# Investigating the Effect of Cardiopulmonary Resuscitation Training on the knowledge and Skills of High and Middle Schools Students and Teachers in Jeddah, KSA.

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**Abstract**

**Background**: Cardiopulmonary resuscitation (CPR) is a basic emergency procedure consisting of manual artificial respiration and external cardiac massage. Good quality CPR that was initiated early by witnesses increased survival after cardiac arrest from 3.9 % to 16.1%. So, it is essential to train teachers and students to increase the proportion of qualified individuals in society. **Objective**: To Investigate the effect of cardiopulmonary resuscitation training on the knowledge and skills of high and middle schools `s students and teachers. **Setting:** The study was conducted at forty middle and secondary female schools from the East educational office in Jeddah, Saudi Arabia. **Subjects:** A convenient sample of 45 female teachers who were nominated to act as student`s guide or health guide and 45 students who were members of the school health association affiliated with previously selected schools. **Tools**: Two tools were used. Tool one: Pre/Post knowledge questionnaire, Tool two: CPR observational checklist. Quazi experimental design was utilized to conduct the study**. Result**: Most of the participants (75.6%) had a previous CPR background, and 87.8% of them recommended adding CPR training to the school curricula. A significant statistical difference was found with the mean knowledge score while 84.4% had good CPR skills post-training. However, no correlation was observed between knowledge and skills scores**. Conclusion**: The level of knowledge and CPR skills were improved among the study participants after the training as well they recommend adding CPR training to the school curriculum. It reflects the need for continued training that may play an important role in saving more lives and disseminating CPR essential knowledge to the community. **Recommendation:** Include CPR training as an essential component in the school curriculum.

**Keywords:** Cardiopulmonary resuscitation; student`s guide, school health association.

## Introduction

Cardiac diseases and out-of-hospital cardiac arrest (OHCA) are major causes of death worldwide. Survival rates are low; about 7% of patients survive to discharge from hospital in whom resuscitation is attempted in the UK (Mpotosa &Iserbyt, 2017; Liu, et al. 2019; Uny, et al. 2023). Böttiger, & Aken, (2015) stated that, following sudden cardiac arrest, the brain can only survive for 3–5 minutes without oxygen. This time is less than the time required for the emergency medical services to arrive in most cases.

So, prompt administration of basic life support (BLS) increases the patient's chances of recovery. It is believed that out-of-hospital mortality could be significantly reduced if at least 15% of the population knew BLS. The main aim of BLS is early recognition of sudden cardiac arrest and activation of the emergency response system. In unconscious patients, cardiopulmonary resuscitation (CPR) supports breathing and circulation to maintain their lives while waiting for emergency medical care. (Narayan, et al. 2015; Savaliya, et al. 2016).

Previous studies indicated that the rates of bystander participation in CPR remain low and may indicate limitations in the training of CPR to the adult population. (Hori, et.al., 2016; Özbilgin, et.al. 2015). In this regard, the key factor that improves survival is good quality CPR which is considered the main component of BLS. During the external cardiac massage, the compression and decompression of the chest allow for the filling of the heart and the dispersion of blood through the circulatory system.

The circulatory system is the main mode of oxygen distribution from the lungs to the rest of the body. In addition, any form of artificial ventilation is administered with cardiac massage to oxygenate the blood in the lungs before being pumped to the rest of the body could prevent irreversible brain damage due to lack of oxygen

supply (Fragkou, et al.2021; Gatesa, et al.2015; Travers et al. 2010).

Özbilgin, et.al. (2015); Sarma, et.al. (2017); Wingen, et.al., (2017) support that early initiation of CPR by witnesses increased survival after cardiac arrest from 3.9% to 16.1%. However, the situation is normally confusing when a sudden cardiac arrest occurs and a rescuer who is not adequately skilled in BLS or not willing to perform CPR due to lack of training. Willingness to perform CPR depends on the bystander's level of knowledge and skills (Chong, et.al. 2021). So, increasing the public knowledge, understanding, and skills of the practical applications of CPR is an important method to increase CPR success in cardiac arrest cases.

In this regard, Beck, Ruhnke, Issleib, et.al. (2016) stated that according to a systematic review including 10 studies from all over the world, the frequency of first aid given by laypeople to trauma casualties worldwide ranges from 10.7% to 65%, and around 83.7% of the cases received incorrect first aid. And in a survey done in the USA in 2013, it was shown that only 20% of laypeople knew about hands-only CPR, while 75% would be willing to perform it (Chong, et.al. 2021; De Buck, et. al. 2015; Jerkeman, et al. 2022). Moreover, wider dissemination of CPR training among the community might effectively increase the proportion of bystanders as well as increase knowledge which results in increased confidence by the rescuer when attempting to perform cardiac resuscitation (Harer, Jeffrey, & Yaeger, 2014; Yu, et.al. 2020).

Scapigliati, et.al. (2021), stated that approximately 70% of all out-of-hospital cardiac arrests (OHCA) happen at home, bystanders, such as family members, friends, or others, are nearby in many cases. As previously shown, survival rates can be significantly increased by early bystander CPR and such resuscitation can decrease brain damage, and nursing home admissions and increase the number who return to work (Uny, et al. 2023; Wingen, et.al., 2017).

Moreover, new studies reported that even students in primary school can master CPR skills. So, training school children in CPR from the age of 12 years or earlier for 2 hours per year is a way to improve survival. The children will be able to teach this to their families if they receive well training. This will see not only an increase in the number of cardiac arrest survivors worldwide but also the social benefits of enthusiastic and positive young people when they learn to help others (Hori, et al. 2016); Weidenauer, et al. 2018).

Furthermore, the American Heart Association advocated compulsory resuscitation training in American schools in 2011. Countries in which resuscitation has been integrated into school educational programs report significantly higher resuscitation rates. Successful training of school children in Denmark has led to double the rate of bystander CPR after five years, and a threefold improvement in survival following OHCA over ten years. In this regard, training school teachers and children to perform CPR is a long-term strategy for the community to increase bystander CPR rate and survival, spreading CPR knowledge among school teachers and children and prompting them to act as 'multipliers' in both private and public settings (Semeraro, et.al., Süss-Havemann, et al. 2020; 2017; Yeung, et.al., 2017).

**Significance of the study:**

A study done by Ahmad, et al. (2018) mentioned that, as estimated almost 23 million people will die from cardiovascular diseases in 2030 in Saudi Arabia. Moreover, earlier reports revealed that from 74% to up to 80% of all cardiac arrests occur at home. One study reported that only 9.1% of victims of cardiac arrest received some CPR help in Riyadh. Another study revealed that only 17% of non-traumatic and 3% of traumatic cases received immediate CPR. Moreover, various research strongly recommends that CPR training and early defibrillation have significant outcomes in out-of-hospital cardiac arrest cases.

In this regard and after an extensive literature review, many pertinent reports from Saudi Arabia evaluated the university students' awareness of BLS, but few data have been reported regarding the awareness of BLS among school students and teachers. And because life-threatening emergencies can occur at any time, anywhere, and in anyone. Also, the outcome and prognosis of cardiac arrest can be significantly improved post-cardiopulmonary resuscitation administration. The present study is undertaken to investigate the effect of cardiopulmonary resuscitation training on the knowledge and skills of high and middle school students and teachers.

**Aims of the Study**

The study aims to investigate the effect of cardiopulmonary resuscitation training on the knowledge and skills of high and middle school students and teachers.

**Research Questions**

1. What is the effect of Cardiopulmonary Resuscitation training on the knowledge level of high and middle school students and teachers?
2. What is the effect of Cardiopulmonary Resuscitation training on skill's level of high and middle schools `s students and teachers?
3. Is there a relationship between Knowledge and skills regarding Cardiopulmonary Resuscitation among participants?
4. What is the relationship between CPR Knowledge, skills, and socio-demographic characteristics among participants?

**Materials and Method**

**Materials**

**Design:** Quasi-experimental design with one-group pre- and post-design was utilized to conduct the study.

**Settings:** The current study used a table of random numbers of schools to select forty middle and secondary female schools from the East educational office in Jeddah to conduct the CPR training among students and teachers. In this regard, Jeddah has 8 educational offices, East educational office was selected randomly. It has 40 secondary female schools and 48 female middle school schools.

**Subjects:** **A** convenient sampling technique was used in this study to approach all the female teachers who were nominated to act as student guides or health guides (teachers who are selected by school administration to guide students to different issues including health issues) affiliated with the previously selected schools were invited to participate in the study. As well as all the students who were members of the school health association (it is a school health committee formulated by school administration including teachers and students) affiliated with the previously selected schools were invited to participate in the study.

Only those who agreed to voluntarily participate were involved in the study. The sample size was estimated by G*power software. The aim was to include N = 75 female students and teachers to achieve the power of 85% with a medium effect size = 0.3, α error probability = 5%, and missing data is estimated as 10%. The total sample size was N = (75+15) = 90 students and teachers.

**Tools:** To collect the necessary data for the study two tools were used:

**Tool one: CPR questionnaire** This tool was developed by researchers after an extensive literature review (Weidenauer, et al. 2018, Yeung, et.al., 2017; and American Heart Association, 2016)

**It consisted of 2 parts:**

- Sociodemographic data of the participants such as age, educational background, and CPR information such as the past experience of the participants, sources of participant`s CPR information, and participants' opinion regarding including CPR training in the schools' curriculum.
- CPR knowledge questionnaire (pretest and post-questionnaire) which had 10 MCQs related to CPR steps such as CPR sequence, the ratio between chest compression and mouth breaths, number of chest compressions \ minute, when the chest compression should start, and when the CPR stop. Each correct answer scored 1 with a total knowledge score of 10.

**Tool two: CPR skills checklist** This checklist was adopted from the American Heart Association BLs booklet for adult CPR **(**American Heart Association, 2016). The automated defibrillator steps were removed because of the unavailability of the device in the selected schools. The checklist had 6 main items and 9 subitems with a total of 15 Statements such as ensuring the scene is safe, checking patient response, calling for help, checking for pulse and breathing, applying 30 chest compressions followed by 2 breathing with its related detailed steps. The participants were evaluated in each step whether done correctly with a score of 1or not done with a score 0.

The scoring system for both knowledge and practice consists of 3 categories: unsatisfactory Less than 60%; Satisfactory from 60 % to 79 %, and Good from 80 % to 100% (El-Gamal, et.al., 2013).

**Method**

**Preparatory phase**

Content validity of the tools was tested by a group of 5 experts in the field and their opinions were taken into consideration. A pilot study was carried out on 9 participants who were not included in the study to ensure clarity, applicability, and comprehensiveness of the tool; accordingly, the necessary modifications were made.

Approval from the research unit at the College of Nursing -Jeddah, KAIMRC, and IRB. Then an official letter from CON-J was sent to

the East educational office administration to gain acceptance, complete information about the research as the research`s aim, settings, and subjects, in addition to the research instrument were clarified in the letter.

Preparation of the required material and equipment was assured.

**Implementation phase:**

The study subjects were approached at the schools after getting permission from the school administration according to the scheduled dates and times. Each school provided the researchers with a special empty place such as a playground, school library or meeting venue to conduct the training based on the predetermined schedules.

Once they were recruited a consent form was signed. Then the researchers distributed the pretest questionnaire and explained the necessary information and guidance needed to fill the questionnaire. The training session started with a PowerPoint presentation about CPR followed by hands-on training on CPR skills using a simulated manikin for each individual participant.

The CPR training was conducted by a certified CPR instructor and a trained instructor by the certified one. Each session took 4 hours (1 hour for the pretest and PowerPoint presentation and 3 hours for demonstration and re-demonstration on the CPR), so the total CPR training hours were 36 hours. Each training session included 10 to 12 trainees. So, the total CPR training sessions were 9 sessions for all the participants. During the practice of the participants, a competency CPR checklist was filled out for each participant by the instructors.

**Evaluation phase**

After the training session, the post-test for both CPR knowledge and CPR skills was done. The data was coded, and statistical analysis was done by using SPSS version 20. Descriptive as well as inferential statistics were carried out. Descriptive Statistics included (mean, SD, and Frequency). Also, the T-test and Person's product-moment correlation coefficient were used to test the relationship between the main outcomes.

**Ethical considerations:**

The participants were informed about the purpose of the research and the main instructions explained by the researchers. The informed consent was secured from each participant with complete assurance of their right to withdraw from the study at any time. In addition, anonymity was assured when a code number was used to label questionnaires. Participant privacy and confidentiality were assured, and all data was kept in a secure place within NGHA premises, both hard and soft copies.

**Statistical Analysis**

A Statistical package for social sciences program software was used to collect and analyze research data as well as present findings clearly and compellingly. Descriptive as well as inferential statistics were carried out using version 20. Descriptive Statistics included (mean, SD, and Frequency). Also, the T-test and Person's product-moment correlation coefficient were used to test the relationship between the main outcomes.

**Results**

**Table 1** revealed that the mean age for students is 16.8 $\pm$1.6, and the mean age for teachers is 40 $\pm$ 5.4. As regards level of education most of the students were from secondary school 43.3%. and from teachers, 37.8% had a university education.

**Table 2** revealed that 92% did not agree to specify cardiopulmonary resuscitation to those working in the medical field. 75.6% of the participants had a background in CPR from television and training courses. Also, 95.6% of them are willing to learn CPR and 87.8 % of the participants want to add CPR to school curricula.

**Table 3** shows that more than 64.4 % of students and 46.7% of teachers had an unsatisfactory knowledge level before training sessions, and 36.7% of both students and teachers had a Satisfactory level while 54.4 % had a good knowledge level after the training program.

**Table 4:** shows that 93.3% had good skills compared to 84.4% of teachers post-training program.

**Table 5:** found that there was no correlation between skills and knowledge, but there is a positive correlation between age, level of education, and knowledge score among both students and teachers.

**Discussion**

The current study revealed that most of the participants (92%) didn't agree to specify learning of Cardiopulmonary resuscitation (CPR) to whom they work in the medical field as well as about three quarters (77.7%) of them had background knowledge on CPR, these results may reflect the high level of awareness

about CPR among both teachers and students in these schools. However, this result disagreed with two studies done in Riyadh, KSA in which they reported that more than half of the participants did not have any information about CPR (Al Harbi, Afifi, Alateeq, et.al. 2018 & Alharbi, Horaib, Almutairi, et.al., 2016).

Concerning the source of information, the current study revealed that TV, receiving training, and the internet were the main sources of information among participants which came in accordance with Alharbi, Horaib, Almutairi, et.al. (2016) who reported that receiving training courses, TV and internet were the main sources of information among the study group, these results indicate the crucial role played by the television and internet in raising the community awareness about important health issues such as CPR. In addition, only 28.9%, of teachers gained their information through receiving training programs which are in agreement with Al Harbi, Afifi, Alateeq, et.al. (2018) who reported that only 10 % of the participants previously received BLS course, these results reflect the importance of providing condensed CPR training for the schoolteachers as basic life support skills.

However, in this study majority of the study sample, either teachers or students want to learn CPR as well as want to add CPR to the school curriculum, lower percentages were reported with Al Harbi, Afifi, Alateeq, et.al. (2018) and Alharbi, Horaib, Almutairi, et.al. (2016) since 38.5% and 53% of the studies sample respectively believe BLS course should be mandatory. Another study that was conducted by Al Enizi, Saquib, Zaghloul, et.al. (2016) came with the same results, they reported that many teachers wanted more training (64.9%) and were willing to take a free course (78.4%), all of these results reflect the positive perception of the schoolteachers and students of the importance of receiving CPR training as mandatory courses.

Regarding the knowledge level, the posttest mean for both students and teachers was higher than the pretest means with a significant difference (p.0001), these results came in accordance with many studies such as Sanela, et al. (2020) who reported Significant progress in cardiopulmonary resuscitation knowledge among the study participants. In addition, Al kalash, (2019) reported that the Post-test mean knowledge; was higher significantly than the pretest mean knowledge. Another study came with the same results since Achmad, (2020) found that the pretest and posttest results showed that there was statically significant improvement of participant's knowledge after training. All of these studies reflect the positive effect of the training programs on improving the knowledge of CPR either among schoolteachers, students, or even university students.

Regarding skills level, this study shows that the majority of students 93.3% as compared to 75.6% of the teachers respectively had a good score in the skills practice, this difference may be explained by the fact that 46.7% of the students had previous CPR training as compared to 28.9% of the teachers however, the results reflect the positive impact of the training program, in acquiring the skills of both teachers and students related to CPR. This results came in accordance with Al kalash (2019) who reported that Post-test mean practice score was higher significantly than pretest mean among study participants. Similar results were found that there were significant differences between the pre, and posttest practices mean score (Muthulakshmi, 2016).

As regard to the correlation between the participant's CPR knowledge and skills, Un-expectedly, the study revealed a negative correlation between knowledge score and skills score Which may be explained by about two-quarters of the study sample had previous knowledge about CPR while they may not apply these skills at the previous time as well as it indicates the need for more practice in further programs. The current study result disagrees with the result of Muthulakshmi, (2016). who revealed a positive correlation between knowledge score and practice score either in pretest or posttest among study participants, but this disagreement could be explained by having different study participants since in study 9 final year nursing students were the participants who were already preoccupied with knowledge about PCR before receiving the training. In addition, another study conducted by Ma, et.al. (2015) revealed that students who received training scored significantly higher scores of knowledge than those students without training.

However, the study reveals a positive moderate correlation between age, level of education, and knowledge level which reflects the fact that the knowledge level usually increases with increasing age and level of education. This result disagrees with Sanela, et

al. (2020) who revealed that the greatest progress in knowledge was seen in the youngest age group, however, Al Harbi, Afifi, Alateeq, et.al. (2018) reflects an association between student level of education and level of knowledge about CPR.

**Conclusion**

The level of knowledge and CPR skills were improved among the study participants after the training as well as they recommended adding CPR training to the school curriculum. It indicates the need for continued training that may play an important role in saving more lives and disseminating CPR essential knowledge to the community. So, it is recommended to include CPR training as an essential component in the school curriculum.

**Limitations**

- The study was conducted at one governorate (Jeddah) which could affect the generalization of the findings.
- Most of the participant's students were in secondary school, only a few of them from middle school and no one from primary school.
- The researchers had only two mobile cardiac resuscitation mannequins for the clinical training which needs more organization and distribution of students to fit the scheduled time.
- Some teachers could not complete the training at the scheduled session because of school duties so rescheduling was done for them.

**Recommendations**

In line with the findings of the study, the following recommendations are made:

- Most cardiac arrests occur at home, so the presence of a trained person in CPR skills could increase the survival rate.
- Good quality CPR skills should be taught to all populations to save patient lives till health care providers arrive.
- Training both teachers and students on CPR skills could increase the percentage of laypeople who can either perform CPR for arrested patients or increase awareness about the importance of CPR training in the community.
- Further studies are recommended to include more schools representing different regions as well as more students and teachers at all educational levels.

**Table1: Sociodemographic data**

| | Student (N=45) | Teacher (N=45) | |
|---|---|---|---|
| **Age** | Mean 16.8 ±1.6 | Mean 40 ±5.4 | |
| | Minimum 13 and maximum 19 | Minimum 25 and maximum 52 | |
| **Education:** | | **N** | **%** |
| • Middle school | | 6 | 6.7% |
| • Secondary school | | 39 | 43.3% |
| • University | | 34 | 37.8% |
| • Postgraduate | | 11 | 12.2% |

**Table 2: General information**

| Both teacher and students (N=90) | Yes | | No | |
|---|---|---|---|---|
| | NO | % | NO | % |
| According to your opinion, is knowledge of the basics of cardiopulmonary resuscitation restricted to those working in the medical field? | 7 | 7.8% | 83 | 92% |
| Do you have a background in the basics of cardiopulmonary resuscitation? | 68 | 75.6% | 22 | 24.4% |
| What are the sources of information? | | | 8 | 8.9% |
| • Training courses | 25 | 27.8% | | |
| • Internet | 24 | 26.7% | | |
| • Television | 26 | 28.8% | | |
| • New paper or brochure | 6 | 6.7% | | |
| • Others | 1 | 1.1% | | |
| Do you want to learn cardiopulmonary resuscitation | 86 | 95.6 | 4 | 4.4% |
| Do you want to add cardiopulmonary resuscitation to school curricula? | 79 | 87.8% | 11 | 12.2% |

**Table 3: Knowledge level:**

| Knowledge Level | | Study Group N=90 | | | | | | Mean and SD | T test | P-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Unsatisfactory < 60 | | Satisfactory 60 - 79 | | Good 80- 100 | | | | |
| | | N | % | N | % | N | % | | | |
| Students (N=45) | Before training | 29 | 64.4% | 14 | 31.1% | 2 | 4.4% | 4.5±2.1 | 7.731 | 0.0001 |
| | After training | 7 | 15.6% | 22 | 48.9% | 16 | 35.6% | 6.9±1.4 | | |
| Teachers (N=45) | Before training | 21 | 46.7% | 16 | 35.6% | 8 | 17.8% | 5.5±1.7 | 9.615 | 0.0001 |
| | After training | 1 | 2.2% | 11 | 24.4% | 33 | 73.3% | 8.3±1.4 | | |
| Both (N=90) | Before training | 50 | 55.6% | 30 | 33.3% | 10 | 11.1% | 4.9 ± 1.97 | 12.225 | 0.0001 |
| | After training | 8 | 8.9% | 33 | 36.7% | 49 | 54.4% | 7.8 ± 1.57 | | |

**Table 4: Skills level:**

| Knowledge score | | | Skills score | Age | Level of education |
|---|---|---|---|---|---|
| After training | Students (N=45) | r | 0.118 | -0.173 | -0.105 |
| | | P value | 0.438 | 0.256 | 0.494 |
| | Teachers(N=45) | r | -0.063 | -0.005 | 0.096 |
| | | P value | 0.681 | 0.974 | 0.0529 |
| | Both (N=90) | r | -0.099 | 0.420** | 0.326** |
| | | P value | 0.354 | 0.00001 | 0.002 |

**Table 5: Correlation between Knowledge, skills, and sociodemographic data**

| Practice Level | Study Group N=90 | | | | | |
|---|---|---|---|---|---|---|
| | Unsatisfactory < 60 | | Satisfactory 60 – 79 | | Good 80- 100 | |
| After training | N | % | N | % | N | % |
| Students (N=45) | - | - | 3 | 6.7 | 42 | 93.3 |
| Teachers (N=45) | 3 | 6.7 | 8 | 17.8 | 34 | 75.6 |
| Both (N=90) | 3 | 3.3% | 11 | 12.2% | 76 | 84.4% |

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