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Simulation and education,

Automated external defibrillation skills by naive schoolchildren☆

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ABSTRACT

Aim: Early defibrillation should achieve the highest survival rates when applied within the first minutes after the collapse. Public access defibrillation programs have increased the population awareness of the importance of defibrillation. Schoolchildren should be trained in basic life support (BLS) skills and some countries have included BLS in their school syllabus. However, little is known of the current knowledge and ability of schoolchildren to use an automated external defibrillator (AED).
Methods: A multicentric descriptive study, 1295 children from 6 to 16 years of age without previous BLS or AED training. Subjects performed a simulation with an AED and a manikin with no training or feedback and were evaluated by means of a checklist.
Results: A total of 258 participants (19.9%) were able to simulate an effective and safe defibrillation in less than 3 min and 52 (20.1% of this group) performed it successfully. A significant correlation between objective and age group was observed ($G = 0.172$) ($p < 0.001$). The average time to deliver a shock was 83.3 ± 26.4 s; that time decreased significantly with age [6 YO (108.3 ± 40.4) vs. 16 YO (64.7 ± 18.6) s] ($p < 0.001$).
Conclusions: Around 20% of schoolchildren without prior training are able to use an AED correctly in less than 3 min following the device's acoustic and visual instructions. However, only one-fifth of those who showed success managed to complete the procedure satisfactorily. These facts should be considered in order to provide a more accurate definition and effective implementation of BLS/AED teaching and training at schools.

Introduction

Shockable rhythms are present in 50–70% of cardiac arrests (CA).[1] In such cases the restoration to a perfusing cardiac activity may be achieved by means of electrical defibrillation, resulting in four-fold higher survival rates when the shock is applied within the first 3–5 min.[1,2] For this reason, early defibrillation is a key link of the chain of survival, which should be immediately initiated by the bystander.

There are recommendations from the international scientific community, led by the European Resuscitation Council (ERC) and the American Heart Association (AHA), that endorse the training of non-medical staff in the use of automatic external defibrillators (AED)[1,3] as well as the implementation of these devices in public spaces where crowds of people occur, such as airports, sports centres, schools, public transports, stations and shows.[1]

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Children are considered to be an interesting target group to train in basic life support (BLS), they are also situated at a vital stage of easy learning[4,5]; their training should provide the guarantee to secure a large number of future rescuers for the community.[5,6] In the last years, several training programs such as those directed by the AHA and ERC have been developed in several countries, using schoolchildren as the target population.[4–10] Alongside Europe, teaching basic cardiopulmonary resuscitation (CPR) is included in the educational curriculum at schools from countries like Norway, Denmark, France, or the United Kingdom.

Public-access defibrillation (PAD) programmes, placement of AEDs in public areas as well as mass media (movies, news, social networks, etc.) have increased the public (including children) knowledge of AED and the awareness of the importance of early defibrillation in case of CA.[11,12]

In order to design effective BLS/AED school-based training programmes aimed at ensuring a large number of present and future first responders in public places where AEDs are deployed, it is necessary to know the children's baseline level of knowledge and skills. The objective of this study was to assess the current ability of schoolchildren to use an AED without any prior training or feedback during the performance.

Methods

Sample and study design

We designed a multicentre, descriptive study. We recruited a convenience sample of 1318 schoolchildren without physical or mental disability from three school centres in Galicia (Spain), aged from 6 to 16 years. The aim and protocol of the study was communicated to the educational team of each school and it was orally presented in the classroom. An informed consent signed by the pupils' parents or guardians was required for the children to take part in the study.

This project was carried out throughout the academic course 2014/2015. Schoolchildren from 6 to 16 years of age were eligible for the study, provided they had some knowledge of what an AED was and had not previously received BLS/AED training. Each subject was tested individually in a simulated scenario including an AED and a manikin. For the development of the test, pupils were asked to use the AED device in the way they believed to be correct by using their own intuition and following only the device's indications. Their performance was evaluated by means of a checklist based on a simple algorithm (Fig. 1) which included three main issues: (1) time, (2) defibrillation objective, (3) quality objective.

Time was registered from the moment the children touched the AED box until the discharge button was pressed. Arbitrarily, the test was considered failed if the pupil spent more than 3 min to deliver the simulated discharge. Safety concerns regarding the use of the AED were taken into account in the evaluation, whereby the participant should not to be in touch with the manikin at the moment of the discharge. For the quality assessment the following variables were taken into account: exchange of pad electrodes (error A), pads slightly displaced towards the longitudinal axis in the frontal plane (error B) and the order of execution (error C), which was the following: 1° turning on the device, 2° placing pad electrodes, 3° inserting the pad connector into the socket, 4° delivering the discharge. If any one of these conditions was not present, the quality objective was considered unmet.

Teaching material used were a Laerdal AED training, a simulation of Heartstart FR2+ Phillips Defibrillator and Litlle Anne Laerdal's maninkin.

Table 1
Age group distribution and analysis of the objective variables.

Age	*N* (%)	Objective N1 (% of *N*)	Quality objective N2 (% of *N**)
6	103 (8)	9 (8.7)	1 (11.1)
7	140 (10.8)	15 (10.7)	2 (13.3)
8	135 (10.4)	23 (17)	3 (13.6)
9	111 (8.6)	27 (24.3)	6 (22.2)
10	182 (14.1)	41 (22.5)	10 (24.4)
11	176 (13.6)	41 (23.3)	10 (24.4)
12	54 (4.2)	10 (18.5)	0 (0)
13	131 (10.1)	25 (19.1)	1 (4)
14	99 (7.6)	27 (27.3)	4 (15.4)
15	107 (8.3)	21 (19.6)	5 (23.8)
16	57 (4.4)	19 (33.3)	10 (52.6)
		$G = 0.172$ $p < 0.001$	$G = 0.150$ $p = 0.152$

G, Goodman and Kruskal's Gamma coefficient.

Statistics

We registered the participants' age group, sex and education level of each participant. The achievement of both the defibrillation and quality objective was categorized as accomplishment/not accomplishment and mistakes were registered as present (committed)/absent (not committed). Categorical variables were presented in terms of absolute frequencies and percentages. Time was recorded in s. Descriptive statistics included mean, standard deviation and 95% confidence interval. Goodman and Kruskal's Gamma coefficient was calculated to investigate the potential association between categorical variables. Values range from −1 (negative association) to +1 (positive association); value 0 indicates the absence of association. ANOVA test was used to investigate differences between means and Bonferroni test was used to check the statistical significance of results between different age groups. The homogeneity between groups was assessed by Kolgomorov–Smirnoff test and the equality of variances was determined using Levene test. A cutoff *p*-value <0.05 was used to determine statistical significance.

Ethics

Participation was voluntary and no personal incentive for participation was given. The study respected the Helsinki Declaration and was approved by the local institutional review board (Research Ethics Committee of the University School of Education and Sports Sciences, University of Vigo, Spain).

Results

Of the 1318 candidates, a total of 1295 children met the inclusion criteria. The age distribution of participants is shown in Table 1.

A total of 258 participants (19.9%) managed to simulate an effective and safe discharge in less than 3 min. Gamma coefficient showed a mild but significant correlation between *objective* and *age group* ($G = 0.172$) ($p < 0.001$). A significant improvement was observed with increasing age, from 6 years old group [9 (8.7%)] to 16 years old group [19 (33.3%)]. From 9 years of age on, almost one out of four managed to achieve the defibrillation objective [9 years old: 27 (24.3%); 10 years old: 41 (23. 3%); 11 years old: 41 (23.3%)] (Table 1).

Fifty two (20.1%) out of the 258 participants who reached the objective, achieved the quality objective too (Table 1). In this case, gamma coefficient showed a direct relation between *age group* and *quality objective* but no statistical significance was obtained ($G = 0.150$) ($p = 0.152$). While the number of participants who achieved the quality objective was small among younger age