

# Evaluation of Teaching Methods in Mass CPR Training in Different Groups of the Society, an Observational Study

Hamed Hasani, Mojtaba Bahrami, Abdorrasoul Malekpour, Mohammadreza Dehghani, MD, MS, Elaheh Allahyary, MD, Mitra Amini, MD, MS, Mehdi Abdorahimi, Sara khani, Mohammad Kalantari Meibodi, and Javad Kojuri, MD, MS

**Abstract:** To determine the efficacy of different methods of cardiopulmonary resuscitation (CPR) training in 3 different groups of the society.

In a prospective and observational study of 2000 individuals in 3 different groups including G1, G2, and G3 4 different protocols of CPR training were applied and their efficacy was compared between the groups. Also, 12 months after the study course, 460 participants from 3 groups were asked to take part in a theoretical and practical examination to evaluate the long-term efficacy of the 4 protocols.

Among 2000 individuals took a part in the study, 950 (47.5%) were G1, 600 (30%) were G2, and 450 (22.5%) were G3. G1 in 4 groups were 2.37 and 2.65 times more successful in pretest theoretical and 2.61 and 18.20 times more successful in practical examinations compared with G2 and G3 and gained highest improvement in CPR skills. Other groups also showed significantly improved CPR skills. Comparison of different methods of CPR learning showed that the workshop using interactive lecture as well as human model, educational film, and reference CPR book has the highest efficacy in all groups. This protocol of CPR training showed more efficacy in long-term postdelayed evaluation. On the contrary, medical students had better long-term outcomes from the course.

Although G1 and G2 obtained better results in learning CPR skills, in G3 also the theoretical and practical knowledge were improved significantly. This course increased confidence for doing CPR in all groups of the study. Considering that the most of the bystanders at emergency states are general population, training this group of the society and increasing their confidence about performing CPR can be so effective and lifesaving at emergency states. (Clinical trial. Gov registration: NCT02120573)

(*Medicine* 94(21):e859)

Editor: Alessandro Durante.

Received: October 3, 2014; revised: April 12, 2015; accepted: April 14, 2015.

From the Quality Improvement in Clinical Education Research Center, Shiraz University of Medical Sciences (HH, MB, AM, MA, MA, SK); Shiraz Quality Improvement in Clinical Education Research Center, Shiraz University of Medical Sciences, University of Medical Sciences (MB); Shiraz University of Medical Sciences (EA); Trauma Research Center, Shiraz University of Medical Sciences, Shiraz, Iran (MK); Education Development and Research Center, Cardiovascular research center, Shiraz University of Medical Sciences, Shiraz, Iran (JK).

Correspondence: Javad Kojuri, Education Development and Research Center, Shiraz University of Medical Sciences, Shiraz, Iran (e-mail: kojurij@yahoo.com).

This study was funded by HSR of Medical Education of Shiraz University of Medical Sciences Faculty of Education, Education Development Center. The authors have no conflicts of interest to disclose.

Copyright © 2015 Wolters Kluwer Health, Inc. All rights reserved. This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

ISSN: 0025-7974

DOI: 10.1097/MD.0000000000000859

**Abbreviations:** AHA = American Heart Association, CPR = cardiopulmonary resuscitation, G1 = medical students, G2 = nonmedical students, G3 = general population, T1 = Interactive lecturing workshop using lecture and human model, T2 = Workshop using educational film, T3 = Workshop using lecture, human model as well as educational film, T4 = Workshop using lecture, human model, educational film as well as reference book.

## INTRODUCTION

The understanding of sudden cardiac death as a public health problem has paralleled the development of modern emergency medical services systems. In 1 study, it was found that sudden cardiac death is one of important clinical and public health problems, that lead to almost 400,000 to 450,000 death per year.<sup>1</sup> A large amount of literature has discussed about the value of cardiopulmonary resuscitation (CPR) training after out-of-hospital cardiac arrest.<sup>2-6</sup> The role of traditional CPR in sudden cardiac arrest survival has been recently disputed, given both the poor CPR skill performance and retention by people who have not currently involved in cardiac resuscitation.<sup>2,7</sup>

Current European Resuscitation Guidelines 2010 recommend the use of prompt/feedback devices when training for CPR.<sup>8</sup> American Heart Association (AHA) also has guidelines for CPR and CPR education.<sup>9</sup> In 1 study it was found that training of large numbers of volunteers is feasible, reliable, safe, and cost-effective.<sup>10</sup>

Substantial societal resources are focused on mass CPR training<sup>11,12</sup> and innovative methods to provide and improve CPR training to the population in large population.<sup>2,7,13-15</sup>

Most of individuals in society do not enough attitudes about CPR<sup>16</sup> and in several studies, CPR training courses have been led to significant attitude changes.<sup>17-19</sup>

The objective of this study was to evaluate the efficacy of different methods of CPR training in 3 different groups of the society and evaluate the changes in participants' attitude.

## METHODS

### Study Design

This was a prospective observational study of 2000 individuals in 3 different groups of the society, and it was approved through expedited review by all participating hospitals' institutional review boards.

### Study Setting and Population

At the first, programs, methods of training, components of the workshops as well as trainers, and medical education administrators were determined. Trainers were from emergency medical department with acceptable and high practical and

scientific capabilities. Contents of the workshops were selected from the reference text book of CPR<sup>20</sup> and prepared as interactive lecturing format.

**Study Protocol**

Three different groups including medical students (G1), nonmedical students (G2), and general population (G3) of the society were admitted at the study via general recall in Shiraz University of Medical Sciences, in Shiraz city.

G1 were registered at School of Medicine, Shiraz University of Medical Sciences; G2 were training volunteers from Shiraz University, and G3 were gathered by a public enrollment in crowded zones of the city.

The persons who had participated at previous courses or workshops about CPR, basic life support, and/or advanced life support were excluded from the study.

Four different used methods of CPR training were:

I—T1 = interactive lecture in human model (Interactive lecturing workshop using lecture and human model [T1])

II—T2 = educational film (Workshop using educational film [T2])

III—T3 = T1+T2 (Workshop using lecture [T3])

IV—T4 = T1 + T2 + T3 + Reference book (Workshop using lecture, human model, educational film as well as reference book [T4])

Efficacy of these different mentioned methods was compared among the groups. In this study, the effects of training methods on knowledge, skill, and proficiency as well as their attitudes of trainees were evaluated and compared between 3 groups. All of the subjects were asked to perform a pretest evaluation of their knowledge about CPR and emergency needed actions including 20 questions from Text book of CPR.<sup>20</sup>

The participants at 4 different groups of the training methods were asked to fill questionnaire before and after the workshop (Table 1).

Also, after performing all training methods, posttest examination including theoretical and course plan practical

examinations was performed for all individuals based on AHA criteria.<sup>21–23</sup> In fact, 4 examinations were taken including theoretical pretest and posttest and practical pretest and posttest.

The results of the theoretical and practical examinations were calculated, and the changes of the individuals’ knowledge and practical performance, as well as their attitudes to perform CPR at emergency states, between before and after education course were compared.

Twelve months after the end of the course, a postdelayed course evaluation of CPR technique awareness was done on 460 participants from 3 different mentioned groups. They were randomly selected and called for asked to take apart in this study via phone calling and to enroll in theoretical and practical examination. In this postdelayed evaluation, long-term efficacy of 4 different methods of CPR education were compared (Figure 1).

It should be noted that training the basics of CPR, theoretical, and practical examinations were done based on AHA guidelines for CPR.<sup>22,23</sup> All participants were informed about the research and filled an informed consent, and the protocol was approved by Ethics Committee of Research Faculty of University with code of 91-1234.

**Statistical Analysis**

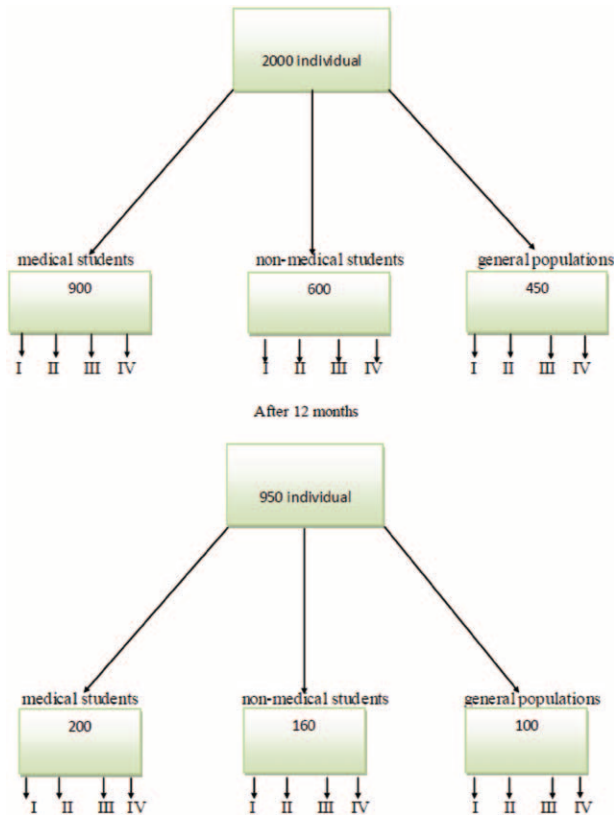
The data were analyzed using Minitab 16.0 and SPSS 20.0, and the results from theoretical and practical pretest/posttest were compared and analyzed with Paired *t* test, one-way ANOVA, and Fischer exact test. All variables exhibited the evidence of a possible relation (*P* < 0.10) to the outcome variable. One way ANOVA and  $\kappa_2$  statistical tests were used to compare the efficacy of CPR training methods.

**RESULTS**

During the study period, 2000 subjects who were involved, including 950 (47.5%) G1, 600 (30%) G2, and 450 (22.5%) participants from G3.

**TABLE 1.** The Questions for the Evaluation of Participant’s Attitude About CPR

Questions	Yes	No	Not Sure
1. If I see someone’s pulmonary—cardiac arrest, before doing anything I will ask for help.			
2. If I see a stranger’s pulmonary—cardiac arrest, I will start CPR as soon as possible.			
3. If I see one of my family member’s pulmonary—cardiac arrest, I will start CPR as soon as possible.			
4. I’m afraid I can’t perform CPR well enough.			
5. I’m afraid of performing CPR because I don’t have enough knowledge and skill for that.			
6. I’m concerned to hurt the patient.			
7. I know that in most cases CPR won’t help so I’m not ambitious to perform it.			
8. I’m concerned about the legal results of my performance.			
9. I’m afraid to touch someone’s body who looks like a dead.			
10. I don’t tend to expose a stranger’s chest.			
11. Because of disease spread (such as Tuberculosis, Hepatitis, and AIDS), I don’t tend to give breath by mouth.			
12. Because of disease spread (Tuberculosis, Hepatitis, and AIDS), I don’t tend to give breath by mouth to my family members.			
13. I’m concerned because probably there’s no necessity to perform CPR.			
14. I think I don’t have physical ability to perform CPR.			
15. When I see a patient with pulmonary—cardiac arrest, I myself am psychologically under pressure, so I can’t perform CPR well enough.			
16. I don’t tend to participate in CPR educational courses.			



**FIGURE 1.** algorithm of attendees and their allocation. I: T1—Interactive lecturing workshop using lecture and human model. II: T2—Workshop using educational film. III: T3—Workshop using lecture, human model as well as educational film. IV: T4—Workshop using lecture, human model, educational film as well as reference book.

Four different methods of education were compared in these 3 different groups of the society including workshop using T1, T2, and workshop using T1 as well as T2, and workshop using T1, T2 as well as reference book. (Table 2)

Two groups of training included 237 G1, 150 G2, and 112 people from G3 in another 2 groups, 238 G1, 150 G2, and 113 people from G3 were included.

G1 in 4 groups were significantly more oriented to CPR compared with other individuals, and better scores achieved at pretest theoretical and practical examinations. Also, mean scores of the G2 were better than G3 in all groups of the education. But there was no significant difference between them.

Highest improvement in CPR skills was also achieved in G1 in both theoretical and practical evaluations. However, other groups of the participants also showed significantly improvements in CPR skills. It is expected that G3 had less knowledge in CPR skills compared with G1 and G2; so, mean scores in pretest theoretical for G1 in 4 groups were 2.37 and 2.65 times more and in practical examinations 2.61 and 18.20 times more compared with G2 and G3 and gained highest improvement in CPR skills.

The comparison of different methods of CPR learning showed that the workshop using interactive lecture as well as human model, educational film, and reference CPR book has the highest efficacy to train theoretical and practical CPR skills in 3 different groups of participants. The results of pretest and posttest evaluation of CPR learning methods in different groups of participants are mentioned in (Table 3).

In 3 groups of the study, the 1st method of CPR training was significantly better than the 2nd method ( $P$  value  $< 0.05$ ). Although the 4th method had better results in CPR training, there was no significant difference between the efficacy of 3rd and 4th training methods in practical and theoretical examinations ( $P$  value  $> 0.05$ ). On the contrary, the 3rd and 4th method significantly were better than 1st and 2nd methods of training ( $P$  value  $< 0.05$ ).

One year after the core study, postdelayed theoretical and practical examinations were taken to evaluate CPR trained skills in 460 participants from previous groups. In each group of training, 50 G1, 40 G2, and 25 participants from G3 were included. The results showed that G1 in 4 different groups of CPR training had better scores compared with other individuals and the method using more and effective facilities such as educational film and reference CPR book showed better performances at theoretical and practical examinations (Table 4).

Participants' attitude about performing CPR at emergency states significantly improved and participants were more willing to do CPR at needed states. The results of attitude changes of the participants about CPR are summarized in Table 5.

**DISCUSSION**

CPR is series of lifesaving actions that improve the chance of survival following cardiac arrest<sup>24</sup> and willingness to perform CPR is a topic that has received much attention in the literature.<sup>25–29</sup>

Some communities provide their first responders with Basic Life Support training and an automated external defibrillator, whereas others rely on paramedics trained to provide

**TABLE 2.** Demographic Data of Attendees

Construct	Age	Sex	Education	Prior CPR Training
Medical students	21.8 (18–23)	%56 F %44 M	Diploma_Master	0%
Nonmedical students	20 (18–23)	%57 F %43 M	Diploma_Master	0%
General population	22 (18–24)	%55 F %45 M	Diploma_Master	0%
<i>P</i> value	0.89	0.78	–	

**TABLE 3.** Mean Score Resulted from Evaluation of Different Methods of CPR Education in 3 Different Groups of the Society (Score From 100)

Workshop using lecture and human model							No. of participants
	<i>P</i> -value	Practical examination Posttests	Pretest	<i>P</i> -value	Theoretical examination Posttests	Pretest	
237	0.001	81.25	36.5	0.000	79.45	19.25	Medical students
150	0.00	67.26	14.03	0.000	63.45	8.05	Nonmedical students
112	0.00	47.85	2	0.000	54.25	7.5	General population
Workshop using educational film							No. of participants
	<i>P</i> -value	Practical examination Posttests	Pretest	<i>P</i> -value	Theoretical examination Posttests	Pretest	
237	0.001	70.75	35.05	0.00	67.15	20.02	Medical students
150	0.00	59.67	13.75	0.00	40.71	7.78	Nonmedical students
112	0.00	41.29	2.01	0.00	25.06	5.96	General population
Workshop using lecture, human model as well as educational film							No. of participants
	<i>P</i> -value	Practical examination Posttests	Pretest	<i>P</i> -value	Theoretical examination Posttests	Pretest	
238	0.001	84.95	37.10	0.00	83.60	20.26	Medical students
150	0.00	72.75	14.08	0.00	70.15	8.78	Nonmedical students
113	0.00	55.60	2	0.00	61.35	7.80	General population
Workshop using lecture, human model, educational film as well as reference book							No. of participants
	<i>P</i> -value	Practical examination Posttests	Pretest	<i>P</i> -value	Theoretical examination Posttests	Pretest	
238	0.001	85.01	37.02	0.00	83.67	20.26	Medical students
150	0.00	73.31	13.95	0.00	71.21	8.78	Nonmedical students
113	0.00	54.59	1.96	0.00	59.91	8.8	General population

advanced life support.<sup>30</sup> It is not clear whether different approaches to provider training affect survival rates from out of hospital cardiac arrest (OHCA).<sup>31,32</sup>

So, many literatures have evaluated the efficacy of different methods of CPR training.<sup>33–36</sup>

This study includes the evaluation of different methods of CPR training in different groups of the society. Some studies reported that video self-instruction to be more effective in teaching CPR performance than the traditional AHA’s classroom training method.<sup>2,5,37</sup>

**TABLE 4.** Mean Score Resulted From Postdelayed Evaluation of CPR Education in Called Participants From 3 Different Groups After 12 Months

Population	Theoretical Examination	<i>P</i> -Value	Practical Examination	<i>P</i> -Value	No. of Participants
Workshop using lecture and human model					
Medical students	67.09	0.000	61.21	0.001	50
Nonmedical students	48.15	0.000	42.75	0.000	40
General population	32.01	0.000	35.05	0.000	25
Workshop using educational film					
Medical students	55.15	0.001	50.75	0.002	50
Nonmedical students	39.60	0.000	26.10	0.001	40
General population	20.15	0.000	13.86	0.000	25
Workshop using lecture, human model as well as educational film					
Medical students	78.95	0.000	76.10	0.001	50
Nonmedical students	68.25	0.000	65.50	0.000	40
General population	50.45	0.000	52.75	0.000	25
Workshop using lecture, human model, educational film as well as reference book					
Medical students	84.95	0.000	82	0.000	50
Nonmedical students	73.05	0.000	71.15	0.000	40
General population	52.25	0.000	54.70	0.000	25
Total population					460

**TABLE 5.** Changes of Participants' Attitudes About CPR Before and After the CPR Course

Questions	Yes			No			Not Sure		
	Pretest (%)	Posttest (%)	P-Value	Pretest (%)	Posttest (%)	P-Value	Pretest (%)	Posttest (%)	P-Value
1	37.4	67.5	0.002	15.7	3	0.000	46.9	29.5	0.001
2	11.1	56.2	0.000	65.7	3.5	0.000	23.1	40.3	0.001
3	13.5	68.5	0.000	64.5	0.5	0.000	22.35	31	0.002
4	71.5	4	0.000	5.85	66	0.000	22.65	30	0.002
5	81	0.3	0.000	1.5	75.8	0.000	17.5	23.9	0.002
6	75.8	3.3	0.000	2.8	82	0.000	21.3	14.7	0.002
7	50.9	1.15	0.000	16.5	88.55	0.000	32.5	10.3	0.001
8	67.3	0.5	0.000	6.8	91	0.000	25.8	8.5	0.001
9	88	31	0.000	1.4	35	0.000	10.5	34	0.000
10	44.8	30	0.002	18.2	40	0.001	37	30	0.002
11	93	23	0.000	1	45.5	0.000	6	31.5	0.000
12	16	4.6	0.000	25.5	69.5	0.001	58.5	25.9	0.001
13	54.5	2	0.000	6.6	65	0.000	38.8	33	0.002
14	34	20	0.002	30.6	45	0.001	35.4	35	0.004
16	9.5	85.5	0.000	62.5	1	0.000	28	13.5	0.001

Díez et al revealed that in comparison to the traditional training method involving an instructor, training G1 in CPR with voice assist manikin (VAM) improves the quality of some practical CPR skills.<sup>8</sup>

This study has 2 dimensions: in 1 aspect, the efficacy of 4 different standard protocols of CPR training is evaluated, and on the other hand, 3 different groups of the society are compared for learning the CPR. The attitudes of the participants about CPR were also compared before and after the course.

Because of different levels of previous knowledge and orientation state about CPR in these groups, significant differences were observed in pretest theoretical practical scores.

Obviously, the knowledge of medical students about CPR is more than of other participants, and they achieved better scores at theoretical and practical examinations. G2 even had more knowledge about CPR compared with general population.

Comparing 4 methods of CPR training in these 3 groups of the society, it seems that the training workshop using lecture, human model, educational film as well as reference book has more quantitative and qualitative efficacy in CPR and BLS training in all groups of the study. On the other hand, the lowest efficacy was in workshop using T2 alone.

It seems that practical training using human model beside the educational CPR film and reference CPR book has a critical role in course efficacy. In other words, using more and practical facilities such as T1 and T2 besides interactive lecturing increase the efficacy of the course.

Performing a postdelayed theoretical and practical CPR examination 12 months after the course allowed us to evaluate the long-term efficacy of mentioned 4 methods of CPR training.

The best persistent method of CPR training in this study was the 4th one, because in this method, effective facilities such as (T4) human model and practical training were used and the CPR reference book and educational films were also available for users.

In this study, it was found that the method that was more effective at the course had more long-lasting effects. In fact, presence of educational film and reference book allows the participants to refresh their skills and knowledge and remember more easily the course components.

CPCR training programs need to be developed in different groups of the society. There are substantial challenges to deliver training programs for G3, in contrast to college-based programs. Other methods for CPR refresher training, such as Internet-based training, also have been advocated but not critically evaluated. Our data also document that a higher educational level is associated with CPR performance. CPR training and retraining programs need to vary at different educational levels of the population.

This CPR course had high and positive effects on participants' attitude and after the course it was found that the participants were more willing to do CPR in emergency states. It seems that suitable training of CPR as well as explaining the key points and its importance and feasibility can improve the individual's attitude about CPR and decrease the individuals' fear of performing not suitable CPR. Such courses that train all society groups lead to more lifesaving attempts in emergency states. On the other hand, suitable training of CPR points can decline the wrong beliefs about CPR such as disease transmission and also increase the dare for performing CPR.

**CONCLUSION**

Such effective CPR courses can lead to improve theoretical and practical skills in G1 and G2 and also in G3. On the other hand, the confidence about performing CPR increased significantly in all groups of the study especially in G3. Considering that the most of the bystanders at emergency states are G3, training this group of the society can be so effective and lifesaving at emergency states.

**Study Limitation**

This study is observational, and randomization could not be done and further randomized studies may determine the best way to teach CPR.

**REFERENCES**

1. Zheng Z-J, Croft JB, Giles WH, et al. Sudden cardiac death in the United States, 1989 to 1998. *Circulation*. 2001;104:2158–2163.



2. Braslow A, Brennan RT, Newman MM, et al. CPR training without an instructor: development and evaluation of a video self-instructional system for effective performance of cardiopulmonary resuscitation. *Resuscitation*. 1997;34:207–220.
3. McKenna SP, Glendon A. Occupational first aid training: decay in cardiopulmonary resuscitation (CPR) skills. *J Occup Psychol*. 1985;58:109–117.
4. Dracup K, Guzy PM, Taylor SE, et al. Cardiopulmonary resuscitation (CPR) training: consequences for family members of high-risk cardiac patients. *Arch Intern Med*. 1986;146:1757.
5. Batcheller AM, Brennan RT, Braslow A, et al. Cardiopulmonary resuscitation performance of subjects over forty is better following half-hour video self-instruction compared to traditional four-hour classroom training. *Resuscitation*. 2000;43:101–110.
6. Hamilton R. Nurses' knowledge and skill retention following cardiopulmonary resuscitation training: a review of the literature. *J Adv Nurs*. 2005;51:288–297.
7. Korttila K, Vertio H, Savolainen K. Importance of using proper techniques to teach cardiopulmonary resuscitation to laymen. *Acta Anaesth Scand*. 1979;23:235–241.
8. Díez N, Rodríguez-Díez MC, Nagore D, et al. A randomized trial of cardiopulmonary resuscitation training for medical students: voice advisory mannequin compared to guidance provided by an instructor. *Simul Healthc*. 2013;8:234–241.
9. Bhanji F, Mancini ME, Sinz E, et al. Part 16: Education, Implementation, and Teams 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2010;122:S920–S933.
10. Capucci A, Aschieri D, Piepoli MF, et al. Tripling survival from sudden cardiac arrest via early defibrillation without traditional education in cardiopulmonary resuscitation. *Circulation*. 2002;106:1065–1070.
11. Pane GA, Salness KA. A survey of participants in a mass CPR training course. *Ann Emerg Med*. 1987;16:1112–1116.
12. del Águila JG, López-Rebollo E, Fernández-Valle P, et al. Mass CPR training. *Resuscitation*. 2013;84:S42.
13. Messmer P, Jones S. Saving lives. An innovative approach for teaching CPR. *Nurs Health Care Perspect*. 1997;19:108–110.
14. Swor R, Compton S, Vining F, et al. A randomized controlled trial of chest compression only CPR for older adults—a pilot study. *Resuscitation*. 2003;58:177–185.
15. Todd KH, Braslow A, Brennan RT, et al. Randomized, controlled trial of video self-instruction versus traditional CPR training. *Ann Emerg Med*. 1998;31:364–369.
16. Suh JW, Choi JY, Lee TR, et al. A study on attitudes toward and knowledge of cardiopulmonary resuscitation in Korean high school students. *J Korean Soc Emerg Med*. 2012;23:901–906.
17. Lynch B, Einspruch EL. With or without an instructor, brief exposure to CPR training produces significant attitude change. *Resuscitation*. 2010;81:568–575.
18. Källested M-LS, Berglund A, Herlitz J, et al. The impact of CPR and AED training on healthcare professionals' self-perceived attitudes to performing resuscitation. *Scand J Trauma Resusc Emerg Med*. 2012;20:1–6.
19. Iwami T, Kitamura T, Nishiyama C, et al., editors. *Systematic CPR Training in Elementary Schools and Students' Attitudes Toward CPR and AED Use*. Circulation 530 Walnut St, Philadelphia, PA: Lippincott Williams & Wilkins; 2011.
20. Hasani H, Kamali M, Kojuri J, Bordbar S, Reisi H. Comprehensive textbook of CPR, Jameenegarh publication 84 Nazari St. Enghelab St. Tehran, Iran; 2001.
21. Stapleton ER. Basic life support cardiopulmonary resuscitation. *Cardiol Clin*. 2002;20:1–12.
22. Berg RA, Hemphill R, Abella BS, et al. Part 5: adult basic life support 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2010;122:S685–S705.
23. Travers AH, Rea TD, Bobrow BJ, et al. Part 4: CPR overview 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2010;122:S676–S684.
24. Sasson C, Rogers MA, Dahl J, et al. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes*. 2010;3:63–81.
25. Axelsson Å, Herlitz J, Ekström L, et al. Bystander-initiated cardiopulmonary resuscitation out-of-hospital. A first description of the bystanders and their experiences. *Resuscitation*. 1996;33:3–11.
26. McCormack AP, Damon SK, Eisenberg MS. Disagreeable physical characteristics affecting bystander CPR. *Ann Emerg Med*. 1989;18:283–285.
27. Brenner B, Kauffman J, Sachter JJ. Comparison of the reluctance of house staff of metropolitan and suburban hospitals to perform mouth-to-mouth resuscitation. *Resuscitation*. 1996;32:5–12.
28. Ryoo H, Park J, Lee M, et al. Factors affecting public recognition and willingness to perform bystander CPR in Daegu metropolitan city. *J Emerg Med*. 2012;43:925.
29. Na YH, Song KJ, Cho GC, et al. Effect of public re-education in willingness to perform bystander cardiopulmonary resuscitation (CPR). *J Korean Soc Emerg Med*. 2011;22:656–661.
30. Jacobs I, Nadkarni V, Bahr J, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update and simplification of the Utstein templates for resuscitation registries. A statement for healthcare professionals from a task force of the international liaison committee on resuscitation (American Heart Association, European Resuscitation Council, Australian Resuscitation Council, New Zealand Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa). *Resuscitation*. 2004;63:233–249.
31. Stiell IG, Nesbitt LP, Pickett W, et al. The OPALS Major Trauma Study: impact of advanced life-support on survival and morbidity. *Can Med Assoc J*. 2008;178:1141–1152.
32. Nichol G, Stiell IG, Laupacis A, et al. A cumulative meta-analysis of the effectiveness of defibrillator-capable emergency medical services for victims of out-of-hospital cardiac arrest. *Ann Emerg Med*. 1999;34:517–525.
33. Brennan RT, Braslow A, Batcheller AM, et al. A reliable and valid method for evaluating cardiopulmonary resuscitation training outcomes. *Resuscitation*. 1996;32:85–93.
34. Cave DM, Aufderheide TP, Beeson J, et al. Importance and implementation of training in cardiopulmonary resuscitation and automated external defibrillation in schools: a science advisory from the American Heart Association. *Circulation*. 2011;123:691–706.
35. Dine CJ, Gersh RE, Leary M, et al. Improving cardiopulmonary resuscitation quality and resuscitation training by combining audiovisual feedback and debriefing\*. *Crit Care Med*. 2008;36:2817–2822.
36. Reder S, Cummings P, Quan L. Comparison of three instructional methods for teaching cardiopulmonary resuscitation and use of an automatic external defibrillator to high school students. *Resuscitation*. 2006;69:443–453.
37. Todd KH, Heron SL, Thompson M, et al. Simple CPR: a randomized, controlled trial of video self-instructional cardiopulmonary resuscitation training in an African American church congregation. *Ann Emerg Med*. 1999;34:730–737.