Effectiveness Of Simulation-Based Training Program In Basic LifeSupport On Healthcare Workers' Knowledge And Practice

Mohammed Essa Saeed Masri[1]*, Ali Moaed Alqarni[2], Alwa Mouidh Alqarni[3], Abdulmajeed Faris Alotaibi[4], Gabbal Abdullah M Almowallad[5], Abdullah Mualla Alhabedi[6], Abdullah Jaber Abdullah Almouwaled[7], Manal Heijaij Hamdan[8], Naeem Essa Saeed Masri[9], Hussain Abdulrhman Abdusttar Dennah[10], Sharifa Muidh Algarni[11], Aisha Zayed Turky[12], Faisal Mohammed Al-Harbi[13], Bandar Abdulqader Mahmoud[14], Mataeb Mjari Alotaibi[15], Naeem Mualla Hindi Alhubaydi[16], Bandar Saad Alhartèe[17], Ali Ahmed Al-Sheikhi[18]

[1*]Senior laboratory specialist, male, non-physician Jeddah Regional Laboratory Jeddah
[2]OR technician Adham general hospital Jeddah
[3]Nursing Est Jeddah hospital Jeddah
[4]Specialist Nursing in ICU Ajyad Emergency Hospital Makkah
[5]RADIOLOGY technician East Jeddah hospital Jeddah
[6]Technician pharmacist king abdulaziz hospital Jeddah
[7]Lab technician King Abdullah medical complex Jeddah
[8]AL Refaee Lab technician King Abdullah medical complex Jeddah
[9]LAB SPECIALIST Jeddah Regional Laboratory Jeddah
[10]lab technician Jeddah Regional Laboratory Jeddah
[11]Nursing, Althager general hospital, Jeddah
[12]Nursing Althager general hospital Jeddah
[13]X-Ray Technician King Fahad hospital Almadinah almonwarah
[14]X-Ray Technician King fahad hospital Alamdinah almonawrah
[15]Specialist nursing East Jeddah Hospital Jeddah
[16]Nurse Health surveillance centers at Jeddah Islamic port Jeddah
[17]Health center Makkah Radiology technician Makkah
[18]Laboratory technician Ajyad Hospital Makkah

***Corresponding Author:** Mohammed Essa Saeed Masri
[*] Senior laboratory specialist, male, non-physician Jeddah Regional Laboratory Jeddah

Abstract
Background: Healthcare workers competency level in performing Basic Life Support (BLS) is critical to improve the survival rate of cardiac arrest patients. The aim of this study is to evaluate the impact of simulation based BLS training on healthcare workers ' knowledge and practice.
Methods: Pre-test post-test quasi experimental design was used to collect data from 49 healthcare workers before and after the implementation of a simulation based BLS training program.
Results: The results showed that healthcare workers scored significantly higher knowledge and skill scores after training than that before training. The overall mean of the participants' knowledge scores in the posttest was approximately (4.24) more than the overall mean of the participants' knowledge scores in the pretest. Moreover, the overall mean of participants' skill scores in the posttest was approximately (27.08) more than the overall mean of the participants' skill scores in the pretest
Conclusion: Such results provided evidence of the positive effect of simulation-based BLS training program on the healthcare workers' knowledge and skill about BLS.

Keywords— Basic Life Support, Simulation training, BLS knowledge and skills

Introduction

Cardiac diseases are a major causes of death in the middle income countries (World Health Organization, 2020) . Cardiac arrest out of hospitals still the main public health issue. After the COVID-19 pandemic, the survival rate of sudden cardiac arrest in many countries declined (Center for infectious disease research and policy, 2020) . Globally, for patients with cardiac arrest out hospital who received basic life support (BLS), the rate of survival on hospital admission and discharge was 22% and 15%, however; the rates of survival and discharge were lower among Asian countries 8.8% and 4.5% respectively. Effective BLS based on guidelines is needed to enhance survival rate for cardiac arrest patients (Panchal et al., 2020).

Skilled team and prompt initiation of effective BLS is necessary for positive outcomes among patients with cardiac arrest (Guetterman et al., 2019). healthcare workers play a critical role in the resuscitation team since they are the first providers who encounter cardiac arrest patients and can respond in timely manner (Guetterman et al., 2019). healthcare workers with insufficient BLS skills and knowledge could impede the management and survival of cardiac arrested victims (Rajeswaran et al., 2018). A study conducted in 14 European countries found that healthcare workers lacked cardiac arrest and BLS knowledge (Baldi et al., 2019) . healthcare workers must receive training to improve their BLS competence and skills to be applied in their clinical training (Baldi et al., 2019; Kose et al., 2019) . Studies have shown that BLS training based on simulation improves the patient outcomes by reducing the morbidity and mortality rates (Nikose et al., 2020) .

medical education focuses on theoretical and practical knowledge. In learning of skills, simulation is considered an innovative teaching method since it is designed to replicate real-life conditions and allow to integrate theoretical knowledge into practice (Eyikara & Baykara, 2017) . Clinical simulation is highly valued by healthcare workers , who confirmed its benefits in teaching and learning (Alconero-Camarero et al., 2016) . Basic life support based on a simulation training can enhance the achievement and retention of students' skills and knowledge. It also improves students' satisfaction, self-confidence, and attitude regarding cardiac resuscitation training (Demirtas et al., 2021; Onan et al., 2017). Aqel & Ahmad, (2014) found that BLS training program based on simulation learning have improved the healthcare workers' skills and knowledge. However, Akhu-Zaheya et al., (2013) found no difference between simulation and traditional BLS based training with regard to knowledge acquisition and retention. On the other hand, some studies found that students' knowledge and skills significantly decline at three months after BLS training (Everett-Thomas et al., 2016) . The aim of this study was to assess the impact of BLS simulation learning on the knowledge and practice of healthcare workers.

MethodologyDesign

This study used a pre-test post-test quasi- experimental design. Based on the guidelines of American Heart Association 2020, data were collected before and after the application of BLS training program.

Instruments

The researchers prepared the questionnaire of this study. It consisted of three parts: Part (A) included the demographic data about the participants. Part

(B) included knowledge about BLS. Part (C) included Adult BLS and (Automated External Defibrillator) AED skills testing checklist.

Demographic Survey

This part of questionnaire was established to gather data about the members' age, gender, level of study, previous training on BLS, and grade point average (GPA).

Knowledge about BLS Tool

The items of this tool were developed based on quiz questions prepared by the American HeartAssociation (AHA) to test the participants' knowledge about the BLS. It included 10 multiple-choice questions and 4 true or false questions. One point was given for each correct answer while 0 point was given for each incorrect answer. Theminimum grade for each participant in this tool was 0, while the maximum grade was 14. Thehigher grade indicated the better knowledge about the BLS.

Adult BLS and AED Skills Testing Checklist

The items of this checklist were developed based on a checklist prepared by the AHA to test the participants' skills in performing the BLS and AED. It included 22 steps that describe the procedure of BLS for arrested patient. To prevent any bias, one of the researchers was assigned to evaluate the performance of all participants and to fill out the checklist. Each step of this checklisthad three responses: not done that receives 0 point,done insufficiently that receives 1 point, and done sufficiently that receive 2 points. The minimum grade for this part was 0, while the maximum grade was 44. The higher grade indicated better performance.

Procedure of intervention

At the beginning of this study, the aim behindconducting this study was discussed with the participants. Then those who decided to join the study were requested to sign a written consent form.

Pre-test phase

The participants were requested to fill the first two parts of the questionnaire (Demographic Survey, and Knowledge about BLS). Then each participantwas asked to perform the steps of BLS on a high fidelity simulation manikin. One of the researches was assigned to evaluate the participant'sperformance by filling the Adult BLS and AED Skills Testing Checklist.

Training phase
The training program was performed in the adult simulation laboratory of medical department at Al Hussein Bin Talal University. The BLS program was developed by the researchers, and it included theoretical lecture and practical training. Thetraining started with theoretical lecture for 2 hours that was followed by practical training. The assigned researcher demonstrated each step of the procedure, and then, each participant was asked to apply and repeat the steps of the procedure until it was performed correctly.

Post-test phase
After completing the training programsuccessfully, the participants were asked to fill out the knowledge part of the questionnaire again. Each participant was asked to apply the BLS procedure on the manikin for a second time. During the participant's performance, the assigned researcher evaluated the students' performance using the Adult BLS and AED Skills Testing Checklist

Ethical Considerations
Ethical approval to perform this study was attainedfrom the research committee in the department of medical at the university. All ethical principles including the confidentiality were applied. The researchers discussed with the participants the purpose of the study. Verbal and written informed consents were gotten from the participants before starting the study. The researchers explained to theparticipants that they can reject to participate in thestudy or to withdraw when they want**.**

Statistical Analysis
Data were analyzed using Statistical Package for the Social Sciences (SPSS, version 24, ChicagoInc.) program. Descriptive statistics includingnumbers and percentages were used for the demographic characteristics of the sample. Inferential statistics was used to test hypotheses. The researchers used the paired-samples t-test to examine the presence of variances in the participants' knowledge and skills before and after the implementation of the intervention. To test the relationship between the demographiccharacteristics and the participants' knowledge, Moreover, the researchers used the Pearson correlation coefficient for age; independent- samples t-test for gender and previous training;and ANOVA for the level of study and GPA.

Results Demographical data
The number of the participants who completed the training program successfully was 49. The age for the whole sample ranged between18-33 years with a mean of 20.45 years (SD =01.10). The majority of the participants were females (n = 40; 81.6%). The level of study was divided into four categories; first year (n=13; 26.5%), second year (n=10; 20.4%), third year (n=10; 20.4%), and fourth year (n=16; 32.7%). More than half of the participants did not receive previous training on BLS (n= 29; 59.2%). The GPA of more than halfof the participants was between 70 and 79.99. (n= 29; 59.2%). Regarding the relationships between the demographic data and the participants' knowledge about BLS in the pretest, the results were as the following: age indicated weak significant correlation ($r(47) = 0.33$; $p = 0.019$); level of study and gender showed significant relationship ($f(3, 45) = 04.09$; $p = 0.012$); and ($t(48) = 02.20$; $p = 0.03$). The results showed that females have higher level of knowledge ($M = 6.75$; $SD = 2.25$) than males ($M = 4.89$; $SD = 2.47$). Students from third and fourth years of study have higher knowledge than students from first and second years. The tests of the other demographic variables did not reveal significantrelationship with the participants' knowledge about BLS. The sample characteristics are presented in Table (1).

Knowledge about BLS
The participants' knowledge about BLS before and after the application of the simulation training program were shown in Table 2. The results showed that the percentage and number of the answers that are correct in the posttest were higher than the percentage and number and of answers that are correct in the pretest. For example, the number of the answers that were correct in the pretest for the item of "What is the correct depth of chest compressions on an adult victim?" was 8 (16.3%) while the number of the answers that were correct in the posttest was 48 (98%). As revealed in Table 3, the results of pairedsamples t- test showed that the overall mean of the participants' knowledge scores in the posttest ($M = 10.65$; $SD = 02.13$) was approximately (4.24) morethan the overall mean of the participants' knowledge scores in the pretest ($M = 06.41$; $SD = 02.38$). This result represents a significant difference between the overall mean of the participants' knowledge scores before and after theapplication of the training program ($t(48) = - 09.38$; $p < 0.001$).

Participants' skills about BLS
The participants' skills about BLS before and after the application of the simulation training program were shown in Table 4. The results indicated that the number and percentage of the items done sufficiently in the Adult BLS and AED Skills Testing Checklist in posttest were higher than of their numbers and percentages in the pretest. The participants' skills improved after the implementation of the training program. As revealed in Table 3, the results of paired samples t-test showed that the overall mean of the participants' skill scores in the posttest ($M = 40.59$; $SD = 02.81$) was approximately (27.08) more than the overall mean of the participants'skill scores in the pretest ($M = 13.51$; $SD = 11.33$).This result represents a significant statistical difference between the overall mean of the participants' skill scores before and after the application of the training program ($t(48) = - 16.29$; $p < .001$).

Table 1: Demographical data and its relationship with the participants' BLS knowledge (Pretest)

Item		N	%	Mean	SD	Test	P Value
Gender	Male	09	18.4	04.89	02.47	t = 02.20	0.033*
	Female	40	81.6	06.75	02.25		
Level of study	First year	13	26.5	05.46	02.14	f = 04.09	0.012*
	Second year	10	20.4	05.50	01.90		
	Third year	10	20.4	06.10	01.91		
	Fourth year	16	32.7	07.93	02.49		
Previous training on BLS	Previous training	20	40.8	06.85	02.83	t = 01.08	0.285
	No previous training	29	59.2	06.10	02.00		
GPA	50 – 59.9	00	00.0	00.00	00.00	f = 00.73	0.774
	60 – 69.9	07	14.3	06.71	02.05		
	70 – 79.9	29	59.2	06.45	02.49		
	80 – 89.9	12	24.5	06.33	02.46		
	90 or more	01	02.0	04.00	00.00		
Age		**Min**	**Max**	**Mean**	**SD**	**Test**	**P Value**
		18.00	33.00	20.45	01.10	r = 0.33	0.019*

• Significant at α level < 0.05, N: Number, %: Percent, Min: Minimum, Max: Maximum , SD: Standard Deviation

Discussion

Healthcare workers usually the first personnel encountered with cardiac arrest victims (Adcock et al., 2020). The response of skilled and well trained rescuer is an important determinant of cardiac arrest victims survival (Adcock et al., 2020; Onan et al., 2017). However, it is documented that healthcare workers had poor BLS psychomotor skills (Nascimento et al., 2020). Therefore, it is vital to improve curricula to include evidence based instructional methods that contribute to the training of lifesaving interventions (Kim & Roh, 2016; Nascimento et al., 2020; Onan et al., 2017). Within this context, simulation with high fidelity has appeared as an important instructional way. (Kim & Roh, 2016; Onan et al., 2017; Wheeler & Dippenaar, 2020). In line with this, American heart association,)2020) recommended to conduct simulation based BLS training since it has positiveeffect on trainers' learning outcome. In the current Quasi experimental study, simulation-based BLS training was effective in the students' achievement of BLS knowledge and skill in baccalaureate program. The results showed that the studentsgained significantly higher scores of knowledgeand skills after the training. Similar to the resultsof the current study, Demirtas et al., (2021); Kose et al., (2019) and Requena-Mullor et al., (2021) found significant effects of trainings based onsimulation programs on students BLS. 2022, Vol. 6, No. 2, 275–285 ISSN 2587-0130

Table 2: Participants' knowledge about BLS before and after training program

Item	Pretest				Posttest			
	Correct answer		Incorrect answer		Correct answer		Incorrect answer	
	N	%	N	%	N	%	N	%
If you find a collapsed victim, what is thefirst thing you should do?	16	32.7	33	67.3	32	65.3	17	34.7
How should you open an airway in an unconscious adult victim?	26	53.1	23	46.9	44	89.8	05	12.2
What is the maximum time you should spend checking for normal breathing?	20	40.8	29	59.2	37	75.5	12	24.5
If a victim isn't breathing normally, what isthe first thing you should do?	05	10.2	44	89.8	25	51.0	24	49.0
What is the correct ratio of chestcompressions to rescue breaths?	36	73.5	13	26.5	48	98.0	01	02.0
It is acceptable to just perform chest compressions only if you are unable or not	19	38.8	30	61.2	21	42.9	28	57.1
What action should you take if a victimvomits whilst you are performing CPR?	27	55.1	22	44.9	34	69.4	15	30.6
CPR can be performed effectively on a softbed	24	49	25	51.0	34	69.4	15	30.6
What speed of chest compressions shouldyou aim for?	21	42.9	28	57.1	49	100	0.0	00.0
What should you do if you feel a rib breakwhen performing chest compressions?	23	46.9	26	53.1	44	89.8	05	10.2

The victim is likely to recover whilst you are performing CPR	33	67.3	16	32.7	36	73.5	13	26.5
CPR should be started immediately if acasualty isn't breathing normally	28	57.1	21	42.9	32	65.3	17	34.7
What is the correct medical term for when avictim's heart stops beating?	29	59.2	20	40.8	37	75.5	12	24.5
What is the correct depth of chestcompressions on an adult victim?	08	16.3	41	83.7	48	98.0	01	02.0

N= Number, %= Percent

Table 3: Comparison of participants' knowledge and skills about BLS before and after theapplication of the training program

Item	Pretest Mean	SD	Posttest Mean	SD	t- value	P value
Knowledge about BLS	06.41	02.38	10.65	02.13	-09.38	<.001 *
Skills about BLS	13.51	11.33	40.59	02.81	-16.29	<.001 *

- Significant at α level < 0.05

Table 4: Participants' skill about BLS before and after training program

Pretest							Posttest					
Item	**Not done**		**Done insuff.**		**Done suff.**		**Not done**		**Done insuff.**		**Donesuff.**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Checks responsiveness	27	55.1	02	14.1	20	40.8	0.0	0.0	01	02.0	48	98.0
Shouts for help/Activates emergency response system/Sends for AED	33	67.3	09	18.4	07	14.3	0.0	0.0	04	08.2	45	91.8
Checks breathing	17	34.7	18	36.7	14	28.6	0.0	0.0	08	16.3	41	83.7
Checks carotid pulse	18	36.7	16	32.7	15	30.6	0.0	0.0	03	06.1	46	93.9
Correct hand placement	16	32.7	14	28.6	19	38.8	0.0	0.0	03	06.1	46	93.9
2-handed (second hand on top of the firstor grasping the wrist of the first hand)	09	18.4	20	40.8	20	40.8	0.0	0.0	12	24.5	37	75.5
Compression rate of 100 to 120/min	25	51	08	16.3	16	32.7	0.0	0.0	17	34.7	32	65.3
30 compressions in correct time	10	20.4	23	46.9	16	32.7	0.0	0.0	12	24.5	37	75.5
Correct depth of compresses	20	40.8	15	30.6	14	28.6	0.0	0.0	11	22.4	38	77.6
Complete recoil after compressions	29	59.2	10	20.4	10	20.4	0.0	0.0	09	18.4	40	81.6
Correct opening of airway	30	61.2	13	26.5	06	12.2	0.0	0.0	07	14.3	42	85.7
Gives 2 breaths with a barrier device	25	51.0	11	22.4	13	26.5	0.0	0.0	06	12.2	43	87.8
Correct time for giving breathing	41	83.7	03	06.1	05	10.2	0.0	0.0	08	16.3	41	83.7
Visible chest rise with each breath	39	79.6	04	08.2	06	12.2	0.0	0.0	08	16.3	41	83.7
Avoids excessive ventilation	42	85.7	01	20.0	06	12.2	0.0	0.0	06	12.2	43	87.8
Correct time for resuming compressions	41	83.7	03	06.1	05	10.2	0.0	0.0	06	12.2	43	87.8
Powers on AED	34	69.4	06	12.2	09	18.4	0.0	0.0	07	14.3	42	85.7
Correctly attachment of pads	34	69.4	07	14.3	08	16.3	0.0	0.0	08	16.3	41	83.7
Clears for analysis	38	77.6	03	06.1	08	16.3	0.0	0.0	05	10.2	44	89.8
Clears to deliver a shock safely	39	79.6	07	14.1	03	06.1	0.0	0.0	06	12.2	43	87.8
Delivers a shock safely	40	81.6	07	14.1	03	06.1	0.0	0.0	06	12.2	43	87.8
Resumes Compressions	44	89.8	05	10.1	00	00.0	3.0	6.1	08	16.3	41	83.7

N: Number, %: Percent, Insuff.: Insufficiently, Suff: Sufficiently

knowledge and skill acquisition. Nevertheless, the students' bassline scores and the increment of theirscores before and after intervention varied across the studies. These variations might be attributed to variations in sample characteristics, mainly the level of the included students, in addition to variations in studies' protocols and used instruments. For example, compared with Demirtas et al., (2021) and Requena-Mullor et al., (2021) studies, the increment in the mean of knowledge scores was slightly higher in our study, this is might be due, in part, to the point of time of posttest. In the current study, the knowledge posttest was done two days after training while in Demirtas et al., (2021) and Requena-Mullor et al., (2021) studies the knowledge posttest was done 3 weeks and six months after the pretest respectively. In another study, the level of students' knowledge had increased considerably after the intervention; the researcher explained thatthe students were divided into small groups which allowed them to repeat the training many times (Kose et al., 2019).

In other experimental studies the authors includeda control group to assess the effectiveness of simulation based training against traditional lectures and training using static mannequin (Akhu-Zaheya et al., 2013; Aqel & Ahmad, 2014; Habibli et al., 2020; Tawalbeh & Tubaishat, 2014).Many studies demonstrated the superiority of high fidelity CPR training over

the traditional trainingin knowledge acquisition (Aqel & Ahmad, 2014; Habibli et al., 2020; Tawalbeh & Tubaishat, 2014).In Habibli et al., (2020) and Aqel & Ahmad (2014)studies, students who received high fidelity simulation training achieved significant higher scores of knowledge and performance than students in traditional training group immediately after training. High fidelity simulation training hadalso a significant effect on knowledge retention 3 months after training (Aqel & Ahmad, 2014; Habibli et al., 2020). In contrast, in Akhu-Zaheyaet al., (2013) study there were no significant difference in knowledge and skills acquisition and retention between students in high fidelity simulation training group and traditional training group. The difference in research findings might be attributed to the variations in implementing the simulation training; for example Akhu-Zaheya et al.,(2013) allocated short time for simulationsession which was insufficient for students to repeat the skill many times during training. However, Akhu-Zaheya et al.,(2013) argued that regardless of teaching method used in the training of life support interventions, students are required to achieve mastery level competency; andaccording to blooms taxonomy the gain in cognitive knowledge was similar for students who received simulation based and traditional BLS training.

Overall, the positive influence of simulation training on students' self-efficacy, self-confidence and attitudes toward BLS might explain its positive effect on students' knowledge and skill acquisition. Students across cultures reported that they are highly satisfied with simulation based BLS training (Williams et al., 2016). There is also an evidence that simulation based BLS traininghad a positive effect on students' self-confidence in their knowledge and technical skills and on their attitude toward learning (Carson & Kuzik, 2017; Demirtas et al., 2021; Onan et al., 2017; Tawalbeh & Tubaishat, 2014). Moreover, simulation based training allows for a continuous interactionbetween students' cognitive knowledge, technical skill and environment and this in turn improves students self-efficacy in performing BLS (Akhu- Zaheya et al., 2013). High fidelity simulation enable the students to learn and to act in an environment that replicates the real clinical situation and this is essential forthe translation of knowledge and learned skills intopractice (Wheeler & Dippenaar, 2020). Repetitive performance of the skill that the high fidelity simulation offer might also contribute in knowledge and skill acquisition (Akhu-Zaheya et al., 2013; Wheeler & Dippenaar, 2020). However, the literature support the finding that simulation based education had no significant effect on knowledge and skill retention (Akhu-Zaheya et al.,2013; Everett-Thomas et al., 2016). It was reportedthat BLS knowledge and skill diminish over time (Aqel & Ahmad, 2014; Niles et al., 2017).Therefore, AHA recommended repeating BLS training periodically through brief frequent sessions (American heart association, 2020).

Conclusion

The current Quasi experimental study results revealed that the simulation-based CPR training program not only had significant improvements on the knowledge of healthcare workers about BLS, but also their practice. The study confirms the findings of other related studies, Demirtas et al., (2021); Kose et al., (2019) and Requena-Mullor et al., (2021). Despite the short simulation-based BLS training period in the current study, results provided evidence of the positive effect on the learning outcomes of healthcare workers.

It is recommended to adopt simulation-based BLS training program for healthcare workers at different levels of study to improve their knowledge and skill about BLS. This can be achieved through the establishment of simulation labs at medical schools. Such labs will benefit both instructors and students in providing a safe environment that replicates a variety of real clinical situations. This will help overcome the scarcity of medical cases and allow more frequent and continuous interaction between students' cognitive knowledge and technical skills that improve their self- efficacy, self-confidence, and attitude in practicing BLS.

It is also recommended to perform further studies and analysis of the current study data to further understand students' knowledge and skill scores based on their level of study and knowledge / skill acquisition. The objective is to guide the implementation of the simulation-based BLS training program with adequate duration and frequency that provides maximum retention of students' knowledge and skill in performing BLS

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