T, et al. European Resuscitation Council Guidelines for Resuscitation 2015 Section 2. Adult basic life support and automated external defibrillation. Resuscitation. 2015;95:81–99.
8. Vaillancourt C.H., Kasaboski A, Charette M, Islam R, Osmond M, Wells AG, et al. Barriers and facilitators to CPR training and performing CPR in an older population most likely to witness cardiac arrest: a national survey. Resuscitation. 2013;84:1747–52.
9. Folke F, Gislason GH, Lippert FK, Nielsen SL, Weeke P, Hansen ML, et al. Differences between out-of-hospital cardiac arrest in residential and public locations and implications for public-access defibrillation. Circulation. 2010;122:623–30.
10. Takei Y, Inaba H, Yachida T, Enami M, Goto Y, Ohta K. Analysis of reasons for emergency call delays in Japan in relation to location: high incidence of correctable causes and the impact of delays on patient outcomes. Resuscitation. 2010;81: 1492–8.
11. Neumar RW, Shuster M, Callaway CW, Gent LM, Atkins DL, Bhanji F, et al. 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 1. Executive summary. Circulation. 2015;132 Suppl. 2:S315–67.
12. Kleinman ME, Brennan EE, Goldberger ZD, Swor RA, Terry M, Bobrow BJ, et al. Part 5: adult basic life support and cardiopulmonary resuscitation quality. 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015;132: S414–35.
13. Anderson ML, Cox M, Al-Khatib SM, Nichol G. Rates of cardiopulmonary resuscitation training in the United States. JAMA Intern Med. 2014;174:194–201.
14. Ballesteros-Pena S, Fernandez-Aedo I, Perez-Urdiales I, Garcia-Azpiazu Z, Unanue-Arza S. Knowledge and attitudes of citizens in the Basque Country (Spain) towards cardiopulmonary resuscitation and automatic external defibrillators. Med Intensiva. 2016;40:75–83 [in Spanish].
15. Böttiger BW, Bossaert LL, Castrén M, Cimpoesu D, Georgiou M, Greif R, et al. Kids save lifes-ERC position statement on school children education in CPR. Hands that help – training children is training for life. Resuscitation. 2016;105:A1–3.
16. García FJ, Montero FJ, Encina RM. La comunidad escolar como objetivo de la formación en resucitación: la RCP en las escuelas. Emergencias. 2008;20:223–5.
17. Connolly M, Toner P, Connolly D, McCluskey DR. The ABC for life programme – teaching basic life support in schools. Resuscitation. 2007;72:270–9.
18. Becker TK, Bernhard M, Böttiger BW, Rittenberger JC, Epitropoulos M-F, Becker SL. Bystander cardiopulmonary resuscitation: a civic duty. Am J Bioeth. 2017:51–3.
19. López-Messa JB, Martín-Hernández H, Pérez-Vela JL, Molina-Latorre R, Herrero-Ansola P. Novedades en métodos formativos en resucitación. Med Intensiva. 2011;35:433–41.
20. Navarro-Patón R, Basanta-Camiño S, Abelairas-Gómez C, López-García S. Análisis de la situación de los primeros auxilios en los planes de estudio de los grados de maestra y maestro de Educación Primaria. Trances. 2015;7:599–612.
21. Navarro R, Arufe V, Basanta S. Estudio descriptivo sobre la enseñanza de los primeros auxilios por el profesorado de Educación Física en centros de Educación Primaria. Sportis Sci J. 2015;1:35–52.
22. Navarro R, Penelas G, Basanta S. ¿Tienen las futuras maestras y maestros de educación primaria la formación necesaria para iniciar las maniobras de reanimación cardiopulmonar en caso de urgencia escolar? Un estudio descriptivo. Educar. 2016;52:149–68.
23. Pavón-Prieto MP, Navarro-Patón R, Basanta-Camiño S, Regueira-Méndez C, Neira-Pájaro MA, Freire-Tellado M. Estudio cuasi-experimental para evaluar la capacidad de los escolares para utilizar un desfibrilador externo semiautomático a los 6 meses tras un proceso formativo. Emergencias. 2016;28:114–6.
24. Basanta-Camiño S, Navarro-Patón R, Freire-Tellado M, Barcala-Furelos R, Pavón-Prieto MP, Fernández-López M, et al. Evaluación del conocimiento y de las habilidades para el uso de un desfibrilador externo automatizado (DEA) por estudiantes universitarios. Un diseño cuasiexperimental. Med Intensiva. 2016 [in press].
25. González-Salvado V, Fernández-Méndez F, Barcala-Furelos R, Peña-Gil C, González-Juanatey JR, Rodríguez-Núñez A. Very brief training for laypeople in hands-only cardiopulmonary resuscitation. Effect of real-time feedback. Am J Emerg Med. 2016;34:993–8.
26. Navarro-Patón R, Freire-Tellado M, Pavón-Prieto MP, Vázquez-López D, Neira-Pájaro M, Lorenzana-Bargueiras S. Dispatcher assisted cardiopulmonary resuscitation (CPR): is it important to continue teaching lay bystander CPR? Am J Emerg Med. 2017;35:569–73.
27. Einspruch EL, Lynch B, Aufderheide TP, Nichol G, Becker L. Retention of CPR skills learned in a traditional AHA heartsaver course versus 30-min video self-training: a controlled randomized study. Resuscitation. 2007;74:476–86.
28. Kelley J, Richman PB, Ewy GA, Clark L, Bulloch B, Bobrow BJ. Eighth grade students become proficient at CPR and use of an AED following a condensed training programme. Resuscitation. 2006;71:229–36.
29. Hsieh MJ, Bhanji F, Chiang WC, Yang C, Chien KL, Husi-Ming Ma M. Comparing the effect of self-instruction with that of traditional instruction in basic life support courses. A systematic review. Resuscitation. 2016;106:8–19.
30. Rodríguez-Núñez R, Regueiro-García A, Jorge-Soto A, Cañas-González C, Leboráns-Iglesias J, García-Crespo P, et al. Quality of chest compressions by Down syndrome people: a pilot trial. Resuscitation. 2015;89(C):119–22.
31. Isbye DL, Rasmussen LS, Lippert FK, Rudolph SF, Ringsted ChV. Laypersons may learn basic life support in 24 min using a personal resuscitation manikin. Resuscitation. 2006;69: 435–42.
32. Liberman M, Golberg N, Mulder D, Sampalis J. Teaching cardiopulmonary resuscitation to CEGEP students in Quebec – a pilot project. Resuscitation. 2000;47:249–57.
33. Lynch B, Einspruch EL, Nichol G, Becker LB, Aufderheide TP, Idris A. Effectiveness of a 30-min CPR self-instruction program for lay responders: a controlled randomized study. Resuscitation. 2005;67:31–43.
34. Bossaert L, Greif R, Maconochie I, Monsieurs KG, Nikolaou N, Nolan JP, et al. European Resuscitation Council. Summary of the main changes in the resuscitation guidelines. Resuscitation. 2015;95:201–21.
35. Edelson DP, Litzinger B, Arora V, Walsh D, Kim S, Lauderdale DS, et al. Improving in-hospital cardiac arrest process

and outcomes with performance debriefing. Arch Intern Med. 2008;168:1063—9.

36. Kronik SL, Kurz MC, Lin S, Edelson DP, Berg RA, Billi JE, et al. Part 4: systems of care and continuous quality improvement. 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015;132 Suppl. 2:S397—413.

37. Bhanji F, Finn JC, Lockey A, Monsieurs K, Frengley R, Iwami T, et al. Part 8: education, implementation, and teams: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation. 2015;132:S242—68.