ORIGINAL ARTICLE

School Children Training for Basic Life Support

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ABSTRACT

Objective: To determine the background knowledge of high school children on basic life support by calculating the points scored in a MCQ-based test; to evaluate results of teaching basic life support skills to them; and assessing their power of retention by re-testing them on skills and MCQ test after the workshop.

Study Design: Quasi-experimental study.

Place and Duration of Study: Armed Forces Institute of Cardiology and National Institute of Heart Diseases, Rawalpindi, Pakistan, from 1st September to 31st December 2008.

Methodology: Thirty children aged 11 - 15 years from 9 different schools of Rawalpindi were subjected to knowledge and skill based test at three different times. First was taken just after brief introduction to the subject of CPR and its related definitions, second after providing them hands-on CPR training, and last, after 3 months of CPR training, knowledge as well as CPR skills were tested.

Results: The children showed highly significant improvement in knowledge after CPR training and retention of knowledge and skills of CPR after 3 months period. There was no correlation of age, gender and weight to depth of compression and fatigue. There was a correlation between height and depth of compression.

Conclusion: Children can learn and perform basic life support skills with reasonable accuracy and can retain these skills for longer periods. CPR training should be provided to all school children after 6th grade.

Key words: *Basic cardiac life support. Cardiopulmonary resuscitation (CPR). Basic Life Support (BLS). School children. Life saving skills. Cardiac arrest.*

INTRODUCTION

Over 700,000 cardiac arrests occur every year only in Europe and about 80% of these occur at home.[1] Waiting for emergency medical services in victims of sudden cardiac arrest would mean lack of cerebral perfusion and permanent brain damage. Less than 1% of general public in UK knows how to assess and manage someone who has collapsed.[2] The situation is surely much worse in Pakistan where literacy rate is much less than UK.

In developed countries, out-of-hospital cardiac arrest (OHCA) occurs in upto 200 per 100,000 persons per year.[1] The odds of survival after OHCA are improved by effective CPR by bystanders and by the early activation and arrival of emergency services. Bystanders perform CPR in fewer than half of witnessed OHCA cases, and lack of training is usually the most common explanation given for that.[1] In school children also, the knowledge of cardiac arrest and required basic life support (BLS) has been found to be insufficient and even the school teachers lack such knowledge and skills, in most developed countries, even USA.[3] CPR remains a set of difficult psychomotor skills that is challenging to teach to the lay public.[4] This is probably one of the reasons in addition to extra financial burden and overfull curriculum that this essential training has not been given regularly in even the most developed countries.[5]

A CPR training programme designed and taught as part of school curriculum would have a significant impact on public health.[2] There are studies indicating that CPR training is a feasible proposition for 6-7 years old children who might well be in a position to save the lives of cardiac arrest victims.[6] Resuscitation skills should be learnt at school, since children are easily motivated, learn quickly, and retain skills.[7,8] If not in 6-7 years old, children of 9 years should be taught to perform cardiopulmonary resuscitation [CPR], including chest compressions.[9]

CPR is specifically important in school children because they tend to engage in high risk behaviours such as extreme sports, challenging tasks, and car crashes etc.; and they live with adults and old age people prone to cardiac arrest. In Pakistan, unfortunately, CPR training at schools level is not a part of curriculum.

It was hypothesized that if Pakistani high school children are trained in basic life support skills, they can be transformed into life savers. This study has been designed to first assess and then provide CPR training to 6th to 10th grade students of our top achieving schools at Rawalpindi, and then assess the retention ability, capability to reproduce and physical endurance to perform chest compressions in these children.

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The objectives of this study were to determine the background knowledge of high school children of private and public schools about cardiac arrest and basic life support (BLS) in adult victims of cardiac arrest and to evaluate results of teaching basic life support skills to high school children and assessing their power of retention of such skills.

METHODOLOGY

This was a quasi-experimental study carried out from 1st September to 31st December 2008 at the Armed Forces Institute of Cardiology and National Institute of Heart Diseases, Rawalpindi. After approval from the hospital ethics committee, 30 (male and female) students from sixth to tenth grade were selected, using convenient sampling, from different schools of Rawalpindi, with the consent of their parents.

Children's weight, height, gender, and class were recorded to assess the correlation of these variables to the final outcome results. Same group of children was put to test three times, once before the training, then immediately after the training, and third time 3 months after the training. First test was called Pretest since it was conducted before any training was imparted and only background knowledge was checked through one-best type multiple choice questions (MCQs). There was no assessment of psychomotor skills in the "Pretest". In second and third tests both knowledge and psychomotor skills were tested.

First, all children received a brief introduction (10 minutes) of course objectives and terminology of the subject. Then they were put through a Pretest (a one best type MCQs test containing 25 questions with one mark each), of 25 marks to assess their background knowledge about the subject.

The children then received a 5 hours DVD-based resuscitation course combined with demonstrations and hands-on training on resuscitation manikin Resusci Anne (Laerdal®) and the Ambu Man®. CPR skills were taught by three instructors individually to each child according to American Heart Association Guidelines 2005. They were taught BLS psychomotor skills for adults with and without obstructed airway.

After the training, all participants were given the post-workshop test that comprised the same questions as were in pretest. After the written test, their psychomotor skills were tested by the same group of anaesthesiologists who provided training to them and results were checked according to a checklist that was designed before the administration of training. The participants knew, before volunteering, that they would receive BLS training, but they were unaware of the skill retention assessment later.

The same group of students was again invited after 3 months of their training, and put through one best type MCQs based test to assess retention of knowledge, and scenario based test of their skills taught in first session. The assessment of psychomotor skills was performed in the same manner.

Learning and retention of psychomotor skills were assessed on a pre-designed checklist with assessment of responsiveness, calling for help, opening of airway, assessment of breathing making sure that all participants perform three recommended actions i.e. look, listen and feel, initial rescue breaths, confirmation of chest rise on every given breath, starting of chest compressions at appropriate time, position of hands during chest compressions, rate and depth of compressions, switching of compressor, and presence or absence of fatigue. Retention of knowledge was assessed by comparing results of Pretest, immediately after workshop and a test 3 months after the workshop.

All values were assessed on Statistical Package of Social Sciences (SPSS) version 15. Student's t-test was applied on the marks scored in the written tests; where-as non-numerical variables (the learning and retention of psychomotor skills) were assessed by McNemar test. Pearson's correlation was assessed for age, gender, weight, height and school grade with initial knowledge about CPR, post-workshop knowledge and skills test, retention of knowledge and skills at 3 months, fatigue and depth of compressions; p-value less than 0.05 was considered significant.

RESULTS

Data was available for 30 students (11 boys and 19 girls) and the demographics of all participants as well as their frequency in different grades of schools are shown in Table I.

During the Pretest, only 5 out of 30 participants (16.33%) scored 50% or above marks. Average marks achieved after the pretest were 10.17 ± 4.17 (Table II). Pearson correlation of children's age with theoretical knowledge was positive and highly significant (2 tailed significance < 0.05). Older children showed better retention of theoretical knowledge as well (Table III). Similarly, children of higher school grades showed better retention of theoretical knowledge, as evident by positive and significant correlation of school grade and post-workshop test and test at 3 months. There was no significant correlation of weight, height and gender of the child with the theoretical knowledge about cardiac arrest and CPR.

In the first post-test, 29 children scored more than 50% marks of the total and only one child (3.33%) scored less than 50%. Average marks achieved by the group in test immediately after workshop were 18.10 ± 3.782 (range: 8-23). Increase in theoretical knowledge after the training was highly significant (p-value < 0.001) when compared with pretest (Table II). Pearson

Table I: Demographics and distribution according to school grades (n = 30).

	Range	Mean ± SD
Age	11-15 years	13.4 ± 1.688
Weight	32 - 70 kg	50.03 ± 11.79
Height	138 - 175 cm	144.17 ± 8.06
Grade 10th		9
Grade 9th		5
Grade 8th		4
Grade 7th		4
Grade 6th		8

Table II: Test of theoretical knowledge.

Tests	Marks obtained (out of 25)		p-value
	(Mean ±SD)	(Range)	
Pre-workshop (Group 1)	10.17±4.170	5-18	–
Immediately after training (Group 2)	18.10±3.782	8-23	(Pair 1 vs. 2) 0.000
Three months after training (Group 3)	17.67±4.122	7-25	(Pair 2 vs. 3) 0.314

Table III: Correlation of theoretical knowledge test with age and school grade.

		Pre-workshop	Post-workshop	Test at 3 months
Age (in years)	Pearson correlation	0.459	0.550	0.466
	Sig. (2-tailed)	0.011	0.002	0.009
School grade	Pearson correlation	0.455	0.559	0.463
	Sig. (2-tailed)	0.11	0.001	0.01
Height (in cm)	Pearson correlation	0.051	-0.077	-0.078
	Sig. (2-Tailed)	0.787	0.684	0.681
Weight (in kg)	Pearson correlation	0.097	0.005	0.141
	Sig. (2-tailed)	0.611	0.981	0.456

Notes: Pearson correlation ("R" value): > 0.5 shows correlation; Sig. (2-tailed): < 0.05 shows significance.

Table IV: Comparison of mean age, school grade, height and weight of participants with and without fatigue and with adequate and inadequate compression depth.

	Fatigue			Compression depth		
	Yes	No	p-value	Adequate	Inadequate	p-value
Mean age (years)	13.1 ± 1.37	13.1 ± 1.83	0.020	13.21 ± 1.78	12.91 ± 1.51	0.35
Mean school (grade)	8.1 ± 1.37	8.1 ± 1.77	0.079	8.21 ± 1.72	7.91 ± 1.51	0.63
Mean height (cm)	143.5 ± 2.68	149 ± 9.23	0.012	149.95 ± 8.90	142.36 ± 2.38	0.00
Mean weight (kg)	49.5 ± 14.81	50.3 ±10.39	0.264	51.79 ± 12.30	47 ± 10.72	0.56

correlation reveals significant positive correlation of age and school grade but insignificantly positive correlation of weight was seen in the comparison of pre- and post-workshop tests. Height of participant had inverse correlation (r = - 0.078) as shown in Table III.

Average marks obtained in the second post-test (after 3 months) were 17.67 ± 4.122. There was no significant difference in marks scored in the first and second post-tests (p=0.314) (Table II). This showed excellent retention of knowledge by the participants. Pearson correlation between test results at 3 months with age and school grade was significant to 0.01 level (Table III). Girls performed slightly better than boys at 3 months with an average score of 18.11 ± 4.78 compared to boys who scored 16.91 ± 2.66.

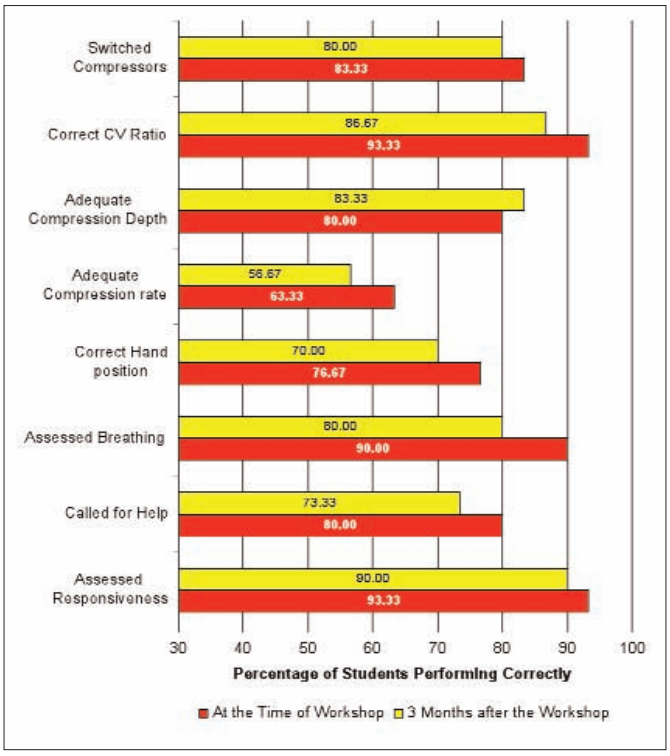

Figure 1: Assessment of psychomotor skills.

In the assessment of psychomotor skills, there was not much difference between the test results of children immediately after workshop and 3 months after the workshop (Figure 1). McNemar test showed no significant difference between the two assessments (p > 0.05). This shows excellent retention of skills at 3 months after BLS training. Most frequently forgotten skill after 3 months, however, was calling for help after assessing responsiveness.

There was no significant difference of mean age, school grade and weight in children getting fatigued or not when compared using independent sample t-test. However, children not having fatigue had more average height (p=0.012). Independent sample t-test between mean height of children performing adequate and inadequate compressions showed significant difference (p < 0.001) signifying that taller children could achieve more depth while compressing the chest.

No significant difference was found in fatigue and depth of chest compressions in boys and girls when compared using chi-square test with p-value of 0.06 and 0.14, respectively.

DISCUSSION

The teaching of resuscitation skills to school children was introduced in Norway as early as 1961.[5] Subsequent international experience has shown that school-age children are more likely to accept CPR training than older people,[10] are motivated to learn and do so quickly and easily.[11-14] Same trend was seen during this study as all children who participated were very excited and showed a lot of enthusiasm and interest in learning all skills of CPR. The results clearly show that vast majority of them not only acquired the knowledge and learned BLS skills but also retained them after a period of 3 months. The results are so encouraging all over the world that the European resuscitation council, the American Heart Association, and the American Academy of Paediatrics have all recommended that resuscitation be taught to school children.[12,18,15,16] In addition to the ability of children to learn fast, the fact that school years have the potential to provide guaranteed exposure of future adults to CPR skills makes teaching of BLS skills at school a very effective education tool. This is especially true in Pakistan's environment where it is almost impossible to collect adult population for teaching and then motivate them to perform CPR at the hour of need. In Pakistan, teaching of resuscitation skills is still not mandatory even in medical colleges.

Resuscitation skills are complex psychomotor skills that need to be performed in a specified sequence within a very limited time frame. Hence, the most important problem in resuscitation education is the rapid fall off in skills and knowledge following initial training.[17] This fact also make school environment much more suitable for CPR training, since it can be repeated every year on same group of students.

The skills taught, such as recognition of symptoms, establishment of an airway, and rescue breathing, will help prepare students to deal with individuals who need their assistance, e.g., due to aspiration or cardio respiratory emergencies. Individual efforts, using only BLS skills, can be effective in rescuing patients in these circumstances. Prompt initiation of cardiopulmonary resuscitation (CPR), after early recognition of a cardiac arrest, has limited success alone. This education must be supported by a community emergency response system. Immediate CPR coupled with access to the community emergency response team will maximize the impact of school education programs.

Isbye and Rasmussen provided CPR training to 35,000 school children in Denmark by providing a personal manikin, a CPR DVD and a manual to every child included in the study who were given whole material to take home and keep. However, incidence of bystander CPR did not increase significantly in the months following the project.[18] This seems an impossible option in our setup because of cost implications. The other problem in this study is that the training was not supervised. Probably, it led to failure of improvement in incidence of bystander CPR in the mentioned study. We provided consultant guided hands on training to every child and hence our children showed excellent results in terms of learning and retention of knowledge and skills.

In the United Kingdom, national syllabus and training programme, developed by the British Heart Foundation through “Heartstart UK” introduces chest compressions to school children at 11 years of age.[9,19] This study included 7 children of 11 years of age, 5 of 12 years and 4 of 13 years. A vast majority of them showed good retention of skills and knowledge, provided chest compression at adequate depth, and could blow the air in the manikin's chest with reasonable power that made the chest rise. There were no signs of fatigue after 5 minutes of continuous compression and ventilation sequences in vast majority of them.

According to Jones and Whitfield, no 5th grade student (age, 9 - 10 years) could compress the manikin's chest to the 38 - 51 mm depth recommended in guidelines.[9] However, 19% of students of grade 7 (age 11 - 12 years) and 45% in grade 9 (age 13 - 14 years) achieved adequate compression depth. Only one 13 - 14 years old performed chest compressions. Compression depth was significantly correlated with age, weight, and height. In this study compression depth was correlated with the height of children (taller children performing better). There was no correlation found with age, gender and weight. In this study, 100% participants of grade 9th and 10th achieved adequate compression depth and continued the same for 5 minutes. This is in contrast to above mentioned study that showed only 45% of grade 9 students performing adequate chest compression.[9] An increase in rate of compression while a decrease in depth was noted in the a/m study in the later part of 3 minutes compressions. This pattern was not observed in this study. Twenty four percent participants of this study had a faster rate of compression from the very beginning.

Connolly and colleagues found out in their study, performed in Northern Ireland, that children instructed in CPR showed a highly significant increase in level of knowledge following the training session. While their level of knowledge decreased over a period of 6 months it remained significantly higher than that of a comparable group of children who had never been trained.[2] In this study also there was a highly significant increase in the knowledge and skills of participants and it remained so for 3 months. We, however, did not investigate the same after 6 months of training.

Some individuals, adults as well as children may not attempt to start CPR for the fear of causing harm to the patient. Although there are known complications of

bystander CPR but international studies have shown that there is no increase in complications when CPR is performed by the bystander as compared to CPR performed by an expert advance cardiac life support provider.[22]

The number of participants was very small to make any firm conclusion and apply it on the whole population. Reason for having such a small number of students was lack of interest shown by the school administrations. Only the student of private schools or Army public school was included in the study. These schools generally contain high achiever students who are more interested in learning new skills. This study does not give us adequate insight about the approach and capabilities of Government schools. Skill retention should also be checked at 6 months and one year duration. Quality of compression beyond 5 minutes was not assessed. Study was carried out on manikins while in real life there could be emotional stress and fear to do harm to the patient that could affect the performance.

On the basis of this study, it is recommended that children of all schools should be provided training of life saving skills. A larger study including more than 1000 students of middle to high school children should be carried out and its results should be used to convince authorities to include the subject in the curriculum of students.

CONCLUSION

A majority of high school students did not have basic knowledge of CPR or Basic Life Support skills. Pakistani children as young as 11 years, can learn BLS skills and reproduce them to a significant degree even after 3 months of initial training. Through training they would acquire physical endurance to perform adequate chest compressions for upto 5 minutes without showing any sign of fatigue. Overall, high school children provide good substrate for CPR training and the subject should be included in their curriculum.

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