Effectiveness of simplified 15-min refresher BLS training program: a randomized controlled trial

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Word count of the paper: 2665 words

Word count of the abstract: 241 words

Number of figures: 1

Number of tables: 2

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Keywords:

Basic life support (BLS)

Bystander CPR

Cardiac arrest

Cardiopulmonary resuscitation (CPR)

Retraining

Chest compression

Education

Randomized controlled trial

A B S T R A C T

Objectives: To evaluate the long-term effectiveness of 15-min refresher basic life support (BLS) training following 45-min chest compression-only BLS training.

Methods: After the 45-min chest compression-only BLS training, the participants were randomly assigned to either the refresher BLS training group, which received a 15-min refresher training 6 months after the initial training (refresher training group), or to the control group, which did not receive refresher training. Participants' resuscitation skills were evaluated by a 2-min case-based scenario test one year after the initial training. The primary outcome measure was the number of appropriate chest compressions during a 2-min test period.

Results: 140 participants were enrolled and 112 of them completed this study. The number of appropriate chest compressions performed during the 2-min test period was significantly greater in the refresher training group (68.9 ± 72.3) than in the control group (36.3 ± 50.8, $p = 0.009$). Time without chest compressions was significantly shorter in the refresher training group (16.1 ± 2.1 seconds versus 26.9 ± 3.7 seconds, $p < 0.001$). There were no significant differences in time to chest compression (29.6 ± 16.7 seconds versus 34.4 ± 17.8 seconds, $p = 0.172$) and AED use between the groups.

Conclusions: A short-time refresher BLS training program 6 months after the initial training can help trainees retain chest compression skills for up to one year. Repeated BLS training, even if very short, would be adopted to keep acquired CPR quality optimal. (UMIN-CTR UMIN 000004101)

1. Introduction

Out-of-hospital sudden cardiac arrest (OHCA) continues to be a leading cause of death in many regions of the world.[1-3] Bystander cardiopulmonary resuscitation (CPR) can double or triple the likelihood of survival after OHCA.[1,4,5] Chest compressions are an especially critical component of CPR.[1] Animal and clinical investigations have suggested that continuous chest compressions without ventilation are as effective as chest compression plus rescue breathing resuscitation for most cases of cardiac arrests [6-8] and even more effective in some types of cardiac arrests.[9-11] Chest compression-only CPR is attractive not only because it can provide a greater number of chest compressions without interruption, but also because it is simpler and easier to learn and perform than conventional CPR.[12-14]

Despite intensive efforts to train the general public in CPR and usage of an automated external defibrillator (AED), the proportions of bystander CPR and AED use generally remain unacceptably low.[1,2,15,16] Because this complex psychomotor task is difficult to learn and perform,[6,13,17] basic life support (BLS) training for laypersons should be more focused on essential skills and performed repeatedly. We have demonstrated that our 45-min chest compression-only BLS training makes it possible for the general public to perform more appropriate chest compressions than the 3-hour conventional BLS program.[18]

However, it is well known that CPR skills and knowledge rapidly deteriorate over time.[1] Current American Heart Association (AHA) BLS training courses certify trainees for two years, but the optimal retraining time for maintaining these skills has not been established.[1] The purpose of this study is to evaluate the skill retention of one year after the 45-min chest compression-only BLS training between those who had or did not have the 15-min refresher BLS training 6 months after the initial training.

2. Methods

2.1 Study design

This study was designed as a randomized controlled trial and was conducted between April 2010 and March 2012.

2.2 Participants recruitment and randomization

The employees and students of Kyoto University aged 18 years or older were recruited for this study via billboard advertisements and the Kyoto University web-site as well as by word of mouth from the participants themselves. Participants were offered

$20 as an incentive to be evaluated at one year after the initial chest-compression BLS training. Health care professionals, medical/co-medical students and paramedics, and those whom the program director considered unsuitable for resuscitation training (e.g., those with obvious physical and mental disabilities) were excluded.

Participants were randomly assigned to either the refresher training group or the control group using permuted blocks after stratification by sex and age (age < 40 or ≥40 years). A computer-generated randomization list was provided by an independent biostatistician. The allocation was concealed from all participants and instructors until the completion of the initial chest compression-only BLS training.

2.3 Intervention

For members of both the refresher training group and the control group, the 45-min chest compression-only BLS training consisting of chest compressions, and AED use was carried out using a digital video disk (DVD) instructional material and a compact personal resuscitation manikin named Mr.PUSH®. This personal training manikin makes a sound when a trainee provides chest compressions with appropriate pressure to reach 5cm based on clinical data.[19] Effectiveness of the 45-min chest compression-only BLS training program was previously evaluated.[18] Mr.PUSH® was designed to train people to perform chest compression. Both the DVD and Mr.PUSH® were developed by the Osaka Life Support Association, a non-profit organization which is one of the most active bodies dedicated to spreading BLS training in communities in Japan (http://osakalifesupport.jp/osakalsa/). The main instructor of the training program conducted the course with the DVD with supporting instructors assigned to every 20 participants. Each supporting instructors observed and assisted 20 trainees whether they followed up the main instructor and DVD instruction or not. If not, the supporting instructors supported them to keep up. A total of 20-100 participants underwent the training at the same time (http://osakalifesupport.jp/push_e/index.html).

The refresher training group members were given an additional 15-min refresher training program 6 months after the initial BLS training. The refresher training program included 5 items: (1) Overview (1 min), (2) emergency call and cardiac arrest recognition (3 min), (3) chest compressions (5 min), (4) AED use (5 min), and (5) questions and answers (1 min). To standardize the quality of training program and instructors, the 15-min refresher training program was carried out based on DVD-based training program. The instructor was only allowed to give brief feedback for basic skills such as hand position or compression depth. The control group members did not attend the 15-min refresher training program.

A total of 20 physicians, nurses and emergency medical technicians, all of whom were instructors of the Immediate Cardiac Life Support (ICLS) course certified by the Japanese Association for Acute Medicine (JAAM), were specifically trained for this study to maintain the quality of this training program.

2.4 Outcome measures

One year after their initial 45-min chest compression-only BLS training, resuscitation skills were evaluated using a case-based scenario. In this test, each participant was called individually into the testing room and provided the following scenario: “Imagine that you are at a department store. Suddenly a man collapses in front of you. You are the only person around. Do whatever you can do to help this man.” After presentation of the scenario, we evaluated their CPR skills including initial assessment, call for 119 (the emergency call number in Japan), call for an AED, and chest compressions. After the CPR evaluation, AED was brought to the participant by the instructor and participants were encouraged to use it. The Laerdal® PC Skill Reporting software™ (Laerdal Medical, Stavanger, Norway) automatically recorded CPR performance variables for each subject.

The primary outcome measure was the number of appropriate chest compressions during a 2-min test period at the evaluation test. An appropriate chest compression was defined as one with a depth of over 5.0 cm, correct hand position, and completely recoiling according to the Japanese CPR guidelines.[5]

The secondary outcome measures included the number of total chest compressions, the proportion of appropriate chest compressions, and time without chest compressions during the 2-min test period. Time from starting the presentation to first chest compression and time from arriving at AED beside the participant to the first defibrillation were measured. Calls for 119 and AED, switching-on the AED, correct positioning of defibrillator pads, and assuring safety of the victim were also assessed by the instructors using the check list.

2.5 Statistical methods

The sample size was calculated for the number of appropriate chest compressions one year after the training based on previous reports,[12,20] and was assumed to be 81 times in the refresher training group and 48 times in the control group. Under the condition of an alpha error of 5% and a power of 80%, 53 subjects were needed per group. Projecting a 10% dropout, the sample size was estimated to be 120 subjects in total.

Analyses were performed on an intention-to-treat basis, but participants who were absent from the one-year-later evaluation test were not included in the analyses regardless of the participation to the refresher training. The data were compared across groups using chi-square test for categorical variables and Student's *t*-test for continuous variables. An analysis of covariance was conducted to adjust for sex and age. Analyses were performed using SPSS Ver.21J (IBM SPSS, Armonk, NY). A two-tailed value of $p<0.05$ was considered statistically significant.

2.6 Ethical considerations

All procedures were conducted according to the Declaration of Helsinki. The participants submitted written informed consent prior to participation. This study was approved by the Ethics Committees of Kyoto University Graduate School of Medicine (registration number E999).

3. Results

3.1 Flow and baseline characteristics

In total, 140 participants were enrolled in this study, and 71 and 69 were assigned to the refresher training group and the control group, respectively. Among those assigned to the refresher training group, 62 participants actually underwent the 15-min refresher training. One year later, 57 (80.3%) in the refresher training group and 55 (79.7%) in the control group were completely evaluated for their BLS skills (Fig. 1). The demographic data of the two groups are summarized in Table 1. There were no significant differences in sex ratio, age, previous CPR training, experience of actual CPR, and family history of sudden cardiac arrest between the groups. Although nine participants who did not attend the refresher training program in the refresher training group, their demographic data was not different from that of those who completed the study. Nineteen participants who did not attend the one-year-later evaluation test also did not have significantly different demographic data from those who completed the study.

3.2 Performance of BLS skills one year after training

Table 2 shows the participants' activation of emergency medical services (EMS) and their chest compression skills one year after the training. Among those whose CPR skills were tested, 55 (96.5%) in the refresher training group tried CPR, as opposed to 52 (94.5%) in the control group. The number of participants placing a 119 call was 46 (83.6%) in the refresher training group and 39 (75.0%) in the control group ($p=0.343$).

Fifty-two (94.5%) of those in the refresher training groups called for AED, while 43 (82.7%) in the control groups did so ($p=0.027$).

The number of total chest compressions was also significantly greater in the refresher training group than in the control group (182.0 ± 41.7 versus 142.0 ± 59.1, $p < 0.001$). The number of appropriate chest compressions performed during the 2-min test period was significantly greater (68.9 ± 72.3) in the refresher training group than in the control group (36.3 ± 50.8, $p = 0.009$). The proportion of appropriate chest compressions was significantly greater in the refresher training group than in the control group (38.3% ± 37.6% versus 27.5% ± 34.4%, $p = 0.009$). Time without chest compressions was significantly shorter in the refresher training group (16.1 ± 2.1 seconds versus 26.9 ± 3.7 seconds, $p < 0.001$). However there were no significant differences in time to first chest compression between the two groups (29.6 ± 16.7 seconds versus 34.4 ± 17.8 seconds, $p = 0.172$).

All participants attempted to use an AED. Specific of AED use including turning-on, pad-positioning, and area clearing were not significantly different between the groups.

4. Discussion

This is a randomized control trial to show the effectiveness of a very short refresher BLS training on longer-term CPR and AED skill retention in the general public. One year after the training, the number of total and appropriate chest compressions were both significantly greater in the refresher training group compared to the control group.

Our novel refresher BLS training was only 15 minutes in duration and focused entirely on the chest compressions and AED use, using the handy personal manikin. It is well accepted that hands-on training is effective for reinforcing the quality of CPR.[21,22] However, limited resources and time have been a barrier to more hands-on practice with a manikin,[23] leading to poor skill acquisition.[24] This is very important because a shorter length refresher training could be better accepted by both instructors and participants. Focusing on chest compressions and AED use and the use of a personal manikin could make this short training program more efficient and effective.

This study successfully suggested that a refresher BLS training program would help the general public retain their chest compression skills for up to one year. Previous studies suggested that CPR skills declined faster than expected,[25, 26] and that a repeated training course can obviously maintain CPR performance for a long time.[22,27] The CPR Guidelines recommend that skill performance should be reinforced more often with an interval of at most 12 to 24 months to maintain the quality of the rescuer's CPR. A previous study suggested that, in order to minimize skill decay, the recommended interval for refresher training should not be longer than seven months.[28] In addition, Wollard M et al. showed that frequent short intervals refreshers improved not only skills but also confidence.[29] Whilst Bohn A et al. reported that annual resuscitation training provided by trained teachers are effective and adequate in children aged 10 years.[30] The optimal timing for reassessment or reinforcement should be future discussed.[1]

Although this study demonstrated that a 15-min short refresher BLS training could maintain CPR and AED skills, CPR qualities including the number of appropriate chest compressions, chest compressions with appropriate depth, and chest compressions with correct hand position were not sufficient compared with the guideline-recommended levels regardless of the group. This suggests the need for more frequent and effective CPR training. The current program, which was scheduled and instructor-led, might still be inconvenient for both trainees and instructors, even though the refresher training course was short. Different approaches to skill retention, such as poster retraining with a manikin, [31,32] self-instruction using voice assistance with a manikin, [22,33] and mobile phone-based reminding have been attempted.[34] Further study initiatives with simpler, more cost-effective, unscheduled, and autonomous refresher training courses would be needed to improve CPR skill retention. In the next study, we plan to evaluate the effectiveness of a self-learning refresher training program.

In terms of AED operations, the participants generally used an AED well irrespective of refresher training. Our previous study also showed that 70% of the untrained citizens who were provided with a self-learning video before attending a BLS training course attempted to use an AED.[14] Gundry et al. reported that AEDs were safely and successfully operated by sixth-year pupils, who performed defibrillation in 90 seconds in a simulated resuscitation.[35] The operation of AED is rather simple and there is almost no skill deterioration.[29,36] In addition, the voice prompts of the AED can support lay rescuers to use it at the actual emergency scene.[37-39] However, the proportion of those who called for AED was significantly higher and the time to defibrillation tended to be shorter in the refresher group. In addition, we have to take into account the fact that we encouraged participant to use an AED in this study. Considering the clinically important rolls of AEDs and simplicity to train how to use an AED, AED training should be included in the refresher training program, even though the training program is short.

Our study has some limitations. First, the resuscitation skills were evaluated by a case-based scenario test, and resuscitation performance in the real setting where lay persons would easily panic was unknown. Second, data on further long-term retention and the effects of repetitive training were lacking. We are planning a study to evaluate the trainees’ BLS skills for regular refresher training programs (such as every 90 days). Third, there might be bias by the allocation because we did not blind training assignment. Moreover, to ensure the effectiveness of this refresher training program, we are planning to evaluate it in the real world, measuring the proportion of bystander CPR and survival after OHCA.

5. Conclusion

A short-time refresher BLS training program would make it possible to retain chest compressions skills for up to one year. Repeated BLS training would be adopted to keep the acquired CPR quality optimal. Further study is warranted to identify whether refresher training delivered with intervals shorter than 6 months may have benefits for chest compression and AED skill retention.

Conflict of interest

Taku Iwami is one of the developers of Mr.PUSH® and is an executive director of the non-profit organization Osaka Life Support Association, but has no financial conflict of interest to declare. The rest of the authors also have no conflict of interest to declare.

Role of funding source

This study was supported by a Grant-in-Aid for Health and Labour Sciences Research Grants (H24-Shinkin-001) from the Ministry of Health, Labour and Welfare.

Acknowledgements

We gratefully acknowledge Masaaki Matsumoto, Katsuharu Hirai, Keiji Akatsuka, Katsuo Ogura, Seiji Kasatani, Nobuyuki Iwai, Yasuyuki Shinkai, and Yuji Yamazaki for instructing in the CPR training program. We also thank all the faculty members of Kyoto University School of Public Health for their helpful comments on the study's design and data analyses, both of which were critical to the study's success.

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Legend to figure

Fig. 1. Participants flow.

Fig. 1. Participant flow.

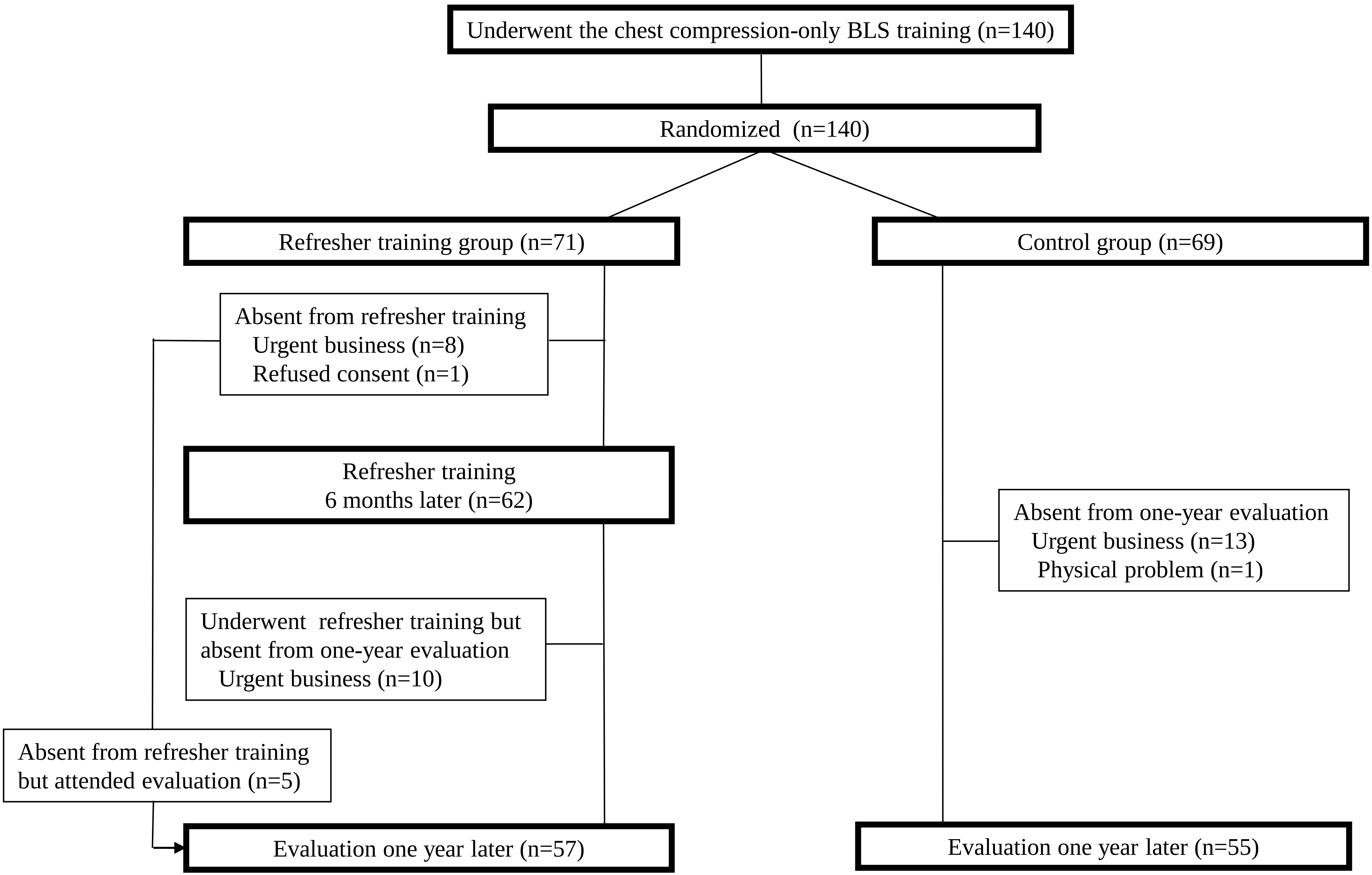

Table 1 Baseline characteristics of participants.

	Refresher training group (n=71)	Control group (n=69)	*p*- value
Men, n (%)	53 (74.6)	49 (71.0)	0.705
Age, yr, means ± SD	37.3 ± 13.8	38.4 ± 14.4	0.650
Previous CPR training, n (%)	28 (39.4)	32 (46.4)	0.495
Experience of actual CPR, n (%)	1 (1.4)	5 (7.2)	0.113
Family history of sudden cardiac death, n (%)	5 (7.0)	8 (11.6)	0.396

CPR denotes cardiopulmonary resuscitation; SD, standard deviation.

Table 2 BLS performance one year after training.

	Refresher training group (n=57)	Control group (n=55)	*p*- value
Activation of EMS, n (%)*			
Call for help (119)	46 (83.6)	39 (75.0)	0.343
Call for AED	52 (94.5)	43 (82.7)	0.027
Chest compressions during 2 minutes test period*			
Total chest compressions, n, means ± SD	182.0 ± 41.7	142.0 ± 59.1	<0.001
Appropriate chest compressions, n, means ± SD	68.9 ± 72.3	36.3 ± 50.8	0.009
Chest compressions with appropriate depth, n, means ± SD	121.9 ± 79.7	87.7 ± 71.9	0.025
Chest compressions with correct hand position, n, means ± SD	101.7 ± 80.3	65.9 ± 60.8	0.006
Chest compressions with appropriate recoil, n, means ± SD	179.7 ± 41.6	140.9 ± 58.1	<0.001
Proportion of appropriate chest compressions, %, means ± SD†	38.3 ± 37.6	27.5 ± 34.4	0.009
Resuscitation time course, sec, means ± SD*			
Time to chest compression	29.6 ± 16.7	34.4 ± 17.8	0.172
Time without chest compression during 2 min-test period	16.1 ± 2.1	26.9 ± 3.7	<0.001
AED operations			
Turn on the AED first, n (%)	36 (63.2)	36 (65.5)	0.845
Correct positioning of defibrillator pad, n (%)	53 (93.0)	49 (89.1)	0.524
Clear self and area, n (%)	49 (86.0)	41 (74.5)	0.209
Time to first defibrillation, sec, means ± SD	86.5 ± 15.1	93.5 ± 27.6	0.103

CPR denotes cardiopulmonary resuscitation; EMS, emergency medical services; 119, emergency call number in Japan; AED, automated external defibrillator; SD, standard deviation.

P-values were derived by analysis of covariance adjusting for sex and age for continuous variables.

* Data are available for those with chest compressions (n=55 (96.5%) in the refresher training group; n=52 (94.5%) in the control group, p=0.676).

† Proportion of appropriate chest compressions over total number of chest compressions.