Effects and Retention of Self-Re-Learning Using Video Recording of Advanced Life Support (ALS) On Nursing Students' Knowledge, Self-Efficacy, and Skills Performance

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Research article

Keywords: Advanced Life Support, retention of skills performance, nursing students

Posted Date: September 21st, 2020

DOI: https://doi.org/10.21203/rs.3.rs-68840/v1

Version of Record: A version of this preprint was published at BMC Nursing on March 31st, 2021. See the published version at https://doi.org/10.1186/s12912-021-00573-8.

Abstract

Background In-hospital cardiac arrests account for 80% of hospital deaths, and the survival rate is not significantly different from that of pre-hospitalized cardiac arrest patients. The nurses would presumably be the first to see an in-hospital cardiac arrest patient. This study proposed to measure nursing students' knowledge, self-efficacy, and skills performance of advanced life support (ALS) 6 months after the training by sending their videos taken during the final skills test after the ALS training.

Methods This is an experimental study with a randomized control group design. The participants' knowledge, self-efficacy, and skill performance of ALS were evaluated immediately after the training and participants were videotaped during the final skills test. Thereafter, we sent the video to the experimental group through the mobile phone messenger application once a month from the third month after training. Approximately six months after the training day, we conducted a follow-up test of the measured variables using the blinded method.

Results Six months after the ALS training, knowledge scores decreased significantly in both groups ($p<0.001$). Self-efficacy decreased by about 3 from 50.55 to 47.18 in the experimental group ($p = 0.089$), while it decreased by 10 in the control group from 50.67 to 39 ($p<0.001$). The skills performance decreased from 27.5 to 26.68 in the experimental group, while it decreased significantly from 27.95 to 16.9 in the control group ($p< 0.001$).

Conclusion Self-study with videos taken during an ALS skills test helps enhance the sustainable effects of training, such as knowledge, self-efficacy, and skills performance.

Introduction

The most common causes of death in Korea include malignant neoplasms, heart diseases, and cerebrovascular diseases. Among them, 62.4 per 100,000 people died due to heart diseases in 2016, which is steadily increasing to 43.8% compared to 43.4 in 2007 [1]. Particularly, due to ageing and increase in chronic diseases that cause cardiac arrest, the proportion of patients with acute cardiac arrest in 2006 was 38.7%, which increased to 50.2% in 2017 [2]. As the country undergoes rapid industrialization, heart diseases continue to increase due to the ageing, westernized eating habits, development of medical technology, chronic diseases, and various accidents. Such an increase in heart disease and ageing can increase the likelihood of sudden cardiac arrest [3]. Additionally, after successful resuscitation, it is often necessary to rely on others or require continuous treatment; therefore, applying appropriate cardiopulmonary resuscitation (CPR) to reduce mortality due to acute cardiac arrest is a very important issue as well as for individuals and families [3].

Cardiac arrest accounts for 80% of deaths in hospitals and survival rates are not significantly different from those in pre-hospital cardiac arrests [4]. In studies [5] conducted in tertiary medical institutions in Korea, the survival rate of cardiac arrest patients in the hospital for 24-hour survival and survival

discharge were 23.7% and 6.4%, respectively. These findings may be related to the healthcare provider's ability to perform CPR besides the patient's age and health status.

In-hospital cardiac arrest chains of survival in the 2015 Cardiopulmonary resuscitation guidelines recommended by the American Heart Association include the five-stage chain of cardiac arrest: early detection – rapid reporting – rapid cardiopulmonary resuscitation – rapid defibrillation – effective specialized cell and post-cardiac arrest integrated treatment [6]. Chances of brain injury begin about 4–5 minutes after cardiac arrest; therefore, the most important part of cardiac arrest is rapid CPR by the first witness [6]. Nurses are more likely to detect cardiac arrest early in their care by observing the patient's condition and its changes over 24 hours [7]. Therefore, the nurses' early response is crucial [8]. When cardiac arrest occurs in a hospital, Advanced Life Support (ALS), including Basic Life Support (BLS), monitor use, emergency medication, and advanced airway maintenance is performed [9]. During treatment, the necessity of defibrillation and the drugs to be administered vary depending on the electrocardiogram (ECG) rhythm [10, 11]. Therefore, nurses require ALS training. Specifically, nursing students who will become nurses in the future are more likely to face cardiac arrest patients for the first time; therefore, training them in ALS is essential [12].

Previous studies on the effects of ALS training revealed that simulation-based ALS training can improve nursing student's knowledge, critical thinking, and problem-solving [13, 14], and can also enhance their self-confidence and clinical performance [15]. However, three to six months after ALS training, the effect decreases [16, 17], and retraining is required to maintain the continuous effect of ALS training [18, 19]. Although prior studies have shown the effectiveness and persistence of ALS, most of these are cross-sectional studies that confirm the effects before and after education. Intervening research is needed to confirm the continuity of educational effects and to maintain knowledge, self-efficacy, and performance.

Therefore, this study compared the continuous effects of ALS training by measuring the nursing students' knowledge, self-efficacy, and skills performance of ALS immediately after the training and 6 months after the training.

Methods

Design and Setting

This experimental study, with a randomized control-group pretest-posttest design, verified the sustained effects of the Korean Advanced Life Support (KALS) training on the nursing students' knowledge, self-efficacy, and skill performance of ALS.

Subjects

The study participants were 4th-grade students of the Department of Nursing at K University, who met the following inclusion criteria: 1) understands the research purpose, participates voluntarily, and agrees to shoot videos, 2) has completed the BLS training of the American Heart Association as a final grade

student, 3) who participated voluntarily in the KALS training of the KACPR and agreed to shoot videos, and 4) who uses a mobile phone messenger application that can send videos. Participants who refused to shoot videos or had already completed the Advanced Cardiovascular Life Support Provider Course (ACLS) of the American Heart Association were excluded from this study because of differences in the parameters to be measured.

Sample

The number of study participants was calculated using the G-Power (ver. 3.1.9 for Mac) program. For t-test, a statistical method used for comparing the means of two groups, the minimum number of participants was 21 per group. Therefore, considering the dropout rate of 25 per county based on a similar prior study25 per group were selected for each [20, 21]. Allocation concealment was applied to the experimental and control groups and we did not inform the participants which group they belonged to until posttest. After the posttest, the control group were also sent their video of the final skills test through the mobile messenger application.

KALS provider course

KALS Training is an ALS training program developed by Korean Association of Cardiopulmonary Resuscitation (KACPR) ALS committee since factors, such as long training hours and expensive training costs of American Heart Association (AHA)'s ACLS Provider Course obstructs the spread of education. This training is a one-day (five to six-hour) course wherein the knowledge and skills required for first aid treatment of cardiac arrest patients in hospitals or ambulances is provided.

Measuring tools

ALS knowledge

The ALS knowledge measuring tool was developed by the researcher based on the contents of the ACLS provider manual and the 3rd edition of the KALS textbook by the KACPR KALS committee. The validity of the knowledge was evaluated by one emergency physician, two ACLS and KALS instructors, two nurses with more than 10 years of emergency room experience, and two nursing professors. All items had a Content Validity Index (CVI) of 0.8 or higher. It comprised 4 questions on BLS, 5 on ECG recognition, 4 on Teamwork, 4 on ACLS, and 3 on post cardiac arrest care (PCAC).

ALS self-efficacy

In this study, resuscitation self-efficacy [22] was measured by ALS self-efficacy using a modified and supplemented tool. The revised tool comprised 12 questions, including 2 questions on BLS, 3 on ECG recognition, 2 on teamwork, 3 on ALS, and 2 on PCAC. Each item had a five-point Likert scale with 5 points for 'very confident' and 1 point for 'very unconfident'. The higher the score, the higher the self-efficacy for professional resuscitation. The tool's internal reliability at the time of development was Cronbach's alpha value of 0.91 [22] and 0.87 in this study.

ALS skills performance

The Training of In-hospital Cardiac Arrest (TROICA) checklist of KALS committee, developed for the KALS provider course, was used after obtaining the KACPR ALS committee's consent to measure ALS skills. The TROICA, a measurement tool for KALS skills, comprised 15 questions, including 2 questions on BLS skills, 3 on teamwork, 3 on ALS algorithms, 5 on cardiac arrest cognition and appropriate treatment instructions, and 2 on post-cardiac care. Each question was scored two, one, and zero points for correct, insufficient, and incorrect performance, respectively.

Procedure

The study process followed the CONSORT 2010 Guidelines [23]. Immediately after ALS training, all the participants were surveyed for ALS knowledge and self-efficacy and evaluated for ALS skills performance. The process of their ALS skills test was recorded. Subsequently, participants were randomly assigned to the experimental and control groups using a blocked randomization method. Block randomization is a method designed to prevent imbalances in the number of experimental and control groups that can occur in simple randomization and is generally used when the sample size is small [24]. Referring to the previous study [17] that found ALS knowledge, ALS self-efficiency, and ALS skills performance to be greatly reduced after three to six months of ALS training, and another study [25] that found a meaningful decrease in ALS knowledge and ALS skills performance three months after ALS training, the participant's recorded video of their skills test process was sent to the experimental group through a mobile messenger application once a month from the third month after training while no arbitration was conducted on the control group. About six months after the date of the initial training, two evaluators participated in the evaluation in the same way as and conducted a post-test of measurement variables without knowing the experimental and control groups.Figure 1 present the flow chart of the research process.

Ethical consideration

This study was approved by the Institutional Review Board Committee of the hospital to which the first author belongs (IRB approval number: 20180518 / 20-2017-33 / 062). The participants were explained the purpose and procedures of the study and informed consent were obtained written consent from voluntary participants. Considering the ethical aspect, the recorded video of their ALS skills test process was also sent to the control group after the study.

Statistical analysis

Collected data were analysed using SPSS 24.0 (for Windows), and the selected statistical significance level for hypothesis testing was $p<0.05$. The general characteristics of the experimental and control groups were analysed using descriptive statistics of frequency, percentage, mean, and standard deviation. To test the normality of the measured variables, the participants were analysed using the Shapiro-Wilk test, which is mostly used for 3 to 50 participants [26]. The *t*-test and Mann-Whitney U test

were used to verify the general characteristics of the experimental and control groups and the homogeneity of the dependent variables before the experiment. To confirm the pre-post change of the experimental group and the control group, the normal distribution was analysed by paired t-test and the non-normal distribution was analysed by using the Wilcoxon signed-rank test. The reliability of the measurement tool was analysed using Cronbach's alpha.

Results

General characteristics of participants and homogeneity test of experimental and control groups

Three of the 25 participants in the experimental group failed to follow up on a personal schedule, and four of the 25 participants in the control group dropped out of contact. Therefore, the analysis included 22 and 21 participants in the experimental and control groups, respectively (Fig. 1). There was no significant difference in the experimental group and control group homogeneity test for general characteristics, including gender, age, average grades, nursing degree satisfaction, and university life satisfaction (Table 1).

Table 1
Homogeneity Test of General Characteristics

Characteristics		Exp. (n = 22)	Cont. (n = 21)	X^2 or F	*p*
		n (%) or mean ± SD	n (%) or mean ± SD		
Gender	Male	5(22.7)	2(9.5)	1.374	0.412
	Female	17(77.3)	19(90.5)		
Age(year)	Under 22	13(59.1)	16(76.2)	0.304	0.694
	22 years or older	9(40.9)	5(23.8)		
	mean ± SD	22.82 ± 4.25	22.3 ± 5.33		
Average Credits	Under 3.0	1(4.5)	1(4.8)	0.75	0.687
	3.0 ~ 3.9	18(81.8)	15(71.4)		
	4.0 or higher	3(13.6)	5(24.8)		
Satisfaction of Nursing	Under 60	4(18.2)	1(4.8)	0.027	0.353
	60 ~ less than 80	10(45.5)	11(52.4)		
	80 or higher	8(36.3)	9(42.8)		
	mean ± SD	67.73 ± 11.10	70.95 ± 10.44		
Satisfaction of College life	Under 60	4(18.2)	1(4.8)	0.095	0.14
	60 ~ less than 80	13(59.1)	14(66.6)		
	80 or higher	5(22.7)	6(28.6)		
	mean ± SD	73.18 ± 12.87	75.71 ± 12.07		

Normality and homogeneity test of experimental and control groups

In the Shapiro-Wilk test of normality, the sub-items of ALS knowledge and ALS skills performance did not show a normal distribution; however, the sub-items of ALS self-efficacy showed a normal distribution. The homogeneity test using the Mann-Whitney U test and t-test showed that the average score in the ALS knowledge ($p = .041$) of the experimental group (3.09) was lower than that of the control group (3.48). Additionally, there were no significant differences in knowledge scores, self-efficacy, and skills performance, ensuring homogeneity between both groups (Table 2).

Table 2
Homogeneity Test of Dependent Variables

Variable		Experimental group		Control group		t/Z	*p*
		Mean	SD	Mean	SD		
Knowledge	BLS	3.77	0.429	3.86	0.359	-0.703	0.482
	ECG Recognition	3.95	0.653	4.1	0.7	-0.917	0.359
	Teamwork	3	0.535	3	0.707	0	1
	ACLS	3.09	0.61	3.48	0.602	-2.044	.041*
	PCAC	2.73	0.456	2.71	0.463	-0.094	0.925
	Total	16.68	1.129	17.19	1.078	-1.545	0.122
Self-Efficacy	BLS	12.64	1.364	12.29	1.231	-0.751	0.453
	ECG Recognition	8.32	1.323	8.48	0.981	-0.191	0.848
	Teamwork	12.5	1.793	12.86	1.459	-0.811	0.417
	ACLS	8.41	1.26	8.38	1.071	-0.038	0.97
	PCAC	8.64	1.217	8.86	0.964	-0.494	0.621
	Total	50.55	6.085	50.67	4.83	-0.072	0.943
Skill Performance	BLS	4	.000a	4	.000a	0	1
	ECG recognition	5	0.756	5.33	0.913	-1.727	0.084
	Teamwork	5.64	0.727	5.76	0.625	-0.681	0.496
	ACLS	9.27	0.767	9.14	0.854	-0.445	0.656
	PCAC	3.5	0.598	3.71	0.463	-1.211	0.226
	Total	27.5	0.74	27.95	1.071	-1.306	0.192

Comparison of dependent variables immediately and 6 months after training of experimental and control groups

Table 3 shows the differences between the experimental and control groups' knowledge, self-efficacy, and skills performance immediately after and six months after training. Regarding the total knowledge score, the experimental group's pretest score (16.68) showed a statistically significant decrease than the posttest score (15.32) ($p = .001$), and the control group's pretest score (17.19) also showed a significant decrease compared to the posttest score (14.67) ($p < .000$). Self-efficacy scores and skills performance scores were reversed. Regarding the total self-efficacy score, the test group's pretest score (50.55) was not significantly decreased compared with the posttest score (47.18), but the control group's pretest score (50.67) was significantly decreased compared with the posttest score (39). Regarding the skills

performance score, the pretest score of the experimental group (27.5) was not significantly decreased compared to the posttest score (26.68), but the pretest score of the control group (27.95) was significantly lower than the posttest score (16.9).

Table 3

Comparison of Variables between Experimental and Control Groups after 6 Months of Training

Variables		Experimental group		Control group		t/Z	*p*
		Mean	SD	Mean	SD		
Knowledge	BLS	3.32	.646	3.05	.498	-1.606	.108
	ECG recognition	4.00	.756	3.76	.944	− .773	.439
	Teamwork	2.45	.739	2.57	.978	− .291	.771
	ACLS	3.14	.640	2.62	.921	-1.905	.057
	PCAC	2.50	.598	2.67	.577	-1.061	.289
	Total	15.32	1.460	14.67	1.278	-1.401	.161
Self-efficacy	BLS	12.36	1.814	10.48	2.581	-3.125	.002**
	ECG recognition	7.55	1.711	6.38	2.037	-1.882	.060
	Teamwork	11.73	2.028	9.05	3.138	3.341	.002**
	ACLS	7.50	1.655	5.90	2.385	-2.325	.020*
	PCAC	8.05	1.495	7.19	1.692	-2.025	.043*
	Total	47.18	7.719	39.00	10.918	2.848	.007**
Skill performance	BLS	3.86	.468	2.52	.981	-4.776	.000**
	ECG recognition	5.59	.503	3.62	1.024	-5.250	.000**
	Teamwork	5.23	1.066	1.67	.658	-5.711	.000**
	ACLS	8.68	1.729	6.81	1.537	-3.481	.000**
	PCAC	3.32	.716	2.24	.768	-4.123	.000**
	Total	26.68	3.107	16.90	3.520	-5.267	.000**

BLS: Basic Life Support, ECG: Electrocardiogram, ACLS: Advanced Cardiovascular Life Support, PCAC: Post Cardiac Arrest Care, SD: Standard Deviation.

Comparison of dependent variables 6 months after training between experimental and control groups

The knowledge, self-efficacy, and skills performance of the experimental and control groups were examined six months after the training. In the total score, the experimental group scored higher than the control group; however, there was no significant difference in the sub-items. In the self-efficacy score, the experimental group was higher than the control group in all the sub-items. ECG reading of the sub-items was higher in the experimental group (7.55) than in the control group (6.38), but there was no significant difference ($p = .06$). However, the other sub-items included BLS: 12.36 vs. 10.48, Teamwork: 11.73 vs. 9.05, ACLS: 7.50 vs. 5.90, PCAC: 8.05 vs. 7.19, and Total: 47.18 vs. 39. With 39.00, the experimental group was significantly higher than the control group ($p = .002$, $p = .002$, $p = .02$, $p = .043$, and $p = .007$). In the skills performance score, the experimental group was higher than the control group in all the sub-items ($p < .001$) (Table 4; Fig. 2).

Table 4
Differences between Pre-test and Post-test in Experimental Group and Control Group

Variable			Pre-test		Post-test		t/Z	p
			Mean	SD	Mean	SD		
Knowledge	BLS	Exp.	3.77	0.429	3.32	0.646	-2.352	.019*
		Cont.	3.86	0.359	3.05	0.498	-3.69	.000**
	ECG recognition	Exp.	3.95	0.653	4	0.756	-0.233	0.816
		Cont.	4.1	0.7	3.76	0.944	-1.393	0.163
	Teamwork	Exp.	3	0.535	2.45	0.739	-2.546	.011*
		Cont.	3	0.707	2.57	0.978	-1.651	0.099
	ACLS	Exp.	3.09	0.61	3.14	0.64	-0.258	0.796
		Cont.	3.48	0.602	2.62	0.921	-2.797	.005**
	PCAC	Exp.	2.73	0.456	2.5	0.598	-1.387	0.166
		Cont.	2.71	0.463	2.67	0.577	-0.302	0.763
	Total	Exp.	16.68	1.129	15.32	1.46	-3.256	.001**
		Cont.	17.19	1.078	14.67	1.278	-3.715	.000**
Self-efficacy	BLS	Exp.	12.64	1.364	12.36	1.814	-0.461	0.645
		Cont.	12.29	1.231	10.48	2.581	-2.702	.007**
	ECG recognition	Exp.	8.32	1.323	7.55	1.711	1.771	0.091
		Cont.	8.48	0.981	6.38	2.037	-3.438	.001**
	Teamwork	Exp.	12.5	1.793	11.73	2.028	-1.549	0.121
		Cont.	12.86	1.459	9.05	3.138	-3.839	.000**
	ACLS	Exp.	8.41	1.26	7.5	1.655	-1.907	0.057
		Cont.	8.38	1.071	5.9	2.385	-3.297	.001**
	PCAC	Exp.	8.64	1.217	8.05	1.495	-1.34	0.18
		Cont.	8.86	964	7.19	1.692	-3.349	.001**
	Total	Exp.	50.55	6.085	47.18	7.719	1.781	0.089
		Cont.	50.67	4.83	39	10.918	4.489	.000**
Skill performance	BLS	Exp.	4	.000a	3.86	0.468	-1.342	0.18
		Cont.	4	.000a	2.52	0.981	-3.8	.000**
	ECG recognition	Exp.	5	0.756	5.59	0.503	-2.372	.018*
		Cont.	5.33	0.913	3.62	1.024	-3.69	.000**
	Teamwork	Exp.	5.64	0.727	5.23	1.066	-2.07	.038*
		Cont.	5.76	0.625	1.67	0.658	-4.084	.000**
	ACLS	Exp.	9.27	0.767	8.68	1.729	-1.312	0.19
		Cont.	9.14	0.854	6.81	1.537	-3.662	.000**
	PCAC	Exp.	3.5	0.598	3.32	0.716	-0.775	0.439
		Cont.	3.71	0.463	2.24	0.768	-3.919	.000**
	Total	Exp.	27.5	0.74	26.68	3.107	-1.021	0.307
		Cont.	27.95	1.071	16.9	3.52	-4.021	.000**

Discussion

This study verified the effectiveness and retention of nursing students after ALS training. Consequently, the experimental group that received the video showed higher persistence in knowledge, self-efficacy, and skills performance than the control group. Based on these results, the ways to increase and maintain the effectiveness of ALS training are discussed.

In a study [27] evaluating BLS and ACLS knowledge of healthcare providers, the average score of participants did not exceed 50%. However, healthcare providers with BLS or ACLS training had higher knowledge scores than those without training. Therefore, ALS training can improve knowledge scores. For nursing and medical school students, a study [17] measuring knowledge scores immediately after, after

3–6 months, and after 6–9 months, using traditional ACLS training and high fidelity mannequins showed that knowledge scores measured after 3–6 months and 6–9 months were reduced, respectively, compared to knowledge scores immediately after training. Additionally, a study [28] comparing the existing and high-fidelity simulations on the persistence effect of ACLS knowledge among medical students also reported that ACLS knowledge scores decreased significantly after one year compared to immediately after training. In the results of this study, the knowledge score measured after 6 months decreased in both the control group and the experimental group, but the experimental group showed a smaller decrease than the control group. These results are similar to a previous study [14] on nursing students in which the control and experimental groups underwent traditional lecture-based ACLS training and simulation-based ACLS training, respectively. The simulation training was more effective in acquiring and maintaining ACLS knowledge than lecture-based education. In a study [29] measuring knowledge 2 weeks and 8 weeks after ACLS training for nurses in the emergency department, knowledge retention decreased eventually. The authors emphasized that knowledge retention could be increased through simulation-based re-learning after the ACLS training. Reduction of knowledge after ACLS training is considered to be a natural result over time, and a renewal education program is necessary to maintain knowledge retention. Additionally, it may be possible to consider ways to maintain the knowledge level through newsletters and email notifications.

Self-efficacy is an individual's belief in her/his ability to perform a specific task or activity [30]. Simulation-based ACLS training can increase self-efficacy for ACLS skills performance. In a study [31] measuring the self-efficacy before and after simulation-based ACLS training undertaken by medical students, the self-efficacy increased significantly after the training. Furthermore, the experimental [14] group showed a significantly higher self-efficacy than the control group in a study comparing the experimental group with the simulation-based ACLS training and the control group with the traditional lecture-based resuscitation training. However, the persistence of self-efficacy was found to decrease significantly over time [17]. In a study [32] comparing healthcare efficacy immediately after and 6 months after PALS (Pediatric Advanced Life Support) training of healthcare providers, self-efficacy measured after 6 months was significantly reduced compared to immediately after training. Additionally, in a study [33] comparing nursing students immediately after and 3 months after BLS training, self-efficacy decreased significantly after 3 months.

The self-efficacy of nursing students can be determined by the ongoing interaction between cognitive, behavioral, and environmental factors [34]. The self-efficacy measured immediately after the training in this study was not different between the control group and the experimental group. Although the self-efficacy measured 6 months after the training was not significantly decreased in the experimental group, it was significantly decreased in the control group. These results suggest that they could have re-learned their knowledge and skills of ACLS by watching their skills test videos, and this could improve their retention of self-efficacy.

Simulation-based ALS training is difficult to improve skills performance based on previous studies. However, this performance ability decreases rapidly over time [25]. Only 30% of the nurses passed the

skills test measured 3 months after ALS training [35], and another studies [36, 37] reported a decrease in ALS skills performance 6 months after ALS training. Furthermore, a systematic literature review of retention of skills performance after healthcare providers' ALS training showed a decrease in skills performance between 6 months and 1 year after training [38]. On comparing the skills performance of the control group, that had no intervention in this study, immediately after and 6 months after training, the skills performance measured 6 months after training decreased significantly. As such, skills performance begins to decline between three and six months and appears to decrease significantly after one year. As a method of retaining these skills performance, iterative simulation-based ALS training can improve the retention of skills [38, 39]. After six months of clinical experience, training results showed a longer-lasting effect on skills performance than those without clinical experience [38, 40]. Moreover, in ACLS training, practicing for a 2-minute cycle similar to the actual time resulted in higher skills performance measured 3 months later compared to short training [41].

In this study, the experimental group was sent a video of their process of final skills test three months later, a relatively simple and cost-effective method, to retrain themselves. Six months later, the experimental group that received the video had better retention of skills performance than the control group. This video delivery method can increase the retention of skills performance and retraining time. Timely reminders to participants who have received ALS training will be required for self-retraining.

Limitations

This study is a randomized control study; however, there are some limitations. First, this study's results are difficult to generalize because the sample size was small and the experiment was conducted in one institution. Second, since the same standardized tool was used at each data collection point, participants could have possibly remembered previous answers. Lastly, this local cross-sectional study of nursing students cannot be generalized in Korea. Still, further trials are needed to improve retention of ACLS knowledge, self-efficacy, and skills performance.

Conclusion

Our study showed that sending videos to the nursing students of their process of final skills test between 3–6 months after training, a relatively simple and cost-effective method after ALS training, to induce self-learning can be effective in retaining knowledge, self-efficiency, and skills performance for ALS. Further studies should confirm the proper timing of sending the video. Replication studies are needed to reconfirm these findings.

Abbreviations

ALS: advanced life support

CPR: cardiopulmonary resuscitation

BLS: basic life support

ECG: electrocardiogram

KALS: Korean advanced life support

ACLS: advanced cardiovascular life support

KACPR: Korean Association of Cardiopulmonary Resuscitation

AHA: American Heart Association

CVI: Content Validity Index

PCAC: post cardiac arrest care

TROICA: Training of In-hospital Cardiac Arrest

Declarations

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgements

The authors would like to acknowledge school of nursing of Kangdong University for providing us the necessary training room and equipment.

Funding

There is no funding for this study. All data collection and analysis fees were paid by the autyhers.

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Contributions

K and JYconceived designed the study, K and SH analysed the data, and K wrote the manuscript. Ja Young and Ji Yeon gathered this study subjects, evaluated them and collected data. K and SH were involved in the interpretation of the data and contributed to manuscript preparation. Ja Young and Ji Yeon involved in title selection, data analysis, drafting of the manuscrip, approved the final manucript.

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Ethics declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board Committee of the hospital to which the first author belongs. The participants were explained the purpose and procedures of the study and we informed consent were obtained written consent from voluntary participants. Considering the ethical aspect, the recorded video of their ALS skills test process was also sent to the control group after the study.

Consent to publish

Not applicable.

Competing interests

All the authers declare that they have no competing interests.

References

1. Shin HY, Lee JY, Kim JE, Lee S, Youn H, Kim H, Lee J, Park MS, Huh S: **Cause-of-death statistics in 2016 in the Republic of Korea**. *J Korean Med Assoc* 2018, **61**(9):573-584.
2. Song MK, Kwon Y, Kim YT: **Noncommunicable disease field management training program: its progress and outcomes over the past 12 years**. *Public Health Weekly Report* 2018, **11**(13):392-400.
3. Lee MJ, Rho TH, Kim H, Kang GH, Kim JS, Rho SG, Park HK, Oh DJ, Oh S, Wi J *et al*: **Part 3. Advanced cardiac life support: 2015 Korean Guidelines for Cardiopulmonary Resuscitation**. *Clin Exp Emerg Med* 2016, **3**(0):S17-S26.
4. Sandroni C, Nolan J, Cavallaro F, Antonelli M: **In-hospital cardiac arrest: incidence, prognosis and possible measures to improve survival**. *Intensive Care Medicine* 2007, **33**(2):237-245.

5. Eo EK, Jang HY, Cheon YJ, Jung KY, Sohn DS, Cho DY, Yang KM: **Outcome of Cardiopulmonary Resuscitation for In-hospital Cardiac Arrest in a Tertiary Emergency Department**. *Journal of The Korean Society of Emergency Medicine* 2002, **13**(3):312-318.
6. Kleinman ME, Brennan EE, Goldberger ZD, Swor RA, Terry M, Bobrow BJ, Gazmuri RJ, Travers AH, Rea T: **Part 5: Adult Basic Life Support and Cardiopulmonary Resuscitation Quality**. *Circulation* 2015, **132**(18_suppl_2):S414-S435.
7. Kim S-S, Kim B-J: **Outcomes of In-hospital Cardiopulmonary Resuscitation according to the In-hospital Utstein Style in a General Hospital**. In*: 2005*: Korean Society of Nursing Science; 2005: 37-37.
8. Shever LL: **The Impact of Nursing Surveillance on Failure to Rescue**. *Res Theory Nurs Pract* 2011, **25**(2):107-126.
9. Craig-Brangan KJ, Day MP: **Update: 2015 AHA BLS and ACLS guidelines**. *Nursing2020* 2016, **46**(2):40-45.
10. Nickasch B, Marnocha S, Grebe L, Scheelk H, Kuehl C: **'What Do I Do Next?' Nurses' Confusion and Uncertainty with ECG Monitoring**. *Medsurg Nurs* 2016, **25**(6):418-422.
11. Pozner C: **Advanced cardiac life support (ACLS) in adults**. *UpToDate Waltham, MA2015* 2015.
12. Powers S, Claus N, Jones AR, Lovelace MR, Weaver K, Watts P: **Improving Transition to Practice: Integration of Advanced Cardiac Life Support Into a Baccalaureate Nursing Program**. *Journal of Nursing Education* 2019, **58**(3):182-184.
13. Cho GY: **Effects of a Simulation-based education on Cardiopulmonary Emergency Care Knowledge, Critical Thinking and Problem solving ability in Nursing Students.***Journal of Fisheries and Marine Sciences Education* 2016, **28**(2):439-449.
14. Tawalbeh LI, Tubaishat A: **Effect of simulation on knowledge of advanced cardiac life support, knowledge retention, and confidence of nursing students in Jordan**. *Journal of Nursing Education* 2013, **53**(1):38-44.
15. Jung HJ, Chae MJ: **Effect of simulation-based advanced cardiopulmonary life support education for nursing students hospitals**. *The Korean Journal of Health Service Management* 2015, **9**(3):127-143.
16. Jung GS, Oh HM, Choi G: **The implication and persistence effect of CPR education on female nursing students' knowledge, attitude, confidence and skills in performing CPR**. *Journal of the Korea Academia-Industrial cooperation Society* 2013, **14**(8):3941-3949.
17. Settles J, Jeffries PR, Smith TM, Meyers JS: **Advanced cardiac life support instruction: do we know tomorrow what we know today?***The Journal of Continuing Education in Nursing* 2011, **42**(6):271-279.
18. Bender J, Kennally K, Shields R, Overly F: **Does simulation booster impact retention of resuscitation procedural skills and teamwork?***Journal of Perinatology* 2014, **34**(9):664-668.
19. Delasobera BE, Goodwin TL, Strehlow M, Gilbert G, D'Souza P, Alok A, Raje P, Mahadevan SV: **Evaluating the efficacy of simulators and multimedia for refreshing ACLS skills in India**. *Resuscitation* 2010, **81**(2):217-223.

20. Jeong KI, Choi JY: **Effect of Debriefing Based on the Clinical Judgment Model on Simulation Based Learning Outcomes of End-of-Life Care for Nursing Students: A Non-Randomized Controlled Trial**. *J Korean Acad Nurs* 2017, **47**(6):842-853.
21. Kang H, Yeon K, Han ST: **A Review on the Use of Effect Size in Nursing Research**. *Journal of Korean Academy of Nursing* 2015, **45**(5):641-649.
22. Roh YS, Issenberg SB, Chung HS, Kim SS: **Development and Psychometric Evaluation of the Resuscitation Self-efficacy Scale for Nurses**. *Journal of Korean Academy of Nursing* 2012, **42**(7):1079-1086.
23. Schulz KF, Altman DG, Moher D, the CG: **CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials**. *BMC Medicine* 2010, **8**(1):18.
24. Schulz KF, Grimes DA: **Allocation concealment in randomised trials: defending against deciphering**. *The Lancet* 2002, **359**(9306):614-618.
25. Hsieh MJ, Yang CW, Chiang WC, Wang HC, Lin HY, Hsu SH, Chen W, Chong KM, Fang CC, Ma MHM: **The effects of different retraining frequency of simulation-based short advanced life support training on health professionals**. *Resuscitation* 2015, **96**:90.
26. Shapiro SS, Wilk MB: **An Analysis of Variance Test for Normality (Complete Samples)**. *Biometrika* 1965, **52**(3/4):591-611.
27. Nambiar M, Nedungalaparambil NM, Aslesh OP: **Is current training in basic and advanced cardiac life support (BLS & ACLS) effective? A study of BLS & ACLS knowledge amongst healthcare professionals of North-Kerala**. *World journal of emergency medicine* 2016, **7**(4):263.
28. Lo BM, Devine AS, Evans DP, Byars DV, Lamm OY, Lee RJ, Lowe SM, Walker LL: **Comparison of traditional versus high-fidelity simulation in the retention of ACLS knowledge**. *Resuscitation* 2011, **82**(11):1440-1443.
29. Campbell D, Clark PC: **An Initiative Using Simulation to Aid in Retention of Advanced Cardiac Life Support Knowledge and Skills in an Emergency Department Nurse Residency Program**. *Dimensions of Critical Care Nursing* 2020, **39**(1):33-38.
30. LAREW C, LESSANS S, SPUNT D, FOSTER D, COVINGTON BG: **INNOVATIONS IN CLINICAL SIMULATION: Application of Benner's Theory in an Interactive Patient Care Simulation**. *Nursing Education Perspectives* 2006, **27**(1):16-21.
31. Bors KP, Drake EA, Fields SA: **Assessing medical student self-efficacy following cardiopulmonary emergency simulation training**. *West Virginia Medical Journal* 2016, **112**:52+.
32. Stellflug SM, Lowe NK: **The effect of high fidelity simulators on knowledge retention and skill self efficacy in pediatric advanced life support courses in a rural state**. *Journal of pediatric nursing* 2018, **39**:21-26.
33. Partiprajak S, Thongpo P: **Retention of basic life support knowledge, self-efficacy and chest compression performance in Thai undergraduate nursing students**. *Nurse Education in Practice* 2016, **16**(1):235-241.
34. Bandura A, Walters RH: **Social learning theory**, vol. 1: Prentice-hall Englewood Cliffs, NJ; 1977.

35. Smith KK, Gilcreast D, Pierce K: **Evaluation of staff's retention of ACLS and BLS skills**. *Resuscitation* 2008, **78**(1):59-65.
36. Bukiran A, Erdur B, Ozen M, Bozkurt AI: **Retention of nurses' knowledge after basic life support and advanced cardiac life support training at immediate, 6-month, and 12-month post-training intervals: a longitudinal study of nurses in Turkey**. *Journal of Emergency Nursing* 2014, **40**(2):146-152.
37. Semeraro F, Signore L, Cerchiari EL: **Retention of CPR performance in anaesthetists**. *Resuscitation* 2006, **68**(1):101-108.
38. Yang C-W, Yen Z-S, McGowan JE, Chen HC, Chiang W-C, Mancini ME, Soar J, Lai M-S, Ma MH-M: **A systematic review of retention of adult advanced life support knowledge and skills in healthcare providers**. *Resuscitation* 2012, **83**(9):1055-1060.
39. Wayne DB, Butter J, Siddall VJ, Fudala MJ, Linquist LA, Feinglass J, Wade LD, McGaghie WC: **Simulation-based training of internal medicine residents in advanced cardiac life support protocols: a randomized trial**. *Teaching and learning in medicine* 2005, **17**(3):202-208.
40. Jensen ML, Lippert F, Hesselfeldt R, Rasmussen MB, Mogensen SS, Jensen MK, Frost T, Ringsted C: **The significance of clinical experience on learning outcome from resuscitation training—a randomised controlled study**. *Resuscitation* 2009, **80**(2):238-243.
41. Krogh KB, Høyer CB, Østergaard D, Eika B: **Time matters–Realism in resuscitation training**. *Resuscitation* 2014, **85**(8):1093-1098.

Figures

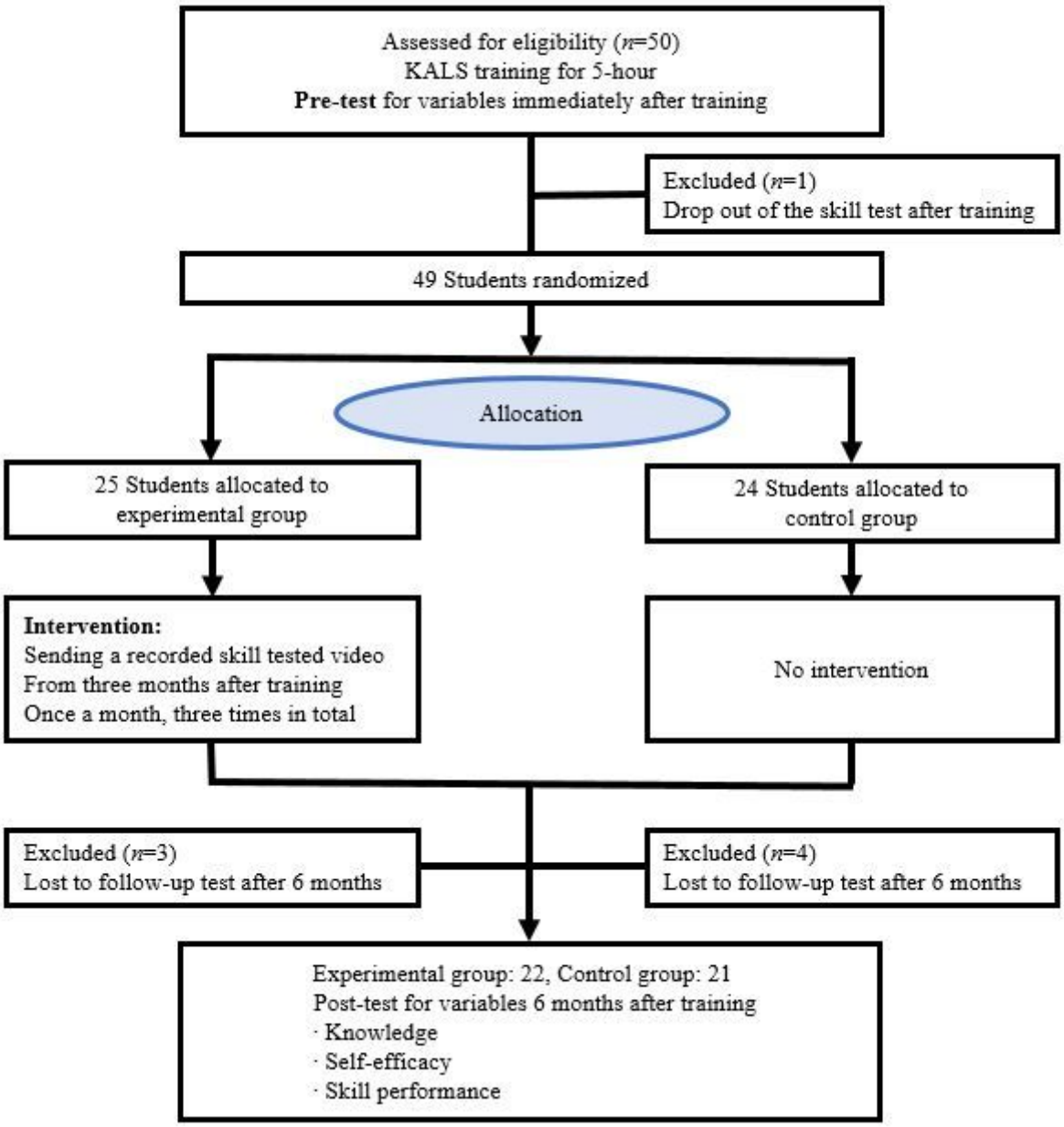

Figure 1

Study process

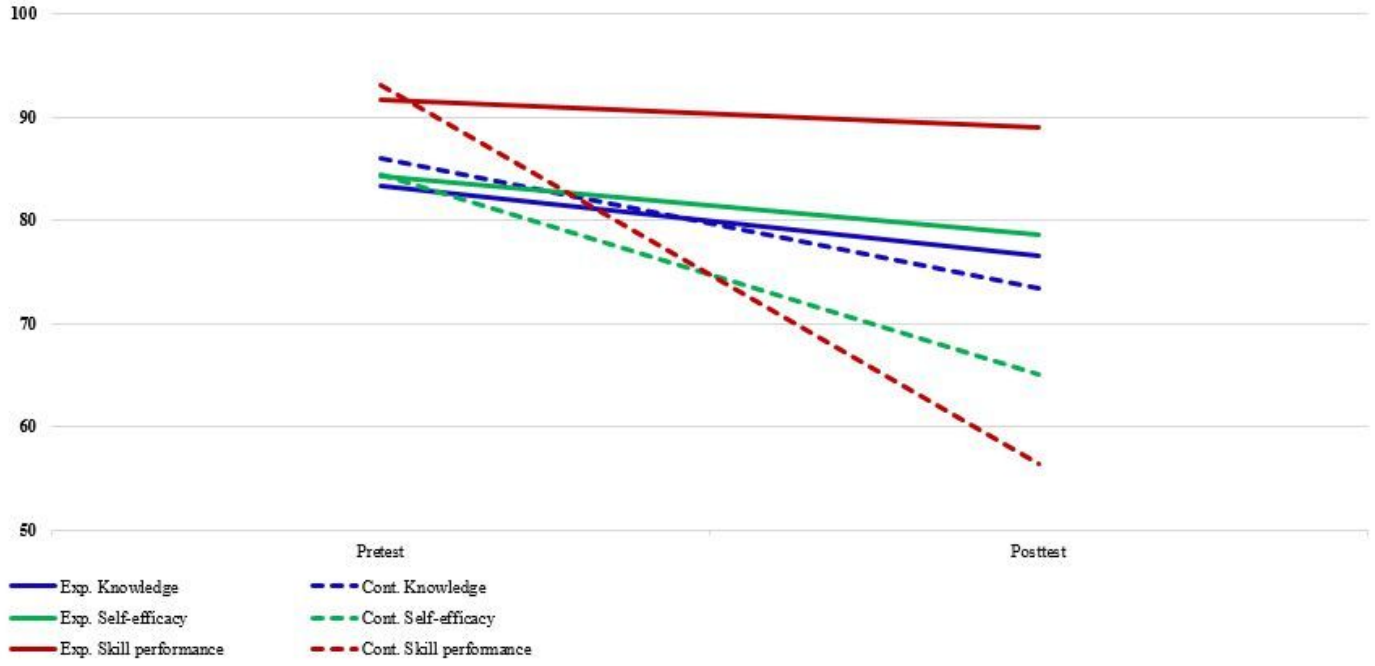

Figure 2

Differences of variables between the pre-test and post-test in both groups; in the skills performance and self-efficacy score, the experimental group was higher than the control group 6 months after the training. However, in the knowledge score, there was no significant difference between the pre-test and post-test in both groups.