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RESEARCH ARTICLE

Impact of simulation-based basic life support training among the medical students

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ABSTRACT

Background: Cardiovascular disease is the leading cause of death and disability in the world, and cardiac arrests are on the rise. Sudden cardiac death is a major clinical, and public health problem, and survival remains poor. Simulation-based basic life support (BLS) training gives the right steps to revive somebody who has a cardiac arrest. This involves “Hands-on training” on manikins to enable fast recognition and skilled response to help save lives after cardiac arrest. In this context, it is important for medical students to know, how to provide timely cardiopulmonary resuscitation which forms an integral part of BLS training. We conducted this study to first know about the existing knowledge and skills of BLS among medical students and then evaluated the impact of simulation-based BLS training by conducting written and practical tests. **Aims and Objective:** The aim of the study was to evaluate the knowledge and psychomotor skills of medical students in providing BLS, after undergoing the simulation-based BLS training. **Materials and Methods:** A total of 85 undergraduate students of II and III year MBBS, of both sexes, were included in this experimental study. Each student had a simulation-based “hands-on” BLS training using Laerdal adult and infant mannikins with feedback device, Ambu bag, and automated external defibrillator trainers. They were taught the sequence of the steps of BLS during the “practice-while-watching,” simulation-based teaching, to facilitate better understanding and retention of the sequence of BLS steps. A self-administered, pre-tested questionnaire was given a pre-test and post-test along with a practical skill assessment. The data were analyzed using the statistical package for the social sciences version 22.0 - paired *t*-test and multiple regression analysis. **Results:** A total of 85, 2nd and 3rd-year MBBS students participated in the study, of which 49 were female (57.6%) and 36 were male (42.4). 45 students (52.9%) were of the age group between 18 and 21 years and 40 students (47.1%) were of the age group between 22 and 25 years. There was no significant difference in pre- and post-test scores between males and females. Simulation-based teaching on BLS has an effect on improving the knowledge and skills in BLS. The two variables age (standardized $\beta = 0.236$, $P = 0.018$) and pre-test scores (standardized $\beta = 0.450$, $P < 0.001$) significantly predicted post-test scores. **Conclusion:** Simulation-based BLS training has an impact on improving the knowledge and skills of the medical students in providing BLS in cardiac arrest.

KEY WORDS: Basic Life Support; Medical Education; Medical Students

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INTRODUCTION

Cardiovascular disease is the leading cause of death and disability in the world, killing 17.7 million people a year and the incidence of cardiac arrest is increasing in present times.

Cardiac arrest is defined as a sudden loss of blood flow due to the failure of the heart to pump effectively. It can occur out of hospital when it is called out of hospital cardiac arrest (OHCA) or in hospital when it is called "In Hospital cardiac arrest" (IHCA), cardiac arrest is a major clinical and public health problem, and survival remains poor unless fast recognition and a skilled response, in the form of cardiopulmonary resuscitation, which is an integral component of basic life support (BLS) are given.[1] Cardiac arrest survival rate declines 5–10% for every minutes[2,3] without cardiopulmonary resuscitation (CPR) and a recent study demonstrated that the survival rate decreased with increasing the time to the initiation of CPR.[4] Several studies indicate that early CPR, substantially increase the survival rate of cardiac arrest.[5-7]

BLS includes both prompt recognition and immediate support of ventilation and circulation in the event of a respiratory or cardiac arrest. It has a combination of skills including mouth-to-mouth breathing to support ventilation and chest compressions to normalize blood circulation to the brain and vital organs called CPR. CPR is a simple and very effective procedure that allows anyone to help sustain life, soon after cardiac and respiratory arrest. Knowledge of BLS and practice of the simple CPR techniques ensure that the patient survives long enough until medical help arrives and in most cases is itself sufficient for survival. BLS requires nothing as far as resources are concerned, and its importance is understandably so vital in saving lives. Proper practice of the techniques and maneuvers enables a person to effectively resuscitate a victim.

CPR training increases resuscitation[8] and therefore proper education regarding early recognition of cardiac arrest, providing the right steps of BLS, is desired across the entire world.[9,10] Medical students will face emergency situations where they are expected to apply BLS skills.

Will a simulation-based training equip medical students better to confidently be able to initiate effective life-saving CPR as a lifesaving measure while providing BLS?

With this background, we carried out this study, to assess the knowledge about BLS among medical students and understand if simulation-based BLS training can create an impact on improving their knowledge and skills.

The purpose of this study is to evaluate the impact of simulation-based BLS training in improving the knowledge and psychomotor skills of medical students in providing BLS and to evaluate the knowledge and psychomotor skills of medical students in providing BLS, after undergoing the simulation-based BLS training.

MATERIALS AND METHODS

Study Design

This was a experimental study.

Study Area

The study was conducted at the SRM/Stratus Centre for Medical Simulation, SRM Medical College Hospital and Research Centre, Kattankulathur, SRM IST.

Study Period

The study was done over a period of one month, in March 2017.

Sample Size

The sample size was 85 undergraduate students.

Equipment

Laerdal Mannikins with feedback device, Ambu bag, and automated external defibrillator (AED) trainers [Figure 1] and Infant manikin [Figure 2] were used.

Methodology

A total of 85 medical students were included in this study, after obtaining their consent. The data were collected from all the participants regarding age and gender and recorded in Microsoft Excel spreadsheet. The study tool used was a self-administered pre-tested questionnaire. The 10 questions included in the pre-test and post-test questionnaire were prepared using with Likert Scale, based on BLS. Institutional Ethical Committee Clearance was obtained.

The duration of BLS training, that each student received was about 8 h. The students, at first, were shown audio-visual presentations on adult, child, and infant BLS. This was followed by "practice while watching" sessions in which every student had "hands-on practice" on the manikins, while watching the video shown about each step of BLS. The steps of BLS are as follows:

1. Check for scene safety,
2. Check for responsiveness, by tapping on shoulders,
3. If there is no response, shout for help, activate the emergency medical services and ask for AED to be brought,
4. Check for breathing and pulse for minimum of 5 s, not more than 10 s,
5. If there is no breathing and no pulse, immediately start CPR, at a rate of 30 compressions: 2 breaths,
6. AED is used.

During these sessions, high-quality CPR, steps to be done as a single rescuer and in a 2-rescuer scenario, while encountering adult, child and infant victims were practiced by the students. High-Quality CPR was assessed by the feedback given from the manikins - green light indicated if CPR was of High-Quality and red light indicated if CPR was not as per adequate depth and time. Defibrillation, using the AED trainer, was also demonstrated, and each student practiced, using the AED trainers provided. The rescue measures to be followed, in case of choking in adult and infants, were also taught. Thus, every student had hands-on practice sessions, on the correct techniques to provide BLS in the event of IHCA or OHCA. Any mistakes done were corrected by debriefing.

At the end of the sessions, a post-test was conducted, and scores were given. A practical “hands-on” test based on BLS was also done to evaluate their psychomotor skills in doing the correct sequence of steps in BLS and in operating AED, as a single rescuer and as a 2nd rescuer. Feedback forms were administered.

Figure 1: Laerdal mannikins with feedback device, ambu bag, and automated external defibrillator trainers

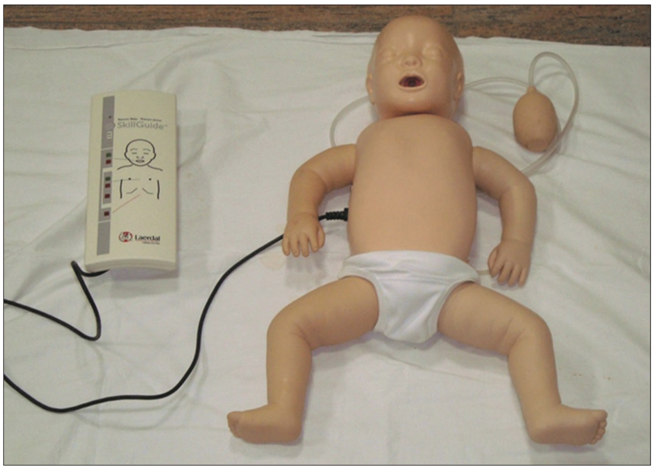

Figure 2: Infant manikin with feedback device

Statistical Analysis

The entire data entered into Microsoft Excel and analyzed using SPSS version 22.0. Frequency and percentages among descriptive statistics were used to describe the data, and Paired *t*-test has been used for the analysis. $P = 0.05$ was considered to be statistically significant. Multiple regression analysis was performed to test if the demographic variables such as age, gender, and pre-test scores significantly predicted post-test scores. To assess the knowledge about BLS and document the effectiveness of simulation-based learning of BLS among medical students, a pre-tested questionaire based on BLS was used [Table 1]. The scoring was done using Likert scaling, based on the options the student selected. Scores ranging from 1 to 4 were given based on the type of statement. A score of 4 was given for strongly agree, 3 for agree, 2 for neutral, and 1 for disagree. For example, if a statement is wrong and if the response was “Disagree” it was given a score of 4, followed by neutral with a score of 3, agree with 2 and strongly agree with 1. If the statement is correct and “Strongly agree” was given a score of 4, followed by agree with 3, neutral with a score of 2, and disagree with 1.

Feedback was collected from the participants as to whether the BLS Training was useful and whether simulation - based BLS hands-on training had improved their psychomotor skills.

RESULTS

The general characteristics of the students who participated in the study, 49 were female (57.6%) and 36 were male (42.4). 45 students (52.9%) were of the age group between 18

Table 1: BLS questionnaires

Questions	Response			
I am confident in giving BLS to an adult victim of cardiac arrest	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
I know how to use the AED	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
In a child victim of cardiac arrest, the compression-ventilation ratio is 30:2	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
CPR alone is enough to bring a patient to normal life	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
In a two-rescuer CPR, during the adult cardiac arrest, the compression-ventilation ratio is 15:2	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
I can perform Heimlich maneuver in a choking adult victim	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
The first step in BLS is the assessment of scene safety	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
During CPR in adult, chest compressions should be 2 and ½ inches depth	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
In an adult cardiac arrest, compression of at least 80 times per minute should be given	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree
Each rescue breath should be given over 1 and ½ s during a resuscitation	(a) Strongly Agree	(b) Agree	(c) Neutral	(d) Disagree

BLS: Basic life support, CPR: Cardiopulmonary resuscitation, AED: Automated external defibrillator and 21 years and 40 students (47.1%) were of the age group between 22 and 25 years.[Table 2]

Impact of Simulation-Based Teaching of BLS to Medical Students [Table 3]

Null hypothesis: Simulation-based teaching of BLS does not have any impact.

Alternate: Simulation-based teaching of BLS has an impact.

Paired *t*-test has been used for the analysis. $P = 0.05$ was considered to be statistically significant [Table 3]. Since *P* value (<0.001) is <0.05, null hypothesis is not accepted. There is the statistically significant difference between pre- and post-test scores. Hence, simulation-based teaching on BLS has an impact.

Gender Difference Regard Impact of Simulation-Based Teaching

Null Hypothesis: There is no difference between male and female in pre-test/post-test scores.

Alternate: There is the difference between male and female in pre-test/post-test scores.

Table 2: General characteristics of the respondents (BLS)

Characteristics	*n* (%)
Gender	
Female	49 (57.6)
Male	36 (42.4)
Age	
18–21 years	45 (52.9)
22–25 years	40 (47.1)
Total	85 (100.0)

BLS: Basic life support

Independent *t*-test has been used to test the difference in pre-test /post-test scores between male and females. There is no significant difference in pre- and post-test between males and females. Both male and female students have got the same level of impact when simulation-based teaching was used [Tables 4-6].

Multiple Regression Analysis

Multiple regression analysis was performed to test if the demographic variables such as age, gender, and pre-test scores significantly predicted post-test scores [Tables 5 and 6].

The initial model can be written as:

$$\text{Post-test score} = \beta+\beta_1(\text{age})+\beta_2(\text{gender})+\beta_3(\text{pre-test scores}).$$

The variation inflation factor of the independent variables was found to be 1.17, 1.007, and 1.166 for age, gender, and pre-test scores, respectively, indicating the absence of multicollinearity among the independent variables.

The results of the regression indicated that two out of three predictors significantly predicted post-test scores with 34.4% of the explained variance ($R^2 = 0.343$, $F(3.81) = 14.11$, $P < 0.001$). It was found that except gender, other two variables age (standardized $\beta = 0.236$, $P = 0.018$) and pre-test scores (standardized $\beta = 0.450$, $P < 0.001$) significantly predicted post-test scores. The beta value of age indicates that one unit increase in age increases the post-test scores by 0.236 and pre-test scores indicates that one unit increase in pre-test score increases the post-test scores by 0.45.

The Multiple regression model can be written as:

$$\text{Post-test score} = 0.236\ (\text{age})+0.45\ (\text{pre-test score}).$$

The response rate was 100% among the 85 participants who were administered the questionnaire. Of the total study

Table 3: Impact of Simulation (BLS)

Variables	Mean	*n*	SD	Lower CI	Upper CI	*t* statistic	*P* value
Post-test	33.42	85	5.35	32.27	34.58	8.75	<0.001*
Pre-test	29	85	4.03	28.13	29.87		

BLS: Basic life support, CI: Confidence interval, SD: Standard deviation. **P* value of 0.05 or < is considered to be statistically significant.

Table 4: Impact of simulation based on gender (BLS)

Gender	Variables	Mean	*n*	SD	Lower CI	Upper CI	*t* statistic	*P* value
Female	Post-test	33.78	49	3.48	32.78	34.77	9.169	<0.001*
	Pre-test	28.92	49	3.58	27.89	29.95		
Male	Post-test	32.94	36	7.19	30.51	35.38	4.025	<0.001*
	Pre-test	29.11	36	4.62	27.55	30.68		

*5% level of significance, BLS: Basic life support, CI: Confidence interval, SD: Standard deviation. **P* value of 0.05 or < is considered to be statistically significant.

Table 5: Impact of Simulation based on age (BLS)								
Age (years)	Variables	Mean	n	SD	Lower CI	Upper CI	t statistic	P value
18–21	Post-test	31.84	45	6.07	30.02	33.67	4.709	<0.001*
	Pre-test	28.04	45	4.47	26.70	29.39		
22–25	Post-test	35.20	40	3.73	34.01	36.39	9.067	<0.001*
	Pre-test	30.08	40	3.19	29.06	31.09		

BLS: Basic life support, CI: Confidence interval, SD: Standard deviation

Table 6: Gender difference regard impact of simulation-based teaching							
Variables	Mean	n	SD	Lower CI	Upper CI	t statistic	P value
Pre-test							
Female	28.92	49	3.58	27.89	29.95	−0.217	0.829
Male	29.11	36	4.62	27.55	30.68		
Post-test							
Female	33.78	49	3.48	32.78	34.77	0.706	0.482
Male	32.94	36	7.19	30.51	35.38		
Pre-test (years)							
18–21	28.04	45	4.47	26.70	29.39	−2.383	0.019*
22–25	30.08	40	3.18	29.06	31.09		
Post-test (years)							
18–21	31.84	45	6.06	30.02	33.67	−3.024	0.003*
22–25	35.2	40	3.73	34.01	36.39		

BLS: Basic life support, CI: Confidence interval, SD: Standard deviation

participants, 49 were female (57.6%) and 36 were male (42.4). 45 students (52.9%) were of the age group between 18 and 21 years, and 40 students (47.1%) were of the age group between 22 and 25 years [Table 2].

Since P value (<0.001) is <0.05, there is the statistically significant difference between pre- and post-test scores. There is no significant difference in pre- and post-test between males and females. Both male and female students have got the same level of impact when simulation-based teaching of BLS was used. The hypothesis tested is "Simulation-based teaching on BLS has an effect." The hypothesis is accepted. It was found that except gender, other two variables age (standardized $\beta = 0.236$, $P = 0.018$) and pre-test scores (standardized $\beta = 0.450$, $P < 0.001$) significantly predicted post-test scores.

DISCUSSION

Our study involved 85 medical students as participants, 36 male and 49 female belonging to II and III year MBBS, in the age group ranging between 18 and 25 years. Pre-test and post-test BLS scores were analyzed along with practical skills, from which it was found that simulation-based teaching on BLS has an impact on improving the knowledge and skills of the medical students. It was found that the impact received was the same in both male and female medical students. However, with an increase in the variables - age and pre-test scores, there was increase in post-test scores.

Several studies have shown that medical students fall short of the required standards for successful resuscitation.[11,12] A recent survey assessing competence in BLS revealed that more than half of the medical students did not know to assess the airway, after checking for safety and calling for help.[13] In our study also, we found that the students did not know the correct steps to assess for airway, after checking for safety and calling for help. In a previous study, it was observed that the average compression rate of student participants in simulation was below the ideal BLS guidelines.[14] There could be several factors such as the lack of competency, lack of knowledge, poor training, and inadequate skills. In our study also, we found the same situation, but corrective steps were taken by the students based on the feedback indications given by the mannikins, thus helping in ensuring high-quality CPR which is crucial to resuscitation. It has been proven beyond doubt that ideal compression rates improve survival following resuscitation.[15] It has been seen that feedback devices, according to the CPR parameters led to vast improvement in CPR skills when compared with no feedback.[16] For our study, we had used mannequins which provided feedback during CPR training, and the students were able to give correct depth of compressions, which is vital in BLS. Studies have shown that medical students who taught BLS skills to others, had better practical skills compared to students who only underwent conventional training, in view of more interaction.[17] Repetition of these essential skills is done by the participants themselves, and this has shown to improve the retention of CPR skills.[18]

From the feedback received from the participants in the study, 100% of them had responded that the BLS Training was useful and that simulation - based hands-on training had improved their psychomotor skills.

CONCLUSION

Our study has proven that simulation-based BLS training creates an impact on improving the knowledge and skills of the medical students so that they can confidently use their skills to resuscitate an adult, child, or infant with a cardiac arrest.

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