Research Article / Özgün Araştırma

DOI: 10.4274/cayd.galenos.2023.48569
J Pediatr Emerg Intensive Care Med 2023;10:169-74

The Effect of Cardiopulmonary Resuscitation Training and Practices on the Knowledge Level of Pediatrics Residents

Kardiyopulmoner Resüsitasyon Eğitimi ve Uygulamalarının Çocuk Sağlığı ve Hastalıkları Asistan Doktorlarının Bilgi Düzeyi Üzerine Etkisi

Bilge Akkaya[1], Nilden Tuygun[2], Can Demir Karacan[2]

[1]University of Health Sciences Turkey, Dr. Sami Ulus Maternity and Children Training and Research Hospital, Clinic of Child Health and Diseases, Ankara, Turkey
[2]University of Health Sciences Turkey, Dr. Sami Ulus Maternity and Children Training and Research Hospital, Clinic of Pediatric Emergency, Ankara, Turkey

Abstract

Introduction: Cardiopulmonary resuscitation (CPR) is a dynamic and memorizing process that is fully defined by guidelines. This process requiring urgent approach can only be achieved through repetitive training and practice. It is aimed to determine whether there are differences of knowledge between these trainings before and after, or whether the repeated training periodically increases the knowledge and skills of trained practitioners.

Methods: CPR trainings were given to pediatric health and diseases assistant physicians by advanced cardiac life certified trainer. Pre-training, post-training and 6 months after the training, 20 questions were prepared based on the 2015 American Heart Association guide assessment questions were applied.

Results: The most correct answers were given to the evaluation questions made immediately after the training (average number of correct answers 16.06±2.50) and the least correct answers were given to the evaluation questions made before training (average number of correct answers 8.41±2.26). Six months after the training, although the number of correct answers of the participants decreased significantly after the post-training; it was found that the scores in the sixth month were still considerably higher than before the training (average number of correct answers 12.76±3.30). There was a significant difference between the correct answers given to pre-training evaluation questions according to the duration of work in emergency, between physicians who have never worked yet and physicians with experience of working in the emergency department for 5 months and more (p=0.024). A significant difference was found between the first year assistant and the third year assistant (p=0.024) and between the first year assistant and the fourth year assistant (p=0.017) in terms of the number of correct answers to the pre-training evaluations questions.

Conclusion: Theoretical and practical training in small groups increases the level of knowledge and skills about CPR.

Keywords: Cardiopulmonary resuscitation training, pediatric residents, level of knowledge

Öz

Giriş: Kardiyopulmoner resüsitasyon (KPR) uygulaması, kılavuzlarla tam olarak belirlenmiş dinamik ve ezber gerektiren bir süreçtir. Acil yaklaşım gerektiren bu işlemin akılda kalıcılığı ancak tekrarlayan eğitim ve uygulamalarla sağlanabilir. Bu eğitimlerin öncesi ve sonrası arasında bilgi farklılıkları olup olmadığı ya da eğitimin belli aralıklarla tekrarlanmasının eğitimli uygulayıcıların bilgi ve becerilerinde artış oluşturup oluşturmayacağının ortaya konulması amaçlandı.

Yöntemler: Çocuk sağlığı ve hastalıkları asistan hekimlerine 2018-2019 eğitim yılları arasında, ileri kardiyak yaşam sertifikalı eğitici tarafından KPR eğitimleri verilerek eğitim öncesi, eğitim sonrası ve eğitimden 6 ay sonra olmak üzere 2015 American Heart Association kılavuzu esas alınarak hazırlanan yirmişer sorudan oluşan değerlendirme soruları uygulandı.

Bulgular: En fazla doğru yanıt eğitimden hemen sonra yapılan değerlendirme sorularına (ortalama doğru yanıt sayısı 16,06±2,50), en az doğru yanıt ise eğitimin öncesinde yapılan değerlendirme sorularına verilmiştir (ortalama doğru yanıt sayısı 8,41±2,26). Eğitimden altı ay sonra ise katılımcıların doğru yanıt sayısının eğitim sonrası yapılan postteste göre anlamlı azalma olmasına rağmen; altıncı aydaki puanların eğitim öncesine göre yine de oldukça yüksek olduğu tespit edildi (ortalama doğru yanıt sayısı 12,76±3,30). Acilde çalışma sürelerine göre eğitim öncesi değerlendirme sorularına verilen doğru yanıtlar arasında, henüz hiç çalışmamış hekimlerile 5 ay ve üzerinde acil serviste çalışma tecrübesi olan hekimler arasında anlamlı fark saptandı (p=0,024). Birinci yıl asistanı ile üçüncü yıl asistanı arasında (p=0,024) ve birinci yıl asistanı ile dördüncü yıl asistanı arasında (p=0,017) eğitim öncesi değerlendirme sorularına verilen doğru yanıt sayısı açısından anlamlı fark saptandı.

Sonuç: Küçük gruplar halinde teorik ve pratik eğitim KPR konusunda bilgi ve beceri düzeyini artırır.

Anahtar Kelimeler: Kardiyopulmoner resüsitasyon eğitimi, pediatri asistanı, bilgi düzeyi

Address for Correspondence/Yazışma Adresi: Bilge Akkaya, University of Health Sciences Turkey, Dr. Sami Ulus Maternity and Children Training and Research Hospital, Clinic of Child Health and Diseases, Ankara, Turkey
E-mail: bilgekorkusuz@hotmail.com **ORCID ID:** orcid.org/0000-0002-6871-0119
Received/Geliş Tarihi: 07.09.2022 **Accepted/Kabul Tarihi:** 17.01.2023

Introduction

Cardiopulmonary resuscitation (CPR), applied to protect the cellular functions of vital organs and to restore spontaneous respiration and circulation, is a set of methods consisting of techniques that require knowledge, experience and skill. While cardiopulmonary arrest mostly develops due to respiratory causes in children, cardiac factors are prominent in adults. In addition, there are differences in CPR practices due to anatomical and physiological differences in children and adults. Pediatric resuscitation practices also differ in themselves depending on age groups. These differences are determined by updating the international guidelines periodically.

The main goal in CPR is to initiate basic life support and advanced cardiac life support (ACLS) within the first four golden minutes before irreversible brain damage occurs.[1] This can only be achieved if the knowledge and skills of the health staff who will firstly aid are sufficient.[2]

In this study, it was aimed to reveal whether there were differences in knowledge between before and after CPR training and after 6 months.

Materials and Methods

Seventy pediatric health and diseases residents studying at University of Health Sciences Turkey, Dr. Sami Ulus Maternity and Children Training and Research Hospital Health Application and Research Center were included in the study. This study was a prospective, observational analytical study and a pretest-posttest model was used. During the 2018-2019 academic year, residents were given two-stage CPR training by a pediatric emergency education officer with an "Advanced life support in children" certificate. In teams of ten, training was given with a visual presentation on CPR for 2.5 hours. The presentation was prepared using current guideline data on basic and advanced life support in children. In the second stage, hands-on CPR training was given for one hour using baby and child simulation models, and then the participants performed one-on-one practice to reinforce them. With this training, it was aimed to increase the knowledge level of resident doctors about anatomy, physiology, practical application, drug dosage, and current guideline information.

They were allowed to answer the multiple-choice evaluation forms, consisting of twenty questions each, prepared together with the pediatric emergency education officer, with the same difficulty level, just before the training, immediately after the training and 6 months after the training. Evaluation items were prepared to question the same information, but the pre-training and post-training questions were different from each other.

Before training, they were asked about their age, the year they graduated from medical school, the years of working in the profession, the years of working in the residency, the status of receiving neonatal resuscitation program training, the status of receiving CPR training, the duration of working in the emergency room, whether they followed experienced people while performing CPR in real cases, how many times they participated in active CPR, and intubation experiences in real cases. This information was not asked again before the evaluation questions to be made 6 months after the training.

The protocol of this study was approved by the Local Ethics Committee of University of Health Sciences Turkey, Ankara Keçiören Training and Research Hospital (KAEK-12-15/1677).

Statistical Analysis

The data of the study were analyzed with the SPSS 22.0 program (Statistical Package for the Social Sciences Inc; Chicago, IL, USA). It was determined whether the variables were normally distributed using visual (histogram) and analytical methods (Kolmogorov-Smirnov). Normally distributed numerical variables were presented as mean and standard deviation, non-normally distributed variables were presented as median and interquartile range (IQR). Qualitative data were presented as numbers (n) and percentages (%). Since the subjects participating in the study constituted a dependent group, the ANOVA and One-Way ANOVA tests were used for repeated measurements for normally distributed continuous variables, and the Wilcoxon, Kruskal-Wallis and Mann-Whitney U tests were used for non-normally distributed variables based on the number of groups. A chi-square test or Fisher's Exact test was applied for categorical variables. A value of $p<0.05$ was considered as a significant difference in the analyses.

Results

The mean age of pediatrics residents included in the study was 27±1.9 years. The professional experience information of all participants and the rate of answering the questions are given in Table 1. The average period of professional experience after graduation was 2.79±1.4 years.

There were 15 people (21.4%) who participated in CPR in the real case 1-4 times before, 10 people (14.3%) who participated 5-10 times, 45 people (64.3%) who participated more than 10 times had. All of the participants followed the experienced people while performing CPR in the real case. There was no significant difference between the number of participation in CPR, intubation experience and correct answers to the pre-training evaluation questions in the real case ($p=0.594$, $p=0.277$, respectively).

There were 31 people (44.3%) who received neonatal resuscitation program training and 39 people (55.7%) who

did not. When the correct answers given to the pre-training evaluation questions of the groups that had received this training and those that had not were compared, it was observed that the participants who had received neonatal resuscitation program training gave 1.68 more correct answers to the pre-training evaluation questions (p=0.02).

Considering the duration of working in the emergency department, there was a significant difference in the correct answers given to the pre-training evaluation questions between the doctors who had never worked in the pediatric emergency clinic and those who had worked in the pediatric emergency clinic for 5 months or more (p=0.024). However, there was no significant difference between doctors who had not worked yet and those who had worked for 2 to 4 months (p=0.237).

It was seen that the number of correct answers given to the evaluation items applied just before the training, right after the training and 6 months after the training was different. While the most correct answers were given to the evaluation questions asked immediately after the training (16.06±2.50), the least correct answers were given to the evaluation questions just before the training (8.41±2.26). It was observed that there was a slight decrease in the number of correct answers given 6 months after the training (12.76±3.30). The correct answers of 70 pediatric resident physicians to the 20-item evaluation just before, immediately after, and 6 months after the CPR training were compared for each question. The answers given to different questions measuring the same information with equal difficulty were compared (Figure 1).

Table 1. Professional experience information of all participants and rate of answering questions

Parameter	n=70
Professional experience, year (median, IQR)	2.79±1.4
Duration of residency	
First year	32 (45.7%)
Second year	8 (11.4%)
Third year	18 (25.7%)
Fourth year	12 (17.1%)
Duration of pediatric emergency rotation	
Had never worked	24 (34.3%)
0-2 months	0 (0%)
2-4 months	8 (11.4%)
>5 months	38 (54.3%)
CPR experience	
1-4 times	15 (21.4%)
5-10 times	10 (14.3%)
>10 times	45 (6.3%)
Intubation experience	59 (84.2%)
Status of taking NRP training	31 (44.3%)
Rate of giving correct answers to the questions	
Before training	8.41±2.26
After training	16.06±2.50
6 months after training	12.76±3.30

CPR: Cardio pulmonary resuscitation, NRP: Neonatal resuscitation program, IQR: Interquartile range

Among the resident doctors in the study, who were receiving specialization training in pediatric health and diseases, the number of first-year residents was 32 (45.7%), the number of second-year residents was 8 (11.4%), the number of third-year residents was 18 (25.7%), and the number of fourth-year residents was 12 (17.1%). The correct answers to the evaluation questions before, after and 6 months after the training were compared according to the years of residency. There was a significant difference in the correct answers given before, after, and 6 months after the training between the first-year residents and the third-year residents (p=0.024, p=0.01, p<0.001, respectively). Similarly, a significant difference was found between first-year residents and fourth-year residents in terms of the correct answers given before, after and 6 months after education (p=0.017, p<0.001, p<0.001, respectively). On the other hand, there was no difference in the correct answers given by the first-year residents and second-year residents to the evaluation questions (p>0.05).

In terms of duration of working in the emergency department, there were 24 people (34.3%) who never worked, 8 people (11.4%) who worked for 2 to 4 months, and 38 people (54.3%) who worked for 5 months or more. There was a significant difference in the correct answers given to the pre-training evaluation questions according to the duration of working in the emergency department, between residents who had never worked in the emergency department and those who had worked in the emergency department for 5 months or more (p=0.024). However, no significant difference was detected between residents who had not worked yet and those who had worked for 2 to 4 months (p=0.237). It is noteworthy that the evaluation questions about epinephrine dose calculation could not be correctly answered right after the training, even by those who worked in the emergency

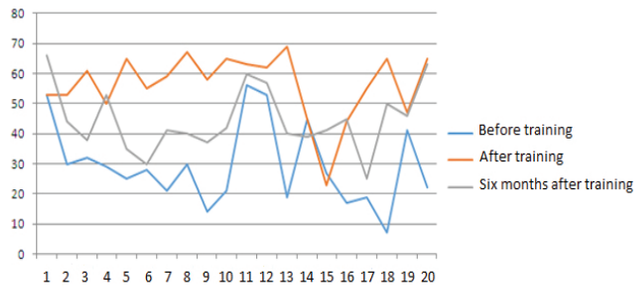

Figure 1. Graphical comparison of pediatric residents' correct answers to twenty questions before, after and six months after training

room and intensive care for a long-time during their residency. For the question 15 evaluating drug administration, while 27 people (38.6%) were able to give correct answer before the training, 23 (32.9%) participants gave the correct answer immediately after the training and 41 (58.6%) six months after the training. It was determined that there were deficiencies in basic knowledge levels, especially in drug administration in resuscitation, before the training.

Discussion

CPR is undoubtedly the most urgent and most important of all medical interventions. In this intervention, which is the most important moment of their lives for the patient and their relatives, it is a race against time. In order for this process to be managed in the most appropriate way, the knowledge, skills and experience of the health personnel should be quite high.

As studies on resuscitation are reported, it is seen that there is a need for updating CPR practices. For this purpose, the American Heart Association has published guidelines for CPR and emergency cardiovascular care every 5 years since 1966, in 1974, 1980, 1986, 1992, 2000, 2005, 2010, 2015, and most recently in 2020, with the aim of researching new approaches and treatments related to CPR, suggesting joint treatment and intervention strategies, and organizing training on CPR.

Although the number of studies measuring the level of knowledge again after a certain period of CPR training is limited in the literature, it has been emphasized that skill levels decrease after an average of 3-6 months when they are not applied frequently.[3] There are studies showing that basic knowledge levels worsen within 1-6 months following the education.[4-7] Studies have shown that repetitive training at the 6th month is effective in maintaining the level of knowledge[8] and it has been recommended to shortly repeat the training every 3-6 months and to repeat the full training once a year.[9] There are studies showing that basic and advanced life support knowledge and skills are quickly forgotten after initial training. Studies have shown that there is a decrease in basic skills in the 1st to 6th months or 7th to 12th months following the training.[10] In the evaluations of advanced life support providers at the 3rd to 6th months, 7th to 12th months and after 12th months, decreases in their knowledge and skills were also shown.[11] These studies differ in participant quality, course duration, training format, type of instructor, and frequency of participants' participation in actual resuscitation.

Studies have been carried out to evaluate the level of knowledge through training in healthcare workers. In a study conducted on the knowledge levels of nurses, the success rate was 36% before the training, while it was 68.3% after the training.[12] In a similar study conducted on doctors, it was shown that while the success rate before the education was 43.15%, it increased to 89.7% after the education.[13] It has been proven by various studies how successful these trainings are, especially in 112 emergency aid and rescue physicians, when critical patient intervention is required and on ACLS.[14-16] It is seen that receiving CPR training at any time after graduation has an effect on success, and results consistent with similar studies have been obtained. In our study, it was determined that those who received postgraduate training on resuscitation were more successful in CPR than those who did not. The average number of correct answers in people who had received neonatal resuscitation program training was higher than that in those who had not received this training. Although there are general similarities in pediatric resuscitation practices, they also show differences within themselves depending on age groups. Therefore, neonatal resuscitation program and CPR training should be repeated independently of each other at certain intervals in the light of current guidelines.

In our study, it is noteworthy that while the average number of correct answers increased by 91.0% after the training, 20% decreased at the end of 6 months. This situation shows us that resuscitation knowledge and practices should be repeated at certain intervals in order to increase the knowledge and skills of health personnel, since resuscitation knowledge and practices are constantly renewed in order to be more efficient and information that is not applied is forgotten over time.

According to the core education curriculum of pediatrics specialty applied in our country, during the four-year training period, rotations of the emergency and pediatric intensive care services are completed within the first two years. When the answers given to the evaluation before, after and six months after the training were compared according to the duration of the residency, a significant difference was found between the answers given by the first year and third year residents, and first year and fourth year residents. Based on these data, it is seen that the doctors who received six-year medical education are insufficient in terms of resuscitation knowledge in the early post-graduate period, and this deficiency is eliminated by applying the courses taken after graduation and in real cases in the emergency and intensive care services.

It is obligatory to complete the pediatric emergency education process for two months, including outpatient and inpatient services, within the four-year education period.[17] In our study, it was observed that the correct response rate of resident physicians who worked in the emergency department for 5 months or longer was higher. This result suggests that if the training period, which is required to be completed in the

emergency department, as specified in the core education curriculum, is arranged to be at least five months in centers with pediatric emergency clinics, the level of knowledge and skill in CPR will be better. When the effect of the participants' working time in the emergency room on the level of knowledge about CPR is evaluated, the fact that the doctors who have worked in the emergency for five months or more are intertwined with resuscitation frequently and that they constantly update themselves in practice can be considered as a factor in the highest success rate.

In our study, it was determined that there were deficiencies in basic knowledge levels of the resident doctors participating in our study before the training, especially in drug administration during resuscitation. It is noteworthy that drug-related deficiencies were detected both in those who completed the emergency service training and in the posttest performed immediately after the training. According to current guidelines, epinephrine is the main drug for CPR therapy. In CPR, there are differences in epinephrine treatment dose, concentration and application form when compared to its use in different indications. For this reason, mistakes can be made in the calculation of epinephrine dose based on rote-learning in current practice. In order to administer drug doses accurately and quickly in life-threatening conditions, easily accessible mind cards can be used in the dose calculation or drug dose reminder boards can be used in emergency services.

The quality of practitioner training and the frequency of training are critical factors in increasing the effectiveness of resuscitation and survival.[18] Measurement, evaluation and feedback during trainings increase the success of resuscitation. While assessments at the end of the resuscitation course are useful in preserving trainees' skills when used for teaching purposes, trainees' competencies should not be assessed using only a written test. In our study, the level of knowledge of the resident doctors about anatomy, physiology, practical application, drug dosage, current guidelines, and case questions and skill levels were measured. In addition, skill level measurement studies can be planned with simulation models or one-to-one questions and applications in real cases.

Study Limitations

The limitations of our study included that assessment was made on a limited sample and practical skill could not be assessed. Studies with simulation models are more suitable for practical skill assessment. In addition, it was another limitation of the study that within six months after the training of the resident doctors, it was not known whether they performed pediatric emergency and/or pediatric intensive care rotations, whether they received an additional course or training, and whether they worked to increase their education level on CPR with their individual efforts.

Conclusion

It is thought that CPR training repetitions will be beneficial for resuscitation knowledge and practice skills to be more efficient and to maintain competence at the highest level. Arranging the emergency service rotation training, which is included in the core education curriculum, for at least 5 months can increase the level of knowledge and skills related to CPR.

Ethics

Ethics Committee Approval: The protocol of this study was approved by the Local Ethics Committee of University of Health Sciences Turkey, Ankara Keçiören Training and Research Hospital (KAEK-12-15/1677).

Informed Consent: Prospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: B.A., N.T., Concept: B.A., N.T., Design: N.T., Data Collection or Processing: B.A., C.D.K., Analysis or Interpretation: C.D.K., Literature Search: B.A., Writing: B.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Li H, Zhang L, Yang Z, Huang Z, Chen B, et al. Even four minutes of poor quality of CPR compromises outcome in a porcine model of prolonged cardiac arrest. Biomed Res Int. 2013;2013:171862.
2. Travers AH, Rea TD, Bobrow BJ, Edelson DP, Berg RA, et al, Chameides L, O'Connor RE, Swor RA. Part 4: CPR overview: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122:S676-84.
3. Sutton RM, Niles D, Meaney PA, Aplenc R, French B, Abella BS, Lengetti EL, Berg RA, Helfaer MA, Nadkarni V. Low-dose, high-frequency CPR training improves skill retention of in-hospital pediatric providers. Pediatrics. 2011;128:e145-51.
4. Makker R, Gray-Siracusa K, Evers M. Evaluation of advanced cardiac life support in a community teaching hospital by use of actual cardiac arrests. Heart Lung. 1995;24:116-20.
5. Su E, Schmidt TA, Mann NC, Zechnich AD. A randomized controlled trial to assess decay in acquired knowledge among paramedics completing a pediatric resuscitation course. Acad Emerg Med. 2000;7:779-86.
6. Kaye W, Mancini ME. Retention of cardiopulmonary resuscitation skills by physicians, registered nurses, and the general public. Crit Care Med. 1986;14:620-2.
7. Soysal S, Karcıoğlu Ö, Korkmaz T, Topaçoğlu H. "Temel yasam destegi egitimi: Ideal ne kadar uzakta." JAEM. 2005;3:40-6.

8. Chamberlain D, Smith A, Woollard M, Colquhoun M, Handley AJ, et al. Trials of teaching methods in basic life support (3): comparison of simulated CPR performance after first training and at 6 months, with a note on the value of re-training. Resuscitation. 2002;53:179-87.

9. Moser DK, Coleman S. Recommendations for improving cardiopulmonary resuscitation skills retention. Heart Lung. 1992;21:372-80.

10. Spooner BB, Fallaha JF, Kocierz L, Smith CM, Smith SC, et al. An evaluation of objective feedback in basic life support (BLS) training. Resuscitation. 2007;73:417-24.

11. Berden HJ, Willems FF, Hendrick JM, Pijls NH, Knape JT. How frequently should basic cardiopulmonary resuscitation training be repeated to maintain adequate skills? BMJ. 1993;306:1576-7.

12. Şener S, Güler V, Türkan H. «The knowledge of nurses, staffed in a training hospital, about basic and advanced life support.» Türkiye Acil Tıp Dergisi. 2004;4:155-9.

13. Erdur B, Turkcuer I, Bostanci M, Boz B, Parlak I, et al. Effects of postgraduate emergency training among general practitioners working in emergency units in Denizli, Turkey. Adv Ther. 2008;25:444-52.

14. Kimaz S, Soysal S, Cimrin AH, Günay T. 112 Acil Sağlik Hizmetleri'nde görevli doktorlarin temel yaşam desteği, ileri kardiyak yaşam desteği ve doktorun adli sorumluluklari konularindaki bilgi düzeylerinin değerlendirilmesi. Ulus Travma Acil Cerrahi Derg. 2006;12:59-67.

15. Bilir Ö, Acemoğlu H, Aslan Ş, Çakır Z. "Knowledge levels as to basic life support of medical doctors and affecting factors." Turk J Emerg Med. 2007;7:18-24.

16. Smith GB, Poplett N. Impact of attending a 1-day multi-professional course (ALERT) on the knowledge of acute care in trainee doctors. Resuscitation. 2004;61:117-22.

17. Tıpta uzmanlık kurulu müfredat oluşturma ve standart belirleme sistemi, Erişim adresi: https://tuk.saglik.gov.tr/TR,31236/cocuk-sagligi-ve-hastaliklari.html

18. Smith KK, Gilcreast D, Pierce K. Evaluation of staff's retention of ACLS and BLS skills. Resuscitation. 2008;78:59-65.