

Readiness to Life Threatening Emergencies in Secondary Schools: A Trial on Skills Among Students and Staff, Jeddah, 2017

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ABSTRACT

Background: Every child on earth is valued. Children are more vulnerable and have a high risk of unintentional injuries because their bodies and behaviors are still developing. Surprisingly, many schools do not employ nurses leaving teachers and other staff in charge of first-aid, cardiopulmonary resuscitation (CPR), and automated external defibrillators (AED) before the arrival of emergency medical services personnel.

Objective: To assess the effectiveness of first-aid/CPR/AED training programs on the skills of public secondary schools students and staff and their impact on life-threatening emergencies in Jeddah in 2017.

Methodology: We conducted a quasi-experimental study of 316 public secondary schools' staff and students. This was a multistage stratified cluster random sampling. A checklist of heart saver first-aid/ CPR/AED was used by qualified instructors to evaluate the students' and teachers' skills. The intervention included a lecture, video, and practical sessions on first-aid and BLS training. This was used to evaluate the school's staff and students before, at the time, and after two months after training. We used a Chi-Square X² and Cochran's Q-test to analyzing scores obtained by the study group. P-values < 0.05 considered as significant results at 95% CI.

Results: The total response rate in girls' school was (93.98%). This was (97.33%) in boys' school. Most schools' staff and students did all tasks correctly in Post-test 1. In Post-test 2, both groups showed a significant reduction in the skills related to CPR for adults, children, and infants. On the other hand, the percentages of those who removed gloves and stopped bleeding correctly maintained a higher level in Post-test 2 without any significant difference (p>0.05).

Conclusion: The effect of heart saver first-aid/CPR/AED training programs on schools' staff and students leads to significant skills improvement. There was a slight decline in the skills afterward. The students had better skill retention than staff.

Keywords: School, Students, Staff, Emergency Plan, Skills, CPR, First-Aid, AED.

Abbreviations:

AHA: American Heart Association; **SHA:** Saudi Heart Association; **BLS:** Basic Life Support; **CPR:** Cardiopulmonary Resuscitation; **AED:** Automated External Defibrillator; **KSA:** Kingdom of Saudi Arabia; **USA:** United States of America; **WHO:** World Health Organization; **CDC:** Centers of Disease Control and Prevention; **EpiPen®:** Epinephrine Auto-injection Pen; **APP:** American Academy of Paediatrics; **EMS:** Emergency Medical Service; **EAPs:** Emergency Action Plans.

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INTRODUCTION

In 2005, the United Nations (UN) Convention on the Rights of the Child, signed a pledge wherein all governments stated that children have the right to safe and protected environments.¹ Children spend a significant proportion of their day within the school environment.^{2,3} They are more vulnerable and have a high

risk of unintentional injuries because their bodies and behaviors are still under development. They have not yet learned to be aware of surrounding hazards.³

Pediatric emergencies can include exacerbation of medical conditions or accidental physical injuries. They are more likely to

occur in schools (more than 40.4%).^{2,3} The leading cause of morbidity and mortality in children less than 18 years around the world is unintentional injuries including drowning, poisoning, suffocation, fires, burns, and falls as well as motor vehicle, bicycle, and pedestrian-related crashes.^{1,3,4}

In 2014, the World Health Organization (WHO) declared in the Global Burden of Disease that injuries and accidents are responsible for 875,000-950,000 deaths in people under the age of 18 years per year worldwide; 90-95% of these cases were considered to be unintentional injuries.^{1,3,4}

These injuries cause an enormous socioeconomic burden because around 25% of children (one out of four children) are wounded annually.⁵ This often requires a prompt medical attention and costs about \$17 billion.⁵

Unfortunately, unintentional injuries are most common in low and middle-income countries⁴. These accidents are compounded by war including the Arab world as raised lately in absence of medical attention in most of children schools, e.g., missiles at schools in Najran city of Saudi Arabia.⁶

Recently, both the American Academy of Pediatric (AAP) and the American Heart Association (AHA) have published guidelines on the necessity for school leaders to obtain emergency-response plans to deal with the life-threatening medical emergencies in children while the children are at school. The guidelines aim to enhance the local emergency service in each school. These medical attentions should be done quickly and efficiently to identify and manage life-threatening emergencies.²

The AHA defines first-aid as help provided to any person suffering a sudden illness or injury with proper care to preserve life, prevent the condition from worsening, and promote recovery.^{7,8} First-aid, Cardiopulmonary resuscitation (CPR), and automated external defibrillator (AED) programs are simple, cost-effective, and fast in treating pre-hospital emergencies.^{2,4} In fact, performing CPR and AED are critical and integrated to first-aid.^{7,8}

School physicians and nurses are leaders in health according to the AAP and AHA guidelines, but not all schools have them. Thus, two or more school staff volunteers are often trained in Basic Life Support (BLS) as first-aid.⁹ The APP and AHA recommend having first-aid/CPR/AED personal and equipment in schools—this is part of preparedness and emergency response plans.⁹

Properly training children can make a remarkable difference in outcomes. Studies have shown that children can retain skills for longer periods than adults because they are full of motivation, curiosity, and the willingness to be trained; this is especially true for children over grade six.¹⁰⁻¹²

Many studies have argued that chest compression depth correlates with physical factors such as weight, Body Mass Index (BMI), and height.¹³

Moreover, Perform CPR in schools within the first 3-4 minutes of medical problem will improve the survival rate by 94%.¹⁴ Additional one-minute delays can decrease the survival rate by 3-4%; after 9 minutes, fewer than 10% will survive.¹⁴

AHA (2015) guidelines suggest a 3:1 ratio of participants to manikin to optimize the amount of time each student spends practicing while keeping the length of the course reasonable.¹⁵⁻¹⁷

This study was carried out to assess the effectiveness of heart saver first-aid/CPR/AED training program on the skills of public secondary schools students and staff and their impact on life-threatening emergencies in Jeddah, Saudi Arabia in 2017.

MATERIALS AND METHODS

Study Population: This was a quasi-experimental study among staff and students in public secondary schools in Jeddah. The inclusion criteria included students consented by parents/guardians, a self-consent from staff, and being present for intervention (not absent). We excluded housekeepers, gatekeepers, visitors, and trainees.

Sample Size: The sample size was calculated with an Open Epi™ calculator. We calculated the effect size from previous studies: the value was $E = 4.901$ among 54 staff; the value was $E = 2.620$ for the 216 students.^{12,18} The acceptable limits of precision was $\alpha = 0.05$ (two-tailed) at 95% CI. This work assumes that the acceptable mean score for knowledge and skills of first-aid and CPR between staff group versus students group are (75.28 (+12.62) vs 62.43 (+13.68), respectively) at 80% power. The sample size in each groups for the before/after study were 214 in students and 52 in staff. Thus, the total estimated sample size was 266. However, we increased the sample size up to 316 (71 staff and 245 students) to compensate for loss of follow up.

Sampling Technique: We carried out the multistage stratified cluster random sampling in public secondary schools in Jeddah.

1st Stage: The stratification was based on gender: two schools for boys and two for girls. Geographic cluster sampling was applied, and we selected four schools: two schools for piloting and two schools (one school boys and one school girls) for interventions.

2nd Stage: The schools' population was divided into students or staff:

Stratum 1: Students were stratified with equal allocations according to their grades (1st grade, 2nd grade, and 3rd grade). Cluster random sampling was then applied to select one class from each grade. All students from the selected class were then included.

Stratum 2: All school staff within both schools were enrolled including teachers and administrative staff.

Tools for the Study: An observational checklist (Heart saver © CPR AED Skills Sheet) was used by certified instructors to test the skills of schools' students and staff after conducting the training program. This was done on two occasions two months apart. The first observation was performed immediately after the training program and considered as Post-test 1. Post-test 2 is the second observation and occurred two months later. The observational checklist was obtained from AHA, Last Edition, 2011. Persons certified by AHA & Saudi Heart Association (SHA) in first-aid/CPR/AED performed the training. The training program included video, lecture, and mini mannequins (CPR School Training Kite) sponsored by the Training, Graduate Studies, and Research Center in public health in Jeddah. The center is accredited by the SHA. The first-aid/CPR/AED training courses were based on AHA (2011) guidelines with regards to instructors' preferences. There were three students per manikin. This optimized the amount of time each participant spends practicing while keeping the length of the course reasonable (4 h). This is a practical timeline for most schools. These techniques are the most appropriate method for accessing data and can answer questions that might arise from this study objective as confirmed via pilot study.

During data interpretation, we calculated the overall percent after the end of each set of skills. Here, the instructor assigned each

participant either a grade of pass (all steps are done correctly) or needs remediation (NR). The set of skills included adult CPR, child CPR, infant CPR, removing gloves, finding problem, using an EpiPen, and stopping bleeding and bandaging.

Statistical Analysis: Descriptive analysis was displayed in the form of frequency distribution for categorical variable. Chi-Squared and Cochran's Q-test were used to test significance in categorical

variables. P-values less than 0.05 were considered to be an indication of significance. A pilot study was done based on the suggested methodology and tested study feasibility and the validity of the data collection sheet. Ethical approval was secured in written form and kept confidential. Data entry and statistical analysis were performed by the principal investigator to maintain confidentiality.

Table 1: Some of Demographic Characteristics of the Staff (n=71).

| Characteristics | No. | Percentage | |
|-----------------|----------------|------------------|------|
| Job title | Teacher | 43 | 60.6 |
| | Administration | 24 | 33.8 |
| | Counselor | 3 | 4.2 |
| | Coach | 1 | 1.4 |
| Gender | Male | 30 | 42.3 |
| | Female | 41 | 57.7 |
| Age | <35 years | 15 | 21.1 |
| | 35-<45 years | 36 | 50.7 |
| | ≥45 years | 20 | 28.2 |
| | Mean ± SD | 39.6 ± 7.3 years | |
| Marital status | Single | 6 | 8.5 |
| | Married | 63 | 88.7 |
| | Divorced | 2 | 2.8 |
| Have children | Yes | 62 | 87.3 |
| | No | 9 | 12.7 |
| Education level | Diploma | 6 | 8.5 |
| | Bachelor | 59 | 83.0 |
| | Master degree | 6 | 8.5 |

Table 2: Demographic Characteristics of the Students (n=245).

| Characteristics | No. | Percentage | |
|-------------------|--------------|------------|------|
| Gender | Male | 120 | 49.0 |
| | Female | 125 | 51.0 |
| Age | ≤16 years | 94 | 38.3 |
| | 17 years | 78 | 31.8 |
| | ≥18 years | 73 | 29.8 |
| Grade level | First grade | 96 | 39.2 |
| | Second grade | 75 | 30.6 |
| | Third grade | 74 | 30.2 |
| Educational track | Preparatory | 122 | 49.8 |
| | Science | 27 | 11.0 |
| | Literary | 96 | 39.2 |

Table 3: Percentages of the Staff and Students Who Passed the Training.

| Performance of CPR | Schools' staff | | P* | Students | | P* |
|---------------------------------|----------------|---------------|----------|----------------|----------------|----------|
| | Post 1 | Post 2 | | Post 1 | Post 2 | |
| | N (%) n=71 | N (%) n=63 | | N (%) n=245 | N (%) n=239 | |
| CPR for adults. | 69 (98.6) | 55 (87.3) | 0.020** | 223 (91.0) | 182 (76.2) | <0.001** |
| CPR for children | 69 (98.6) | 54 (85.7) | 0.011** | 220 (89.8) | 155 (64.9) | 0.006** |
| CPR for infants | 60 (84.5) | 20 (31.7) | <0.001** | 205 (83.7) | 127 (53.1) | <0.001** |
| Removing gloves | 71 (100.0) | 61 (96.8) | 0.317 | 233 (95.1) | 232 (97.1) | 0.683 |
| Finding the problem | 69 (97.2) | 57 (90.5) | 0.059 | 213 (86.9) | 155 (64.9) | <0.001** |
| Using epinephrine pen. | 71 (100.0) | 47 (74.6) | <0.001** | 223 (91.0) | 184 (76.4) | <0.001** |
| Stopping bleeding and bandaging | 71 (100.0) | 63 (100.0) | 1.000 | 231 (94.3) | 226 (94.6) | 0.724 |

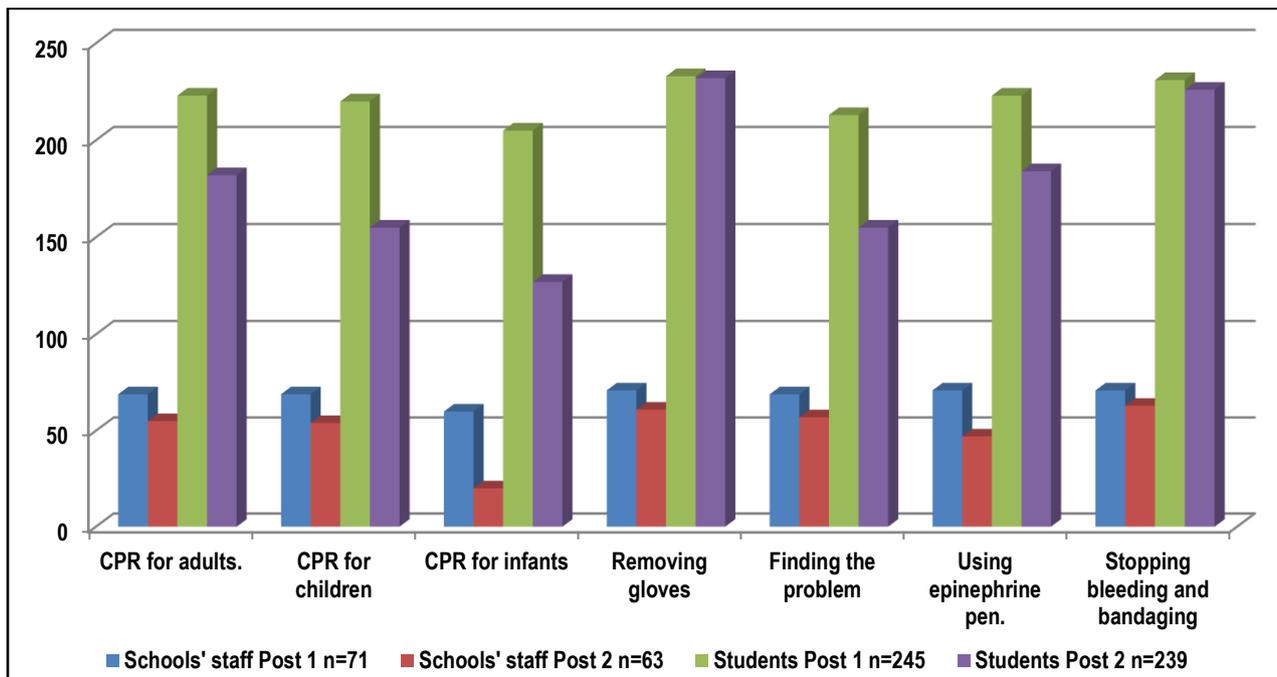


Fig 1: Performance of CPR: Staff and Students Who Passed the Training.

RESULTS

We enrolled 71 staff (22.47%) and 245 students (77.53%). The total response rates were 93.98% for girls and 97.33% for boys.

Table 1 demonstrates that, Out of all participated school staff (n=71), teachers constituted 43 (60.6%), females constituted 41(57.7%), the mean age accounted for 39.6±7.3 years, it ranged between 25-56 years, and one half of them 36 (50.7%) aged 35-<45 years. The great majority of staff was married 63 (88.7%), and has children 62 (87.3%). Only 6 (8.5%) of the staff a had master's degree; most were bachelor qualified 59 (83%).

Male (49%) and female students (51%) were equally represented (Table 2). They were also almost equally distributed on the three grades and age groups. In terms of educational track, half of the students were in the preparatory stage (49.8%) with 11% in the science track and the rest (29.8%) in the literary track.

According to the "Heart Saver First-Aid/CPR/AED Skills Sheet", the trainee passes if they do all tasks correctly. Table 3 shows that the overwhelming majority of both the staff and students did all tasks correctly in Post-test 1: CPR, removing gloves, finding problems, stopping bleeding, and bandaging. However, the percentage of those who did all tasks correctly in Post-test 2 decreased significantly in both groups—especially in CPR for adults, children, and infants. Moreover, the skills declined significantly when using the epinephrine pen among students and staff at $p < 0.05$. On the other hand, the percentage who did all tasks correctly remained higher in Post-test 2 without any statistically significant differences among the groups in terms of removing gloves, stopping bleeding, and bandaging $p > 0.05$.

DISCUSSION

Life-threatening emergencies such as major bleeding, anaphylactic shock, seizure, heart attack, and hypo/hyperglycemia can occur in any school at any time.^{2,4,8} This can be due to violence, injuries, pre-existing medical conditions, and other accidents. Nevertheless, Saudi schools rarely employ nurses leaving teachers and other staff responsible for first-aid, CPR, and AED before the arrival of emergency medical services.^{2,8,19}

We assumed that teaching staff and students about Heartsaver® First-Aid/CPR/AED is the best approach to educate the public about this lifesaving technique. This has been supported in many studies.^{2,8,12,19} Training in schools will play a significant role in reducing mortality and promoting survival while waiting for EMS to arrive. On average, 20% of the population should be trained in first-aid and basic life support if a significant reduction in mortality is to be accomplished.^{2,4,8,19} In this study we assessed the effectiveness of first-aid/CPR/AED training programs on the skills of public secondary schools students and staff and their impact on life-threatening emergencies in Jeddah in 2017.

Our demographic findings showed that the staff age was 25-56 years. Most (63; 88.7%) were married and had children (62; 87.3%) and a bachelor's degree (59; 83%). The students were 15-19 years: half were in the preparatory track (49.8%), and 39.2% were in the first grade. Most staff (85.9%, 93%) had not been trained in CPR/AED respectively, and it seemed that lower proportions of schools' students than staff (70.6%, 91%) didn't attend any courses of first-aid and CPR/ AED as well. Many studies' results support our findings also.^{8,19}

Generally, first-aid/CPR/AED skills e.g. removing gloves, applying Epipen, stopping bleeding, performing chest compressions, and ventilation in adults, children, and infants decreased in post-2 assessment. Most of studies have shown similar results after training for three to six months. There is strong evidence that retention of BLS skills rapidly declines after the initial training.^{12,15,20-23} It is recommended that every school establish a comprehensive training program for teachers that includes a theoretical part and a practical part (video footage, manikins, lectures, etc. Visual recognition significantly increases the level of information given to teachers—70% in a sample of 45 schools after one-hour duration.²⁰

Skills in stopping bleeding and removing gloves did not decrease after intervention ($p > 0.05$). The students retained more knowledge than the staff. This illustrates the ease of applying the correct steps to the affected victim. It does not need to correlate with physical factors such as weight, height, and BMI during chest

compressions as in perform CPR.¹³ Many prior studies have shown that students retain more knowledge and skills than staff.^{12,15,20-23} On the other hand, the staff was better at performing adult and child CPR; students were better at infant CPR. However, this may be because the changes in BMI significantly impact the strength of compression—this allows complete chest recoil after each compression. Better chest compressions (i.e., with adequate rate and depth and allowing complete chest recoil) result in more blood flow. Chest compressions that are too fast or too slow—as well as chest compressions that do not allow complete chest recoil—deliver less blood flow than high-quality chest compressions.^{12,15,20-23} Few individuals were ready to do mouth-to-mouth perhaps because of insufficient practical skills or worries about disease.²⁴ Emphasizing and promoting Heartsaver® First-Aid/CPR/AED is an important investment and can enhance the well-being of children. We recommend further research be done in this field to identify the optimal re-training time (refreshing courses) after primary courses. These should be mandatory for all staff and older students. This study was limited in the time and number of follow-up sessions, and more replicates are needed.

CONCLUSION

In conclusion, the heart saver first-aid/CPR/AED training programs increased on the skills of the staff and students, but these skills decreased slightly after two months. The students retain more skills than the staff, but the staff was better than the students in performing BLS.

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