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ORIGINAL RESEARCH

The basic life support knowledge of medical students undergoing standardized training after basic life support courses

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Abstract

The study developed an online closed-book question bank using wechat. Pre- and post-training scores were recorded and compared, taking into account total scores and scores based on various socio-demographic characteristics. Sociodemographic characteristics were used as explanatory variables and total score as dependent variables. Finally, statistical analysis was used to evaluate the relationship between explanatory and dependent variables. A p value less than 0.05 was considered statistically significant. The study involved a total of 216 students. The majority of the participants 149 (68.98%) were aged between 20 to 25 years. Out of these, 137 (63.43%) held a bachelor's degree while 182 (84.26%) had less than or equal to one year of work experience. Additionally, 212 (98.15%) of held a junior professional title, and 121 (56.02%) of them were medical staff. Participants who completed similar training had scores on the BLS (68.55 $\pm$ 17.19) and those who did not (58.96 $\pm$ 21.73). BLS training has shown a significant improvement in BLS scores ($p < 0.001$) for people of all ages, genders, educational, experiential and professional levels and departments, regardless of prior training. The results of this study show that attending BLS training courses has a significant impact on BLS scores. This effect remained significant even after adjusting for sociodemographic characteristics through linear regression analysis ($\beta = 27.30, p < 0.001$). Therefore, BLS training is an effective way to increase BLS knowledge. The study found that trainees who received BLS training had a higher level of knowledge in standardized training than those who did not receive such training. This suggests a significant correlation between basic life support training and BLS knowledge in trainees.

Keywords

Basic life support; BLS training course; Standardized training; Standardized training trainees

1. Introduction

Basic life support (BLS) refers to the care given to patients experiencing sudden cardiac arrest before professional help arrives [1]. The reported rates of survival and neurological function after cardiac arrest in China are between 1% and 1.3%, which is lower than the 10% reported in the United States [2]. There are significant differences in the survival rates of cardiac arrest patients, mainly due to the quality of immediate treatment. Those who have received BLS training are capable of identifying of cardiac arrest, initiating and performing cardiopulmonary resuscitation (CPR) correctly, and using automated external defibrillators. It has been observed that the survival chances and long-term prognosis of a patient can be significantly improved by having knowledge of BLS [3]. Studies have found that the knowledge of BLS varies between countries among both medical professionals and general population. The public's knowledge of BLS was recorded as 44.4% in Ethiopia, 39.2% in Saudi Arabia, 50.3% in Addis Ababa, 43.7% in Iran, 74.3% in Egypt and 44.0% in Jimma [4–7]. In Iran, 37% of dentists demonstrated good knowledge of BLS, while in Nepal, only 12% of healthcare workers had adequate knowledge, 55% had moderate knowledge and 32% had inadequate knowledge [8–10]. The reason for these disparities might be attributed to insufficient education and training in the medical emergency system.

The BLS training course developed by the American Heart Association has become quite popular in recent years. It not only teaches BLS knowledge and CPR techniques to the public but has also become a primary source of BLS training for medical professionals [11]. There are various BLS curricula and teaching techniques used internationally. Research conducted with US students revealed that those who received BLS training through a computer-based course called HeartCode™ BLS, with voice advisory manikin feedback, had better BLS knowledge than those who underwent instructor-led training with traditional manikins [12]. It is important to note that while this course was designed for American medical institutions, it may not be suitable for Chinese medical personnel due to differences in healthcare systems. BLS training and practice are crucial for standardized trainees, especially residents. However, there hasn't been much research on the level and quality of BLS knowledge of standardized trainees. This study aims to analyze the BLS knowledge of standardized training medical students both before and after they receive BLS training. Additionally, we will examine relationship between sociodemographic characteristics and the accuracy of BLS knowledge.

2. Materials and methods

2.1 Study population

In order to conduct a study on standardized training for medical students in our hospital's 2023 cohort, we established inclusion and exclusion criteria. The inclusion criteria were as follows: (1) Participants must be young medical personnel with a medical background who have recently graduated. (2) They should not have any joint mobility dysfunction or recent injuries to the arms or knees. (3) They should not have any cardiovascular or cerebrovascular diseases, not pregnant, and no physical discomfort on the day of the training. (4) Participants must give informed consent before taking part in the study.

The exclusion criteria included: (1) Pregnant individuals, those with cognitive impairments, or those who did not complete the pre- and post-training surveys. (2) Those who withdrew after giving consent, (3) and those who withdrew due to sudden illness or discomfort during training.

2.2 BLS training

Offline collective training was provided to students of standardized training (Fig. 1). BLS training courses adopt a large-scale class teaching mode and require completing six lectures in one day. The lectures cover topics such as high quality cardiopulmonary resuscitation, cardiac arrest detection, monitoring and prevention, training in recognition of electrocardiogram (ECG) waveforms characteristic of cardiac arrest, general CPR and CPR for special groups (such as pregnant women, children and infants), the use of automatic external defibrillators and respiratory equipment, and the cultivation of a sense of teamwork. The teaching methods involve multimedia teaching, integrated simulation equipment training and simulated real-situation teaching.

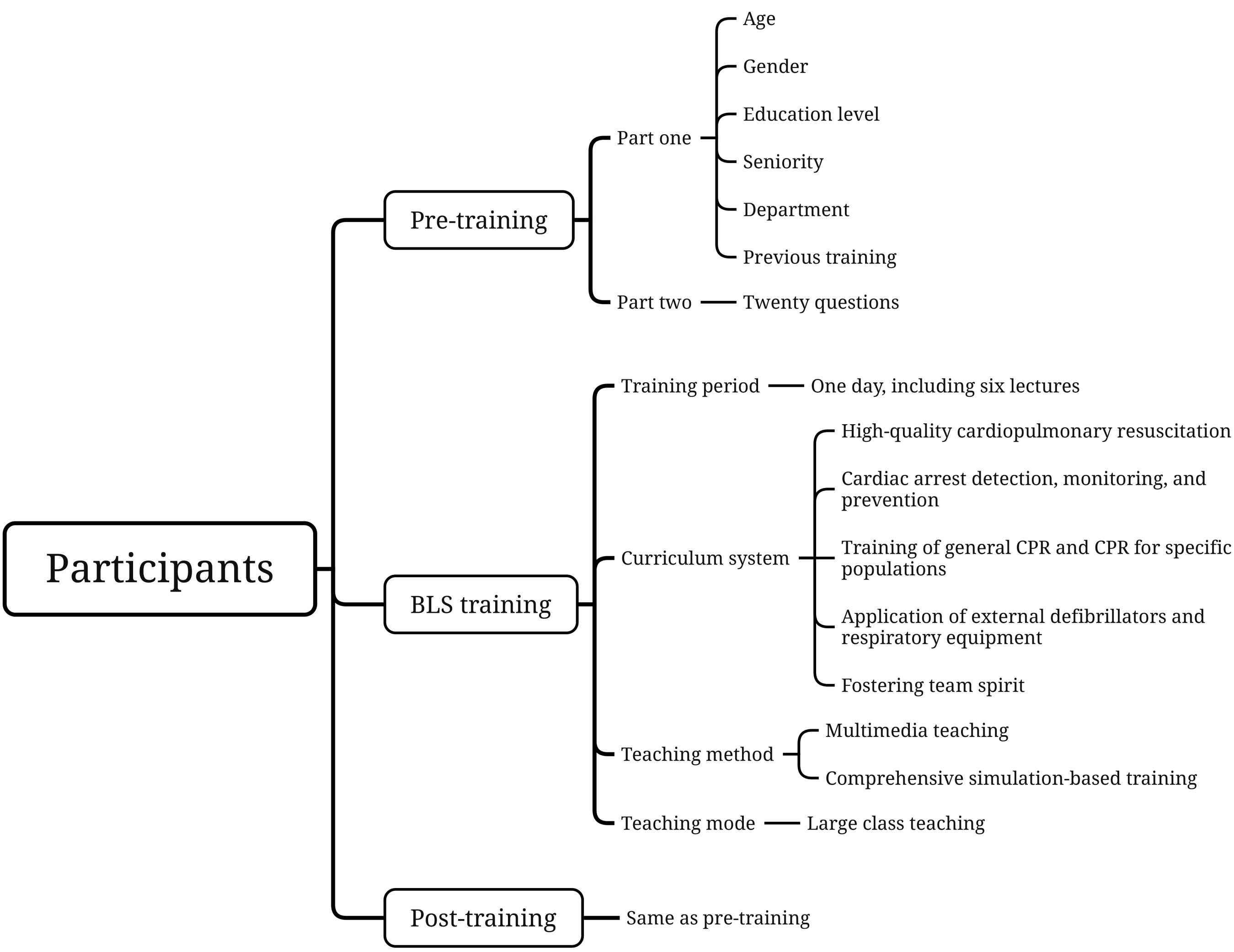

FIGURE 1. Schematic representation of the basic life support-training program used in this study.

The WeChat application was utilized to create a series of online closed-book questions in order to assess the BL *via* S knowledge of the students both before and after the training. The participants were expected to complete a questionnaire consisting of two parts. The first part of the questionnaire gathered sociodemographic information, including age, gender, educational level, major, professional title, years of medical work experience, and previous basic life support training experience. The second part of the questionnaire was the test of basic life support knowledge, which comprised of 20 questions. Each correct answer was awarded 5 points, while incorrect answers received 0 points. Thus, the possible score range was 0–100. The average scores of the pre- and post-training assessments were documented for every sociodemographic subset. If a participant scores above 60 points, it means that their BLS knowledge is sufficient. If a participant scores less than 60 points, it means that their BLS knowledge is insufficient and they need additional training. The entire training program lasts for three days. To reduce potential discrepancies, a single instructor conducted all participants' training sessions while maintaining anonymity of collected information throughout the study.

2.3 Statistical analysis

To determine the basic characteristics of the research object, we used the number of people (component ratio) and recorded the total BLS scores as mean ± standard deviation. We compared the BLS scores of participants based on sociodemographic characteristics using analysis of variance and t-tests. To compare BLS scores before and after the training course, we used paired-sample t-tests. Lastly, we performed linear regression analysis with BLS scores and training course as dependent and explanatory variables, respectively, after adjusting for sociodemographic characteristics. We used Stata software for all statistical analyses. The significance level for all analyses was set at $p < 0.05$.

3. Results

The research involved 216 individuals, with the major part of the group aged between 20 to 25 years, representing 149 (68.98%) of the sample. Those aged 26 to 30 accounted for 59 (27.31%) of the total, whereas those aged 31 to 40 made up 8 (3.70%). In terms of gender distribution, females constituted the majority, accounting for 161 (74.54%) of the cohort, while males represented 55 (25.46%). The participants were classified into three categories based on their department: Medical, Pharmaceutical and Technical. The majority of the group held professional titles at the primary level, with 212 (98.15%) of them holding this title, while the remaining 4 (1.85%) held the middle-level title. The majority of participants 121 (56.02%) hailed from the medical department, while 71 (32.87%) were from the technical department and 24 (11.11%) belonged to the pharmaceutical sector. Half of the respondents 110 (50.93%) reported having received prior training in their respective fields, whereas 106 (49.07%) had no previous experience or instruction in this area (as shown in Table 1).

TABLE 1. Sociodemographic characteristics of the new standardized medical training students in this study.

Variables	Participants (n/%)
Age group	
20–25	149 (68.98%)
26–30	59 (27.31%)
31–40	8 (3.70%)
Gender	
Male	55 (25.46%)
Female	161 (74.54%)
Education	
Junior college	15 (6.94%)
Undergraduate	137 (63.43%)
Masters or PhD	64 (29.63%)
Years of experience	
<1 yr	182 (84.26%)
2–3 yr	22 (10.19%)
>4 yr	12 (5.56%)
Professional title	
Primary	212 (98.15%)
Middle	4 (1.85%)
Department	
Medical	121 (56.02%)
Pharmaceutical	24 (11.11%)
Technical	71 (32.87%)
Previous training	
Yes	110 (50.93%)
No	106 (49.07%)

Before BLS training, the technical professional group had relatively inadequate knowledge (55.07 ± 21.79) compared to the medical professional group (68.18 ± 15.28) and the previous training experience group (68.55 ± 17.19). There were no notable connections found between participants' level of knowledge and their age, gender, education, years of work, professional title and department. However, a robust association was noticed between the level of knowledge and the participants who had prior training scored significantly higher (t = 4.00, $p < 0.001$) as shown in Table 2. Following BLS training, the overall BLS scores of participants exhibited a significant enhancement across all sociodemographic categories, irrespective of age, gender, educational background, work experience, professional designation or previous training. The average rise in examination scores was approximately 30%. After adjusting for sociodemographic characteristics, our linear regression analysis revealed that the BLS training courses had a significant effect on improving BLS scores (β = 27.30, $p < 0.001$, 95% confidence interval (CI): 24.47–30.13) as shown in Table 3.

TABLE 2. Analysis of the basic life support test score differences of medical postgraduates before and after basic life support training.

Variables	Pre-BLS training (A)		Post-BLS training (B)		A *vs.* B
	Total score	*F*/*t*	Total score	*F*/*t*	*p*-value
Age group					
20–25	65.91 ± 21.25	2.81	92.01 ± 11.49	2.04	0.0003
26–30	58.64 ± 16.02		88.39 ± 12.88		0.0001
31–40	63.75 ± 20.03		88.75 ± 16.20		0.0137
Gender					
Male	61.55 ± 19.46	−0.58	88.55 ± 13.01	−1.68	0.0007
Female	64.63 ± 20.30		91.71 ± 11.74		0.0010
Education					
Junior college	65.33 ± 23.34	1.35	89.00 ± 14.17	1.46	0.0034
Undergraduate	65.29 ± 20.69		91.97 ± 11.24		0.0008
Masters or PhD	60.39 ± 17.73		89.06 ± 13.33		0.0007
Years of experience					
<1 yr	64.40 ± 19.86	0.91	91.21 ± 12.12	0.40	0.0004
2–3 yr	58.41 ± 22.11		88.86 ± 11.33		0.0009
>4 yr	65.42 ± 19.94		90.00 ± 14.14		0.0062
Professional title					
Primary	63.94 ± 20.13	0.14	90.87 ± 12.15	−0.27	0.0008
Middle	58.75 ± 19.31		92.50 ± 11.90		0.0238
Department					
Medical	68.18 ± 15.28	11.03	94.17 ± 7.23	12.75	0.0002
Pharmaceutica	67.92 ± 27.50		90.42 ± 16.61		
Technical	55.07 ± 21.79		85.49 ± 14.93		
Previous training					
Yes	68.55 ± 17.19	4.00	92.32 ± 10.79	1.76	0.0006
No	58.96 ± 21.73		89.43 ± 13.26		0.0009

BLS, basic life support; F/t, analysis of variance/t-test.

4. Discussion

Globally, cardiac arrest stands as a prevailing factor contributing to mortality among the adult population. In China, over 230 million people suffer from cardiovascular disease, and around 550,000 have cardiac arrests annually [13]. Effective rescue within 3–5 minutes of cardiac arrest onset can significantly increase the chances of survival, according to World Health Organization guidelines. Despite ongoing progress in CPR technology, survival rates following cardiac arrest vary greatly between countries or regions. High-quality BLS knowledge and skills in BLS can improve survival and reduce disability rates of cardiac arrest patients. However, this requires improving the BLS knowledge and skills of medical personnel and the public. It also presents challenges for the developers of CPR training curriculums [14, 15].

In this study, the dependent variable was the BLS scores before BLS training. The explanatory variables included gender, age, educational background, years of work, professional title, major and previous participation in similar training. We found a significant correlation between BLS knowledge and previous BLS training, which aligns with findings from previous research [16]. It has been shown that an annual 50-minute training course is effective in maintaining BLS knowledge, while a brief review every four months is even more effective [17]. We recommend providing short, periodic BLS training sessions at medical schools and hospitals. Our study found that there were no significant differences in BLS test scores before or after the training, regardless of gender, age, educational level, years of work, professional title or profession (Table 2). Analogous findings were procured in a survey conducted in Nepal, pertaining to the understanding of BLS among healthcare professionals [18]. However, surveys carried out in Portugal and India have found that there are significant associations between BLS knowledge and education levels, gender, region and income. These differences could be due to variations in the ways that BLS information is communicated, including channels, methods and tools [7].

Most studies have found significant improvement in BLS scores after training, regardless of the teaching method [19].

TABLE 3. Basic life support test scores of medical postgraduates analyzed by linear regression.

Total score	*β*	SE	*p*-value	95% CI
Intervention				
Pre-intervention	Ref			
Post-intervention	27.30	1.44	<0.001	24.47–30.13
Age group				
20–25	Ref			
26–30	−5.29	2.35	0.025	−9.91–−0.68
31–40	−6.12	5.44	0.261	−16.81–4.56
Gender				
Male	Ref			
Female	2.22	1.66	0.180	−1.03–5.48
Education				
Junior college	Ref			
Undergraduate	−2.51	2.81	0.373	−8.04–3.02
Masters or PhD	−4.98	3.48	0.153	−11.81–1.85
Years of experience				
<1 yr	Ref			
2–3 yr	2.98	2.50	0.233	−1.93–7.90
>4 yr	4.64	4.23	0.273	−3.67–12.96
Professional title				
Primary	Ref			
Middle	−0.39	5.26	0.942	−10.72–9.95
Department				
Medical	Ref			
Pharmaceutical	−2.24	2.75	0.415	−7.62–3.16
Technical	−12.99	1.67	<0.001	−16.26–−9.72
Previous training				
Yes	Ref			
No	−5.29	1.51	0.001	−8.26–−2.31

CI, confidence interval; SE, standard error.

This finding aligns with the outcomes of our research. A study found differences in BLS knowledge and training effectiveness across countries [20]. Some experts have suggested that the reason behind the variation in quality of education could be attributed to various factors such as differences in teacher training, access mechanisms, the use of standardized video and synchronous teaching methods [21, 22], team cooperation training content, single veto skill assessment, the teacher team, BLS curriculum design and the training and assessment models [23, 24]. Previous studies aimed to optimize teaching methods, increase multimedia utilization and integrate simulation training [21].

The present standardized curriculum includes training on how to detect, prevent and monitor cardiac arrest. It also covers the recognition of ECG waveforms that are indicative of cardiac arrest, as well as general CPR and CPR for special populations such as pregnant women, children and infants. In addition, the curriculum teaches the use of automated external defibrillators. Based on our findings, it can be concluded that this program is effective in educating students in BLS. We found that 90% of the participants obtained good BLS test scores. However, due to the large number of trainees and limited training time, we were unable to assess their practical BLS skills. A review of CPR teaching methods found that BLS courses that only focus on CPR training, without emphasizing improving students' subjective initiative in emergencies, result in sub-optimal results. This could be a possible reason why some students in this study were unable to achieve satisfactory BLS test scores. BLS knowledge and skills can be improved through self-directed learning, realistic scenario simulations and video-guided exercises and various other methods [25].

A study comparing teaching methods in healthcare education found that mixed learning and interactive methods enhance knowledge, improve clinical skills and increase BLS knowledge accuracy compared to traditional models [26]. Since 2010, BLS training providers in China have focused on educating professional rescue personnel in the provision of high-quality CPR. However, the general public has poor BLS awareness and knowledge [27]. This was corroborated by our findings of markedly superior BLS proficiency among healthcare professionals in comparison to technicians, necessitating the need for resolution. Recent literature has emphasized the importance of a multi-system perspective, with the slogan, "Systems save lives". To improve cardiac arrest outcomes, it is essential to have both CPR knowledge within communities and advancements in emergency medical services. Crucially, it is important to develop strategies that improve communication and collaboration between non-professional rescue personnel and expert resuscitation teams Dedicated cardiac arrest centers have been established in different regions of the United States. These centers offer relevant lectures and CPR training to residents and groups. As a result, the awareness of BLS among medical professionals in all fields has significantly improved. Additionally, the number of non-professionals who can provide rapid life-saving care in emergencies has increased [28, 29].

5. Limitations and future research

The study is limited by a small sample size and a narrow scope of sample selection. There is a need for further evaluation of the BLS knowledge among standardized trainees. Additionally, the study primarily took the form of a longitudinal study, and the BLS training was carried out with large class sizes without controlling for variations in teaching modes or comparing with smaller class size training groups. Moreover, the study did not assess whether the individuals possessed practical BLS skills. These limitations may have influenced the BLS aptitude ratings of our sample, as well as the precision and applicability of the findings.

Furthermore, an issue of concern is the lack of innovation in the study design and methodology. To address these limitations and enhance the innovation of future research, randomized controlled trials of different training methods in different regions, with a multi-center sample recruited from both clinical and educational institutions can be conducted in future research to address these issues. Such trials would allow for a more comprehensive evaluation of BLS training effectiveness and provide valuable insights into the impact of class size and teaching modes on practical BLS skills. By addressing these issues, future research can offer more robust and applicable conclusions to inform BLS training practices.

6. Conclusions

The strong correlation between BLS training and BLS knowledge highlights the importance of improving BLS training programs. This emphasizes the need for everyone involved to work toward enhancing BLS training, not just as a professional obligation, but also as a societal responsibility. Ultimately, this will contribute to better emergency healthcare outcomes worldwide.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

BX and QH—designed the research study, wrote the manuscript. QH—performed the research. QH and PP—analyzed the data. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Biomedical Ethics Review Committee of West China Hospital of Sichuan University, Grant number: 493 in 2022. All participants provided consent to participate in the study. All methods were performed according to the relevant guidelines and regulations.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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