Medicine®

OPEN

Basic life support training programme in schools by school nurses

How long and how often to train?

Santiago Martínez-Isasi, PhD[a], Mario García-Suárez, RN[b], Medea Aglaya De La Peña Rodríguez, RN[c], Juan Gómez-Salgado, PhD[d,e,*], Nélida Fernández, PhD[f], Carlos Méndez-Martínez, RN[b], Esther Leon-Castelao[g], Alvaro Clemente-Vivancos[g,h], Daniel Fernández-García, PhD[i]

Abstract

Background: Cardiopulmonary resuscitation (CPR) training in schools, despite being legislated in Spain, is not established as such within the subjects that children are taught in schools.

Objective: to evaluate the acquisition of CPR skills by 11-year-old children after a brief theoretical-practical teaching programme taught by nurses at school.

Methods: 62 students were assessed in a quasi-experimental study on 2 cohorts (51.4% of the sample in control group [CG]). In total, 2 sessions were given, a theoretical one, and a practical training for skill development in children, in which the CG performed the CPR in 2-minute cycles and the intervention group in 1-minute cycles. The anthropometric variables recorded were weight and height, and the variables compression quality and ventilation quality were recorded using the Laerdal ResusciAnne manikin with Personal Computer/Wireless SkillReport.

Results: The assessment showed better results, in terms of BLS sequence performance and use of automated external defibrillator, in the CG and after training, except for the evaluation of the 10-second breathing assessment technique. The quality of chest compressions was better in the CG after training, as was the quality of the ventilations. There were no major differences in CPR quality after training and 4 months after the 1-minute and 2-minute training cycles.

Conclusions: 11-year-old children do not perform quality chest compressions or ventilations but, considering their age, they are able to perform a BLS sequence correctly.

Abbreviations: AED = automated external defibrillator, CG = control group, CPR = Cardiopulmonary Resuscitation, CPR-B = basic CPR, EMS = Emergency Medical Services, ERC = European Resuscitation Council, IG = intervention group.

Keywords: basic life support, cardiopulmonary resuscitation, children, school, school nursing

1. Introduction

BLS training is the key element to increase cardiopulmonary resuscitation (CPR) performed by bystanders. Following this principle, BLS training for children in school age is one of the most important steps to increase the rate of CPR performed by bystanders and, in consequence, increase survival.[1]

Editor: Ediriweera Desapriya.

SM-I and MG-S authors contributed equally to this work.

The authors have no conflicts of interest to disclose .

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

[a] Life Support and Medical Simulation Research Group, Health Research Institute of Santiago de Compostela (IDIS), Santiago de Compostela, Spain; CLINURSID Research Group. Faculty of Nursing, University of Santiago de Compostela, Santiago de Compostela, [b] Servicio de Anestesia y Reanimación, Complejo Asistencial Universitario de León (CAULE), Gerencia Regional de Salud de Castilla y León (SACYL), Leon, [c] Primary Care Board Management. Guayaba Health Center, Madrid Health Service, Madrid, [d] Department of Sociology, Faculty of Labour Sciences, Social Work and Public Health, University of Huelva, Huelva, [e] Safety and Health Postgraduate Programme, Universidad Espíritu Santo, Guayaquil, Ecuador, [f] Department of Biomedical Sciences, Institute of Biomedicine (IBIOMED), University of Leon, Leon, [g] Clinical Simulation Lab, School of Medicine and Healthcare Sciences, University of Barcelona, [h] Escola Superior de Enfermeria Mar (ESIMar), Universitat Pompeu Fabra, Barcelona, [i] Unidad de Radiología Vascular Intervencionista, Complejo Asistencial Universitario de León (CAULE), Gerencia Regional de Salud de Castilla y León (SACYL), Leon, Spain.

[*] Correspondence: Juan Gómez-Salgado, Department of Sociology, Social Work and Public Health. Campus El Carmen, Universidad de Huelva. Av. de 3 de Marzo. Huelva, 21007. Spain (e-mail: salgado@uhu.es).

How to cite this article: Martínez-Isasi S, García-Suárez M, De La Peña Rodríguez MA, Gómez-Salgado J, Fernández N, Méndez-Martínez C, Leon-Castelao E, Clemente-Vivancos A, Fernández-García D. Basic life support training programme in schools by school nurses: How long and how often to train?. Medicine 2021;100:13(e24819).

Received: 30 June 2020 / Received in final form: 23 September 2020 / Accepted: 28 January 2021

http://dx.doi.org/10.1097/MD.0000000000024819

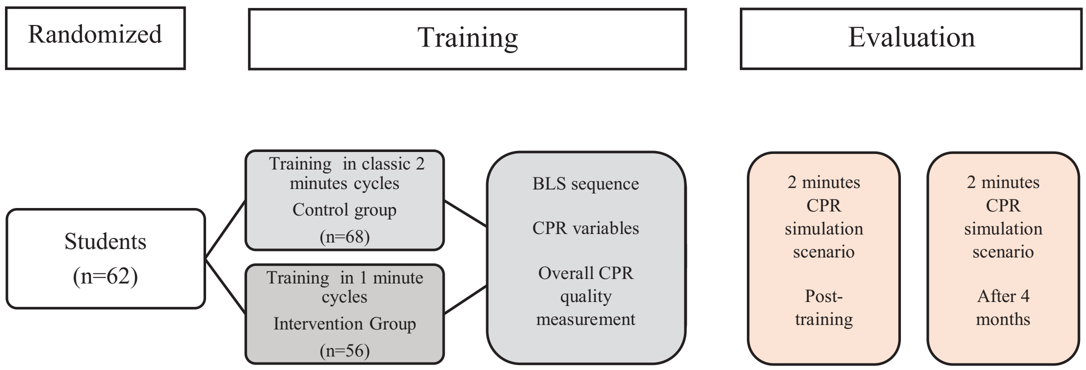


Figure 1. Flowchart of the study design.

Since 1992 the European Resuscitation Council (ERC) and the American Heart Association have committed to the inclusion of basic CPR teaching in the official school curriculum.[2] The research "Kids Save Lives" showed that in 2015 only 5 countries had legislated the inclusion of the teaching of CPR in the school curriculum, and in 16 countries this was only a recommendation.[3] In Spain, the implementation in the school curriculum was legislated in 2016 (Royal Decree 126/2014).[4] In spite of this, the teaching of basic cardiopulmonary resuscitation techniques in our country is not standardised, although numerous projects have been developed with published results.[5,6]

There are many unanswered questions, such as the age at which basic CPR (CPR-B) should be taught, the contents that should be explained considering the children's age, how often this knowledge should be taught, and which methodology would be the most appropriate. Differences can be found in the literature regarding the type of training, the necessary support material, the instructors' profile, the duration of the training, and the period of repetition of the training.[7–11]

Many other questions are already being answered, such as that the age at which this training is started, the anthropometric characteristics and the physical condition of the performer are determining factors for the quality of compressions, establishing 50 kg and/or 12 years to 13 years as the barrier to perform high quality chest compressions.[12] At 6 years of age, children can learn the basic CPR sequence and activate the survival chain.[13]

There is no doubt regarding the fact that CPR-B training in schools will allow, in the future, that the vast majority of the population have knowledge on CPR-B which, complemented by telephone instructions from the Emergency Medical Services (EMS), will enhance the CPR performed by bystanders as well as its quality, and consequently, this will increase the survival rate of out-of-hospital cardiac arrest.

1.1. Objective

To compare 2 nurse-led training strategies (classic 2 minutes length training cycle VS 1-minute length training cycle) in terms of learning and acquisition of CPR skills in 11-year-old children at school.

2. Material and methods

2.1. Design

A quasi-experimental study on 2 cohorts was carried out with a convenience sample which was approved by the Ethics Committee of the University of Leon. The students' parents were informed and gave their consent.

The sample corresponds to 2 schools in the province of Leon (Spain), and the distribution in the control or intervention group was randomised for classes. The study design consists of 2 parts (Fig. 1).

In the first part, nurses trained the children for 2 sessions of 50 minutes each:

(1) In the first session, the theoretical content was taught.
(2) In the second session, the practical training was carried out with a manikin that had a quality real-time feedback system for chest compressions and an Automated External Defibrillator (AED). The manikin/student ratio was 1:5, and the teacher/student ratio 1:10.

Each student performed 6-minute compressions (Control Group [CG] in 2-minute CPR training cycles, and the Intervention Group "[IG]," in 1-minute CPR training cycles) in 3 sessions of 20 minutes each. The sessions were: continuous chest compressions on a manikin with real-time feedback, CPR sequence and chest compressions on a simple manikin, and execution of the complete sequence of basic CPR and AED on a simple manikin.

In the second part of the study, students were evaluated through 2 BLS simulation-based scenarios. Evaluations were performed just after training and 4 months later.

2.2. Inclusion criteria

The inclusion criteria were: children enrolled in the centre, parents who agreed to participate in the study, and the absence of physical or mental disability that prevented them from performing CPR correctly.

2.3. Exclusion criteria

Children who had incomplete data or did not attend one or more sessions.

2.4. Variables

The anthropometric variables recorded were weight and height, and the variables "quality compression" and "quality ventilation" were recorded using the Laerdal ResusciAnne manikin with personal computer/wireless skill report.

2.5. Training

The CG trained in 2-minute cycles and the IG in 1-minute. Evidence shows that children get tired during CPR and the quality of compressions decrease in the second minute.[12]

2.6. BLS Variables

The recorded variables regarding compressions were: the average depth of compressions and the percentage of compressions at the correct depth (5–6 cm), the percentage of compressions with full re-expansion, the average rate and the percentage of compressions at the correct rhythm (100–120 com/min).

The variables of the registered ventilations were: the total number of ventilations, tidal volume due to insufflation in ml, the percentage of effective ventilations with visible chest elevation, and the percentage of ventilations with adequate volume, excessive, and inappropriate volume.

2.7. BLS Quality Variables

The quality values of the CPR-B are extracted from the registered parameters. The compression quality value was calculated using the formula (continuous compression percentage+ correct depth percentage+ correct rhythm compressions)/3), and the ventilation quality was established when reaching between 500 to 600 ml. The overall quality of the CPR formula (compression quality value + ventilation quality)/2 was used.

The quality standards proposed by the European Resuscitation Council (ERC) in its 2015 recommendations have been used,[14] and the arbitrary value of 70% used in the literature has been applied to indicate the quality of the manoeuvres.[15]

2.8. Perceived effort scale

After each evaluation, children have reported the perceived exertion using the modified 10-point Borg scale.[16]

2.9. Ramdomization

It was done by cluster randomization. Cluster was defined as the school predefined classrooms. Randomization was done by Excel software RAND formula.

2.10. Statistical analysis

The demographic and anthropometric variables of the sample (age, height, weight, body mass index [BMI]) were expressed by absolute and relative frequencies. Compression quality variables were expressed with measures of central tendency and dispersion [mean (Standard Deviation) (SD)]. The Pearson's chi-squared statistical test was used to study the association between categorical variables. However, the McNemar's statistical test was used to contrast the hypothesis of equal proportions of the "evaluation after training vs evaluation after 4 months" dichotomy. For the quantitative variables' assessment, normality was checked by using the Kolgomorov-Smirnov test. The independent averages comparison was carried out by means of the Student *t*-test or the Mann-Whitney *U* test, while the comparison of those related variables was carried out through the Student *t*-test or the Wilcoxon test. Regarding the quality of the resuscitation, an analysis of the variance was performed using repeated measures ANOVA.

This analysis integrated 2 factors: the first one, an inter-subject factor (1 minute versus 2 minutes of practical training); the second one, an intra-subject factor (immediate evaluation of the variables after training versus evaluation after 4 months). The data processing and analysis was carried out using the statistical package SPSS v.21.0. A significance level of $P < .05$ was established.

3. Results

The study sample was 62 school students, divided into a control and an intervention group (51.4% and 48.6%). 56.8% of them were girls, being the average age 11.86 (SD: 0.54) years, average height 149.60 (SD: 7.00) cm, average weight 45.00 (SD: 10.88) kg, and a BMI of 19.94 (SD: 3.79) kg / cm^2. The groups were homogeneous in terms of sex, age, weight, height, and BMI.

3.1. BLS & AED sequence

Table 1 and Figure 2 show the sequence data based on the practical skills training time (IG vs CG). Differences were observed when assessing the 10-second breathing assessment technique (61.1 vs 15.8%; $P < .000$), the way of pinching the nose (86.1 vs 100%; $P = .025$), and in the correct placement of AED patches (83.3 vs 100%; $P = .011$).

When comparing the sequence completion data after immediate training and after 4 months, a significant decrease in the percentage of students who secured the scene [95.9 vs 47.7%; $P < .001$], who checked for response [98.6 vs 49.9%; $P < .001$], who opened the airway [86.5 vs 43; $P < .001$], who checked breathing [94.6 vs 47%; $P < .001$], who called 112 [84.2 vs 40.9%; $P < .001$], and who initiated BLS (30:2) [58.1 vs 45.6; $P < .001$] was observed.

When analysing the different steps of the AED application sequence, after immediate training and after 4 months, differences were observed in the percentage of students who requested AED [83.2 vs 41.6; $P < .001$], who followed the instructions [95.3 vs 47.7%; $P < .001$], who placed the AED patches adequately [91.3 vs 45.6; $P < .001$], who performed chest compression while AED was charging [61.7 vs 30.9; $P < .001$], and who continued to perform chest compressions after the effective shock was delivered [95.3 vs 47.7%; $P < .001$].

3.2. Quality of the Chest compressions

Table 2 and Figure 3 show the results of the parameters that determine the quality of the chest compressions. Statistical differences were found in favour of the CG, as compared to the IG regarding the following variables: the average percentage of continuous chest compression [65.65% (SD: 12.22) vs 57.89% (SD: 16.34); $P = .024$], the mean depth [27.08% (SD: 7.89) vs 22.17% (SD: 7.65); $P = .009$], and the average percentage of correct chest compression [0.62% (SD: 2.03) vs 0.31% (SD: 1.83); $P = .012$].

When analysing the quality variables of compression after immediate training and after 4 months, an increase in the mean percentage of continuous chest compression and of the average percentage of chest compressions at the correct depth of the chest [0.52% (SD: 2.04) vs 2.75% (SD: 8.22); $P = .012$] were found.

3.3. Quality of the ventilation

Regarding the quality of the ventilations (Table 2 and Fig. 3), the results showed significant differences in favor of the CG vs the IG

Table 1

BLS sequence variables.

		After training				After 4 mo	
				Training			
		1 min	2 min	*P*	*Total* (mean)	*Total* (mean)	*P*
1	Safe approach	97.4	94.7	.521	95.9	47.7	**.000**
2	Checks consciousness	100	97.4	.514	98.6	49.9	**.000**
	Asks and shouts	100	92.1	.130	95.9	47.7	**.000**
	Shakes it	97.2	92.1	.328	94.6	47	**.000**
3	Opens airway	86.1	86.8	.597	86.5	43	**.000**
	Head tilt/chin lift	80.6	78.9	.547	79.7	39.6	**.000**
4	Checks breathing	97.2	92.1	.328	94.6	47	**.000**
	Holds head tilt/chin lift	83.3	77.8	.383	78.4	38.9	**.000**
	See-Hear-Feel	97.2	89.5	.196	93.2	46.3	**.000**
	Assesses in 10 seconds	61.1	15.8	**.000**	37.4	18.8	**.000**
5	Calls 112	86.1	78.9	.308	84.2	40.9	**.000**
	Asks for AED	77.8	89.5	.147	83.8	41.6	**.000**
6	Performs 30:2	88.9	94.7	.311	58.1	45.6	**.000**
	Opens airway	80.6	84.2	.457	82.4	48.9	**.000**
	Clamps nose	86.1	100	.025	91.9	45.6	**.000**
	Insufflates 1 second	100	97.4	.514	98.6	49.0	**.000**
7	Turns AED on	94.4	100	.233	97.3	48.3	**.000**
	Follows Instructions	97.2	94.7	.521	95.4	47.7	**.000**
	Place pads	83.3	100	**.011**	91.9	45.6	**.000**
	Chest compressions while charging	52.8	71.1	.084	62.2	45.6	**.000**
	Effective discharge	100	100	1	100	100	**1**
8	Continue CPR	100	92.1	.130	95.9	47.7	**.000**

AED = automated external defibrillator, BLS = basic life support, CPR = cardiopulmonary resuscitation.

regarding both the immediate evaluation after training and the evaluation after 4 months as for the average percentage of ventilations that did not reach the appropriate volume (62.91% [SD: 39.53] vs 28.51% [SD: 38.29]; $P < .001$) and (47.47% [SD: 40.76] vs 21.07% [SD: 32.03]; $P = .006$) respectively.

3.4. CPR quality

The different ways of measuring the overall quality of CPR (Table 3) did not show significant differences regarding the quality of compressions after the immediate evaluation, as compared to the evaluation after 4 months [42.23% (SD: 14.49) vs 41.60% (SD: 12.19); $P = .152$], when only one student performed quality compressions.

3.5. Perceived exertion

The perceived exertion after the immediate post-training evaluation and after 4 months did not show significant differences

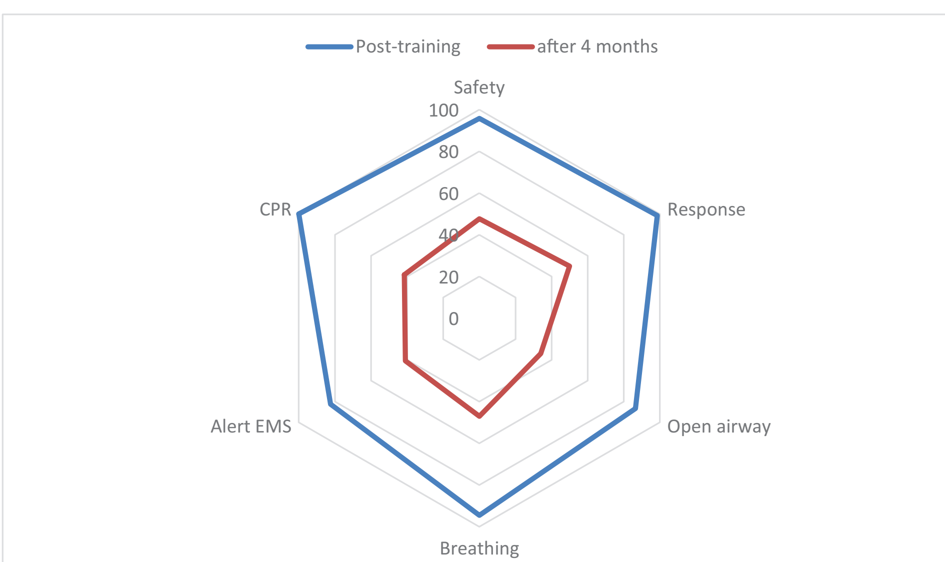


Figure 2. Percentages of sequence performance according to the moment of evaluation.

Table 2

Analysis for the CPR variables.

	Training duration	Evaluation							
		After training (E1)			After 4 mo (E2)			E1 vs E2	E1 vs E2 Repeated measurement
	Minute	Mean (SD)	P	Overage Mean (DE)	Mean (SD)	P	Overage Mean (DE)	P	P
Chest Compression									
CCP	2	65.65 (12.22)	**.024**	62,45 (15,11)	67.47 (9.08)	.771	67.45 (9.50)	**.038**	.165
	1	57.89 (16.34)			66.82 (8.24)				
HP	2	96.73 (15.41)	.224	97,98 (11.70)	97.00 (9.47)	.229	94.34 (18.94)	.224	.173
	1	99.72 (1.3)			90.50 (26.69)				
MD	2	27.08 (7.89)	**.009**	25.15 (8.24)	28.76 (10.05)	.106	26.80 (9.15)	.138	.832
	1	22.17 (7.65)			24.93 (7.92)				
CDcP	2	82.41 (27.06)	.829	87.83 (21.45)	87.38 (20.67)	.079	89.65 (17.62)	.829	.894
	1	93.33 (15.58)			94.21 (7.25)				
CDP	2	0.62 (2.03)	**.012**	0.52 (2.04)	4.12 (10.58)	.177	2.75 (8.22)	**.012**	.086
	1	0.31 (1.83)			1.39 (4.27)				
CRC	2	42.97 (34.52)	.318	39.44 (32.90)	32.03 (30.98)	.897	30.55 (30.15)	.204	.479
	1	35.47 (28.94)			31.00 (30.54)				
RM	2	114 (12.96)	.402	113.56 (15.79)	113.76 (18.52)	.922	114.08 (19.23)	.996	.699
	1	111.31 (17.87)			114.26 (20.58)				
Ventilation									
MV	2	409.91 (190.56)	.722	431.56 (279.187)	400.79 (221.87)	.124	453.27 (281.58)	.532	.359
	1	433.69 (344.68)			517.21 (337.92)				
VEV	2	18.67 (27.00)	.287	23.11 (33.82)	19.12 (29.24)	**.014**	29.41 (36.75)	.152	.129
	1	27.03 (37.55)			42.86 (41.30)				
AVV	2	13.06 (15.43)	.566	14.92 (21.49)	21.59 (26.80)	.285	18.89 (25.89)	.487	.235
	1	16.00 (25.87)			14.50 (24.43)				
NAVY	2	62.91 (39.53)	**.000**	46.27 (42.43)	47.47 (40.76)	**.006**	35.78 (38.82)	.091	.555
	1	28.51 (38.29)			21.07 (32.03)				

AVV = appropriate volume ventilations, CCP = continuous compression percentage, CDcP = correct decompression percentage, CDP = correct depth percentage, CRC = correct rhythm compressions, HP = hands position, MD = mean depth, MV = mean volume applied, NAVV = non appropriate volume ventilations, RM = rhythm of compressions per minute, VEV = ventilations exceeding the maximum volume.

(3.60 [SD: 1.61] vs 3.43 [SD: 1.37]; $P = .503$). Neither when the training time of practical skills (CG vs. IG) was compared regarding the immediate post-training evaluation (3.88 [SD: 1.66] vs 3.25 [SD: 1.51]; $P = .165$), and the evaluation after 4 months (3.52 [SD: 1.48] vs 3.32 [SD: 1.25]; $P = .587$).

4. Discussion

Our study shows that children who have followed a short training programme and have been taught by nurses learn the basic life support sequence, with a success rate similar to the one recorded on adults, as well as CPR skills according to their age. It is observed that, over time, the sequence steps cease to be performed and the compression and ventilation skills are maintained.

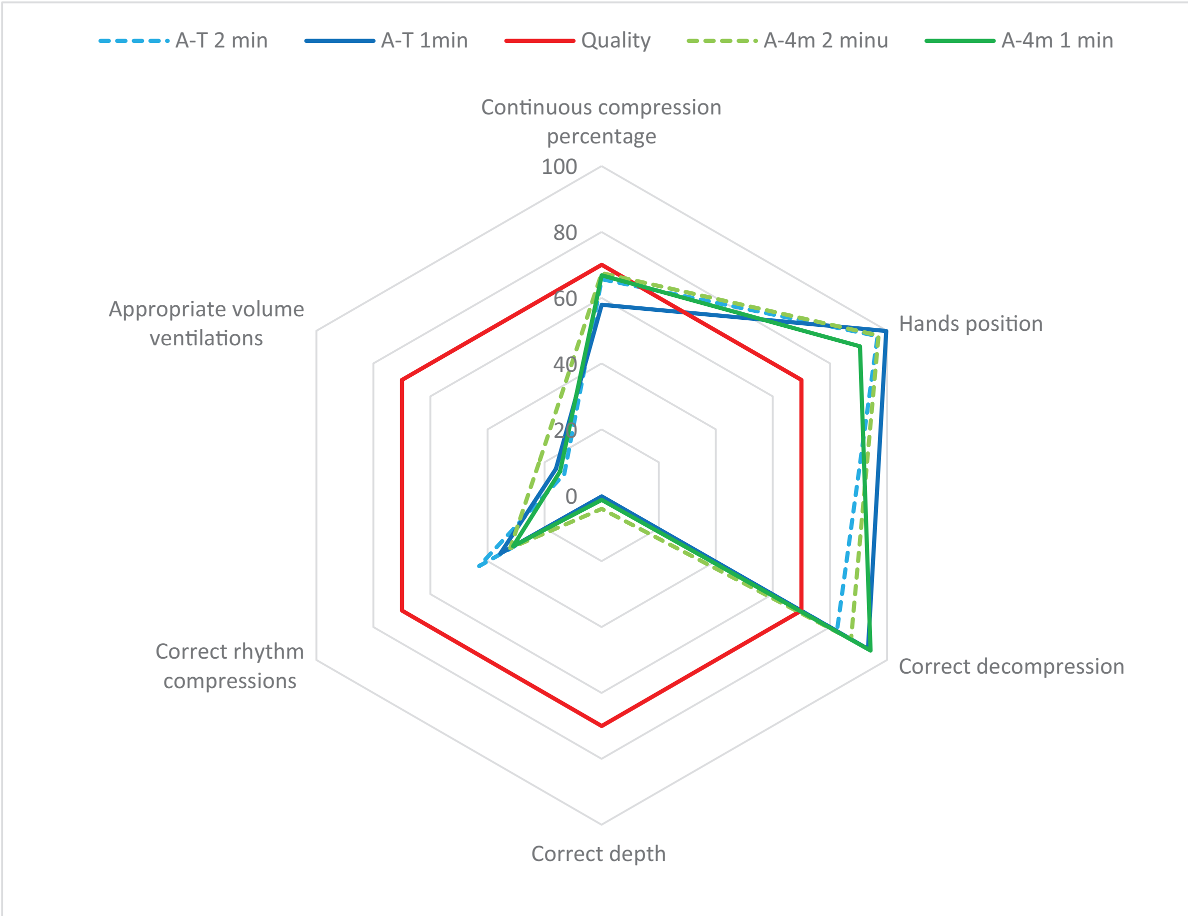
The ERC recommends to start teaching BLS at 12 years or even earlier.[17] Although they are not able to perform quality chest compressions due to their anthropometric characteristics,[12] they have the cognitive ability to learn, retain knowledge and reproduce learned manoeuvres.[18] We have selected this age group for being the group immediately below the recommendations stated in the guidelines. The subjects of our study correspond to the 86.4% percentile of weight and height for their age.

The trainers in our research are nurses with BLS knowledge who have previously demonstrated CPR knowledge and performance skills. The reason why the nursing staff was selected as trainers was for their presence in schools and primary care, being education and health promotion functions attributed to this group of workers.

The methodology used in our study was adjusted to the teaching schedules, not exceeding 2 hours of training, and was both theoretical and practical, as suggested by the ERC.[17] Feedback devices were used as a teaching aid, with proven useful benefits, and as a system for measuring the quality of compressions and ventilations.[19,20]

Our study shows that, with a brief theoretical-practical training, 11-year-old students are able to learn the steps needed for the basic life support sequence and how to activate the survival chain with results similar to previous studies.[18,21,22] The percentage of children who perform the different steps of the sequence in our study drops after 4 months, a fact observed in another study.[23] In both studies, about 50% of the children made the call to the EMS correctly after 4 months, which was very important since the telephone operator was able to guide the children and remind them of the different sequence steps in order to perform them correctly. Therefore, it is very important to place particular emphasis on the importance of calling the EMS during the training.

A relevant fact found during the study corresponds to the differences found in certain steps of the sequence depending on the type of training. Although this appears to have no influence on the sequence itself and the trainers are the same in the different sessions, it may be thought that students attach more importance to some steps than others. Therefore, the trainer must effectively highlight the most relevant steps.



A-T: After training; A-4T: after 4 months

Figure 3. Percentages of training-related quality CPR variables.

The compression quality results found in our study show that children are not able to compress the chest to the recommended depth, as compared to other studies performed with the same age range.[12,21,23,24] However, they do place their hands in the right place and decompress the chest correctly, coinciding with a previous study.[25] In addition, in the correct decompression of the chest and the average rhythm, the study of He et al[24] presents very similar data.

Although the ERC suggests that children only do chest compressions, our study, as do similar ones,[21,24–26] shows that the mean insufflated volume is lower when performed by children. In our study, the percentage of insufflations with adequate volume is greater at 4 months after training, and this causes an increase in the overall results regarding quality of compressions.

In our study, it was also observed that CPR skills do not deteriorate over time, although it is true that many of the analysed variables do not reach the random figure of 70% accepted by the scientific community to determine quality. Regarding the variables in which children reach quality, such as correct hand

Table 3

Overall CPR quality measurement.

		Evaluation after training (E1)			Evaluation after 4 mo (E2)			E1 vs E2	E1 vs E2 Repeated measurement
	Training duration	Mean (SD)	P	Overall mean (SD)		P	Overall mean (SD)	P	P
QCC	2	42.45±16.27	.897	42.23 (14.49)	41.09 (13.48)	.726	41.60 (12.19)		.697
	1	41.96±12.27			42.20 (10.67)				
QCPR	2	27.95 (9.64)	.606	28.70 (12.49)	49.84 (15.44)	.163	46.75 (19.12)		.067
	1	29.61 (15.41)			43.00 (22.54)				
E-QCPR	2	49.84 (15.44)	.163	46.75 (19.12)	42.64 (16.77)	.846	43.04 (17.15)		.163
	1	43.00 (22.54)			43.50 (17.90)				

E-QCPR = Effective Cardiopulmonary Resuscitation, QCC = Chest Compression Quality, QCPR = Global CPR quality.

position, percentage of continuous compressions and complete decompression of the chest, they are still correctly performed after 4 months.

The type of training in cycles of 1 or 2 minutes does not show any real improvement in CPR quality after immediate training or after 4 months, and there is no observed relation when looking at students' effort.

The main limitations of our study are that, so far, very few studies have used the same chest compression assessment tools, and few studies have analysed the quality of the ventilations, thus making it difficult to compare results.

The trainers and assessors were the same during the whole process. In addition, in order to minimise observation bias, assessment of the different sequence steps and of the used technique was carried out by following a standardised template which included the agreed criteria beforehand.

Randomization was done by clusters to reduce information bias. This way, the risk of children in the same class receiving different training was avoided.

Other limitation is the sample size, is small and the generalization is not possible.

5. Conclusion

It can be concluded that CPR training in cycles of 1 or 2 minutes has no influence on its quality in the short or medium term, nor does the feeling of perceived effort vary, being qualified by the children as "soft."

11-year-old children do not perform quality chest compressions or ventilations but, considering their age, they are able to perform a BLS sequence correctly. In addition, we conclude that re-training and/or re-assessment should be performed in periods shorter than the 4 months originally established.

Author contributions

Conceptualization: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Juan Gómez-Salgado, Nélida Fernández, Carlos Méndez-Martínez, Esther Leon-Castelao, Daniel Fernández-García.

Data curation: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Nélida Fernández, Carlos Méndez-Martínez, Esther Leon-Castelao, Alvaro Clemente-Vivancos, Daniel Fernández-García.

Formal analysis: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Nélida Fernández, Carlos Méndez-Martínez, Esther Leon-Castelao, Daniel Fernández-García.

Investigation: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Juan Gómez-Salgado, Nélida Fernández, Carlos Méndez-Martínez, Esther Leon-Castelao, Alvaro Clemente-Vivancos, Daniel Fernández-García.

Methodology: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Juan Gómez-Salgado, Nélida Fernández, Carlos Méndez-Martínez, Esther Leon-Castelao, Alvaro Clemente-Vivancos, Daniel Fernández-García.

Project administration: Santiago Martínez-Isasi, Mario García-Suárez, Daniel Fernández-García.

Resources: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Juan Gómez-Salgado, Carlos Méndez-Martínez, Esther Leon-Castelao, Alvaro Clemente-Vivancos.

Software: Nélida Fernández, Esther Leon-Castelao.

Supervision: Santiago Martínez-Isasi, Mario García-Suárez, Daniel Fernández-García.

Validation: Santiago Martínez-Isasi, Nélida Fernández, Esther Leon-Castelao.

Visualization: Juan Gómez-Salgado, Esther Leon-Castelao, Daniel Fernández-García.

Writing – original draft: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Juan Gómez-Salgado, Nélida Fernández, Carlos Méndez-Martínez, Esther Leon-Castelao, Alvaro Clemente-Vivancos, Daniel Fernández-García.

Writing – review & editing: Santiago Martínez-Isasi, Mario García-Suárez, Medea Aglaya De La Peña-Rodríguez, Juan Gómez-Salgado, Nélida Fernández, Carlos Méndez-Martínez, Esther Leon-Castelao, Alvaro Clemente-Vivancos, Daniel Fernández-García.

References

[1] Wissenberg M, Lippert FK, Folke F, et al. Association of National Initiatives to Improve Cardiac Arrest Management With Rates of Bystander Intervention and Patient Survival After Out-of-Hospital Cardiac Arrest. JAMA 2013;310:1377.

[2] Lester CA, Weston CFM, Donnelly PD, et al. The need for wider dissemination of CPR skills: are schools the answer? Resuscitation 1994;3:233–7.

[3] Semeraro F, Wingen S, Schroeder DC, et al. KIDS SAVE LIVES implementation in Europe: a survey through the ERC Research NET. Resuscitation 2016;107:e7–9.

[4] Real Decreto 126/2014, de 28 de febrero, por el que se establece el currículo básico de la Educación Primaria. [Internet]. Boletín Oficial del Estado no 52 2014 19349-19420. Available at: http://www.boe.es/boe/dias/2014/03/01/pdfs/BOE-A-2014-2222.pdf

[5] López-Unanua MC, Freire-Tellado M, Pérez-Romero E, et al. RCP na aula: programa de enseñanza de la reanimación cardiopulmonar básica para estudiantes de secundaria. Emergencias 2012;24:74–80.

[6] Miró O, Escalada X, Jiménez-Fábrega X, et al. Programa de Reanimación Cardiopulmonar Orientado a Centros de Enseñanza Secundaria (PROCES): conclusiones tras 5 años de experiencia. Emergencias 2008;20:229–36.

[7] García-Vega FJ, Montero-Pérez FJ, Encinas-Puente RM. La comunidad escolar como objetivo de la formación en resucitación: la RCP en las escuelas. Emergencias Rev la Soc Española Med Urgencias y Emergencias 2008;20:223–5.

[8] López-Messa JB, Martín-Hernández H, Pérez-Vela JL, et al. Novedades en métodos formativos en resucitación. Med Intensiva 2011;35:433–41.

[9] Plant N, Taylor K. How best to teach CPR to schoolchildren: a systematic review. Resuscitation 2013;84:415–21.

[10] Reveruzzi B, Buckley L, Sheehan M. School-based first aid training programs: a systematic review. J Sch Health 2016;86:266–72.

[11] Yeung J, Okamoto D, Soar J, et al. AED training and its impact on skill acquisition, retention and performance - A systematic review of alternative training methods. Resuscitation 2011;82:657–64.

[12] Abelairas-Gómez C, Rodríguez-Núñez A, Casillas-Cabana M, et al. Schoolchildren as life savers: at what age do they become strong enough? Resuscitation 2014;85:814–9.

[13] Ammirati C, Gagnayre R, Amsallem C, et al. Are schoolteachers able to teach first aid to children younger than 6 years? A comparative study. BMJ Open 2014;4:e005848–15848.

[14] Perkins GD, Handley AJ, Koster RW, et al. European Resuscitation Council Guidelines for Resuscitation 2015. Section 2. Adult basic life support and automated external defibrillation. Resuscitation 2015; 95:81–99.

[15] Perkins GD, Colquhoun M, Simons R. Training manikins in ABC of Resucitation. BMJ books 2004;97–101.

[16] Borg G. Psychophysical bases of perceived exertion. Med Sci Sport Exerc 1982;14:377–81.

[17] Böttiger BW, Bossaert LL, Castrén M, et al. Kids Save Lives? ERC position statement on school children education in CPR.:? Hands that help? Training children is training for life? Resuscitation 2016;105: A1–3.
[18] Connolly M, Toner P, Connolly D, et al. The "ABC for life" programme-Teaching basic life support in schools. Resuscitation 2007;72:270–9.
[19] Cortegiani A, Russotto V, Baldi E, et al. Is it time to consider visual feedback systems the gold standard for chest compression skill acquisition? Crit Care 2017;21:166.
[20] Cortegiani A, Russotto V, Montalto F, et al. Use of a real-Time training software (Laerdal QCPR®) compared to instructor-based feedback for high-quality chest compressions acquisition in secondary school students: a randomized trial. PLoS One 2017;12:1–1.
[21] Lorem T, Palm A, Wik L. Impact of a self-instruction CPR kit on 7th graders' and adults' skills and CPR performance. Resuscitation 2008; 79:103–8.
[22] Lubrano R, Romero S, Scoppi P, et al. How to become an under 11 rescuer: a practical method to teach first aid to primary schoolchildren. Resuscitation 2005;64:303–7.
[23] Banfai B, Pek E, Pandur A, et al. "The year of first aid": effectiveness of a 3-day first aid programme for 7-14-year-old primary school children. Emerg Med J 2017;34:526–32.
[24] He D, Huang K, Yang YI, et al. What is the optimal age for students to receive cardiopulmonary resuscitation training? Prehosp Disaster Med 2018;33:394–8.
[25] Hill K, Mohan C, Stevenson M, et al. Objective assessment of cardiopulmonary resuscitation skills of 10-11-year-old schoolchildren using two different external chest compression to ventilation ratios. Resuscitation 2009;80:96–9.
[26] Bohn A, Van Aken H, Lukas RP, et al. Schoolchildren as lifesavers in Europe - Training in cardiopulmonary resuscitation for children. Best Pract Res Clin Anaesthesiol 2013;27:387–96.