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Review

School Children Save Lives

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Abstract

Sudden cardiac death is one of the most common causes of preventable death in the industrialized world. In countries with organized emergency health services, it is possible to increase the rate of resuscitation performed by the public and save more lives. Increasing the rate of correct intervention by those witnessing sudden cardiac death requires an increase in the number of adults with training in CPR in society. Resuscitation training should begin in the school years to reach the whole of society within time. As school children with training in CPR increase, the proportion of individuals in society with training and the desire to help others increases, which causes a general increase in resuscitation rates. To teach children "Basic Life Support" the training models should be applied in theory, with training kits, and accompanied by educators, with a variety of figures based on video or computer based training. One of the most important steps in increasing the resuscitation rates performed by the public globally and enhancing survival is through training school children.

Keywords: School children, basic life support, education, cardiopulmonary resuscitation

Introduction

In the industrialised countries, after cancer and cardiovascular diseases, sudden cardiac arrest is the third most common cause of death outside the hospital (CAOH) (1). In Europe and the United States together, 700,000 people lose their lives due to CAOH every year. The survival rates are generally 2%–10% after cardiac arrest outside the hospital (2-4). If educated persons who witness sudden cardiac arrest immediately initiate cardiopulmonary resuscitation, the survival rates can be increased (2).

While billions of euros, dollars, and other currencies are being invested to reduce deaths in traffic accidents, the budget allocated to prevent sudden cardiac arrest and for cardiopulmonary resuscitation (CPR) to be applied in such a situation and for educating the society on this subject is very limited. However, failure to immediately perform CPR in people who experience CAOH can cause deaths in a number that is 20 times higher than that in traffic accidents. Few patients who have sudden cardiac arrest outside the hospital can maintain their previous life quality (5).

'Everywhere, everyone can immediately initiate CPR. All that is necessary for this is two hands' specified Kouwenhoven, Jude, and Knickerbocker in their first publication on CPR in 1960 (6). However, it is necessary to raise awareness in society and give education regarding it. In 2013, 400 members of the European Parliament supported the 'Restart a heart day' event organised by the European Resuscitation Council (ERC) (www.erc.edu).

After a sudden cardiac arrest, the brain cells can tolerate only 3–5 min of anoxia. In almost all cases, this is a much less time than the time needed to reach emergency medical services. There is strong scientific evidence that survival increases 2–4 times after basic life support (BLS) is immediately initiated by those who witness cardiac arrest outside the hospital (7-9). The rate of CPR performed by witnesses is only 60%–80% in a few countries (8-10), and this rate is much lower than 20% in most countries (10).

Family members, friends, and other third parties witness the event in approximately 70% of CAOHs (2, 9). Neurological damage begins in the brain at the end of 3–5 min of anoxia; therefore, usually, nothing is done in this period, which goes on until

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the emergency medical personnel arrive, which is important for a quality survival of the patient. However, heart massage performed by the surrounding people can be life saver until the arrival of urgent health services (11). An effective CPR is quite easy, and contrary to what is thought, the possibility of harming that person with incorrect CPR application is very low. If CPR is not applied, the possibility of death is very high (12). In a questionnaire survey conducted in our country, when the community was questioned about the concerns regarding CPR application, it was determined that 77.2% of the respondents were concerned about doing something wrong, 19.3% were concerned about stopping a working heart and 11.8% were concerned about harming the organs (13). To reduce these concerns, awareness should be raised and the community needs to be educated. The greatest impact of mandatory CPR training for school children across the country is the increase in the rate of CPR initiated by witnesses (5, 11, 14-18).

In an article, Böttiger emphasised the importance of the issue by saying 'School children create a domino effect: at home, they teach their siblings, parents, grandparents and many others in their families' (5). Teachers have stated that teaching CPR to children is fun and that they rarely see their students as enthusiastic as in the CPR training. Another aspect of CPR training in schools is the acquisition of children who learn to help others and are happy with this (5).

CPR training in school children is compulsory in several countries; local, regional and national initiatives have been introduced in many countries (5). The ERC, the American Heart Association (AHA) and other institutions that focus on resuscitation have made a significant effort towards this approach and have become pioneers of it. A detailed curriculum has been developed for CPR training at schools (www.grc-org.de). The declaration of 'Children Save Life', which is a joint declaration made by the ERC, European Patient Safety Foundation, International Liaison Committee on Resuscitation and World Federation Of Societies of Anaesthesiologists was acknowledged by the World Health Organisation in 2015 (5, 12, 16). In this declaration, it is suggested that all over the world, a 2-h CPR training should be provided to students aged 12 years in schools every year (15).

AHA supported compulsory resuscitation training in American schools in 2011 (19). The countries where resuscitation training was integrated into educational programmes of the schools reported significantly higher resuscitation rates (7, 9).

Clinical and Research Effects

The rate of CPR initiated by the witnesses in some Scandinavian countries, where CPR training for school children has been made obligatory for >10 years, is very high. Five years after the compulsory CPR training was added to school curriculums in Denmark, the rate of resuscitation performed by the witnesses increased almost twofold, and the rate of survival after cardiac arrest outside the hospital increased threefold in 10 years (9, 11).

It is important to start resuscitation training at school ages. All groups in the society can be accessed this way. To obtain a statistically significant increase in resuscitation results, it has been estimated that at least 15% of the population must have been trained, and this number cannot be achieved through voluntary courses (5). The development of the sense of responsibility at a young age is more permanent and makes it easier to overcome social barriers (5). Researches examining the social approach have found that children who have not yet entered puberty, in other words, children in the prepubertal period show a less timid approach towards resuscitation training. The most powerful factor that prevents performing the action in real-life situations is the fear of making mistakes. This factor can be resolved through a more comfortable and natural communication with school children. It would also make sense to include resuscitation training in the related school subjects such as biology, sport or health education (5).

There is a training given under the title of 'Explanations about Traffic and First Aid Course' in the primary education curriculum of our country; this is not resuscitation training. As far as high schools are concerned, this education is not included in the education curriculum of Anatolian and Science High Schools. Considering the vocational schools, theoretical and practical CPR training is available under the title of 'First Aid and Emergency Care' only in the medical vocational high schools (https://www.smlogretmenleri.com/ilk-yardim-ve-acil-bakim-yillik-plan).

In each country, the Ministries of Education and/or responsible individuals in schools and other prominent politicians should conduct a national-scale programme for CPR training in school children (20). Individuals who will be involved in resuscitation training in schools within the framework of a created programme may be health care professionals, physical education teachers and biology teachers who have been trained to teach CPR (21).

Traditional resuscitation training involves a video and/or instructor demonstration and a hands-on training on a training model, which are accompanied by a guide. A written or practice exam is performed, although studies have shown that there is a weak correlation between the two in children (23, 24). Hands-on training is an important part of resuscitation training. Some studies have reported that the children trained only theoretically perform poorly in practical exams (25). In another study, only an educational video was shown to a group of school children for training, and in the other group, education was given by an instructor and hands-on training was performed on a model. Consequently, when the groups were compared, the rate of passing the practical tests was 37% in the first group and 73% in the second group (26). While the guides include the use of chest compressions and ventilations in resuscitation training, the application of only continuous chest compressions is an alternative approach that may increase volunteerism in witnesses to initiate

CPR. It is not clear yet whether chest compressions-respiratory cycles performed by children are more effective than compressions alone (27).

As for the educational tools, training kits (a 30-min DVD and an inflatable model) are also available for resuscitation training. An advantage of the self-study kit is that it can be used to train a large number of children. In a Norwegian project, >54,000 children were trained in this way (28). Another advantage of the kits is that CPR training can be given to adults or peers at home. Studies conducted in Norway reported that between 2.9 and 3.8 people were trained with a single kit (28, 29). An Italian study showed a domino effect of 1.77, which was significantly higher in girls (30). The Danish group reported that an average of 2.5 people used each kit (31).

Despite significant improvements after training, the CPR quality is still observed to be poor when tested. Despite favourable results obtained in other areas tested, it has been shown in a study that chest compressions performed by 9–12-year-old American children were 'effective' only at a rate of 29% (32). In another study, <17% of trained children were able to make airway, respiration or circulation assessments during the BLS test scenario 5 months after training, and this rate was significantly higher than that in the controls who were not trained (33).

Hands-on training has an important place in resuscitation training. Although theoretical training alone can reduce the time and resources required, children who receive only theoretical training perform poorly on skill tests. Researchers have shown that there is no difference between those who have not received hands-on training and those who have received online training (34). Another study found that children who attended online and hands-on training performed basic CPR better than those who received only online training (32). Children aged 8–11 years who received only theoretical training failed in the multiple-choice assessment test at a rate higher than that in those who additionally received hands-on training (35). In other studies, it has been found that the children who receive hands-on training have better practical skills related to CPR (36).

In a study (18) that was conducted by searching the literature on the subject and through the compilation and summarisation of various published scientific articles to determine the most appropriate BLS education for school children, it was reported that the optimal age for giving CPR training was 12–13 years. It is suggested that the best training method is the application of a questionnaire, providing interactive education that covers theoretical and hands-on training and reapplication of the same questionnaire after the training (2 months and/or 6 months later).

Regarding computer-based education, there are various studies wherein school children used computer-based education for CPR training. In addition, studies examining the 'virtual world' (internet environment) or 'multiplayer online simulation' for the 16–20-years age group have reported that young people watch video games that include CPR scenarios once a week/month and that the programme is easy to use and immersive (37). These studies suggest that it may be an interesting tool for use in this age group and/or for remembering in mind what they have learned.

A training that is short and focuses on practice can be successful. After a 50-min intensive training programme, CPR skills were achieved in 87.5% of the children aged 12–14 years (38). After a 20-min training, 30% of the children aged 13–14 years were able to perform sustained chest compressions at the correct rate, 45% at the appropriate compression depth, and 31% by constantly positioning their hands properly (39). After teaching ventilation skills in a 10-min training, it was found that 23% of 17-year-old children were able to ventilate at the optimal volume (700–1000 mL), and the mean minute ventilation achieved was 7.5 and 10.93 L min^{-1} (40). Another study found that 81.5% of 10-year-old children and all of 14-year-old children were able to successfully perform five ventilations after 30 min of training (41). In this study, ventilation assessment was performed by measuring the tidal volumes (mL) recorded by a software program on a computerised training model (Laerdal Megacode Platz HeartSim 4000, Laerdal Medical AS, Stavanger, Norway), wherein the practical application was made.

Regarding strategies of information protection, studies examining the retention rates of knowledge gained in 2 months to 5 years showed significant improvements in tests performed immediately after training, and then, there was a regression towards the starting point (33, 42-44).

In a study, a video programme and practical application, then individual applications on training models and a total of 100 min of training sessions were conducted in 265 children. After 6 months, the training was repeated in half of those who received training. In the tests performed a few months after the last training, the performance on basic skills was found to be significantly better in those who received training twice (45). In another study that lasted 4 years, a 2-h practical training was given after a training program including 1 h of theoretical training with a standard computer presentation. Consequently, in practical application, the focus is on the correctness and quality of chest compressions, particularly without mouth-to-mouth respiration. In this study, in yearly and 6-month periods (in which the same training is repeated), the groups receiving education twice a year were examined yearly (before repeated training and at least 7 months after last training); no significant advantage was found with respect to training that is given twice a year, and the authors noted that there were complaints of boredom and lack of motivation due to frequent trainings (46).

CPR instructors are usually health professionals or school teachers. When the branches of teachers are assessed in terms

of CPR training, the success rate of one is not very different from the other. However, because healthcare workers are used less, the reduction of cost and programming difficulties is among the benefits of school teachers. The training of teachers by health educators should provide a longer-term investment. Teachers are voluntary trainers as long as they receive appropriate training. Students trained by high-rated teachers perform considerably better than those trained by low-rated teachers (47). Another potential trainer pool is the medical faculty students, from 1st to 5th grades having a BLS certificate, who trained school children in several studies. After receiving a total of 7.5 h of training, 2.5 h for 3 days, from the instructors of anaesthesiology department, 1st grade medical faculty students who were determined as instructors participated in the study period as an instructor. In another study, medical student trainers were used for CPR training in school children (mean age, 17 years), and it was suggested that the success partly depended on the facilitation of teaching due to the age similarity between instructors and students (48-51).

Studies have shown how little training children need to successfully use an automatic external defibrillator (AED). Fifteen children aged 11–12 years who were not previously trained were given verbal instructions about AED. All of them used AEDs to defibrillate the model by placing the pads properly, and the duration from the beginning of the scenario to the application of shock was approximately 90 s. In brief, without receiving any practical training, 81%–95% of children who received only 'computer-based education' performed basic AED behaviours on the test. After the training, children aged 6–7 years performed an AED simulation, and because they switched on AED, stuck adhesive pads on the training model, and applied shock with AED commands, they were found 'successful'. The authors concluded that using AED is as simple as using a TV remote control for these children (52).

Conclusion

In summary, an ideal resuscitation training for school children can be achieved through a training for 2 h every year and repeating this training every year. This training can be realised through a 15–20 min theoretical lesson using a pre-prepared video presentation, followed by a practical training on a model, which should constitute a total of 50–70-min duration for practical and theoretical training. Before and after the training, 'learnability of education' can be assessed with CPR knowledge and skills of the children, and 'retainment of education' can be assessed by repeating this questionnaire periodically. CPR training given at school ages will help educate children and in turn save thousands of lives.

Ten basic principles of ERC on resuscitation education in schools:

1. Everyone can save a life; children can also save lives (5, 9, 15-17, 21, 27, 51)
2. Up to 2 h of CPR training is required for school children in an academic year (5, 15, 16, 21, 27).
3. Hands-on training should be given, and it can be supported by virtual and theoretical trainings. No special equipment is required for this.
4. The annual training of school children should be started at the age of 12 years or earlier (5, 15, 16, 21).
5. Trained children should be encouraged to train others. For example, after training, all children should be asked to give lessons to 10 people in 2 weeks as homework and to report this to the teacher.
6. This training can be given by various people at various places: Anaesthesiologists, cardiologists, emergency room physicians, nurses, paramedics, medical and other health care students, trained teachers and many other volunteers can teach CPR to school children at hospitals or other appropriate places (11, 21, 27, 36).
7. In each country, the Ministries of Education and/or other prominent politicians should conduct a national-scale programme for CPR training in school children (9).
8. Each nation's own Resuscitation Association and/or related institutions and associations should support its national initiatives and the campaign of 'Children Save Life'.
9. With the campaign of 'Children Save Life', children will also acquire the relevant social responsibilities and social skills (5, 15, 21, 27).
10. National programmes that educate school children on CPR can contribute to saving lives and reducing the cost of social and health services (9, 53).

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