6-1-2020

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Recommended Citation

Paloncy, Kristin A., Leah Georges, and Allan J. Liggett. "A high-fidelity simulation is effective in improving athletic training students' self-efficacy with emergency cardiovascular care skills." Athletic Training Education Journal 14, no. 2 (2019): 108-116.

ATHLETIC TRAINING EDUCATION JOURNAL
© National Athletic Trainers' Association
www.natajournals.org
ISSN: 1947-380X
DOI: 10.4085/1402108

ORIGINAL RESEARCH

A High-Fidelity Simulation Is Effective in Improving Athletic Training Students' Self-Efficacy with Emergency Cardiovascular Care Skills

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Context: High-fidelity simulation can provide an ideal adjunct to clinical or real-world experience by providing a realistic and safe learning environment for the practice of low-incident encounters.

Objective: Given that levels of perceived self-efficacy are malleable and high-fidelity simulation can provide many positive outcomes, the purpose of this study was to determine whether participation in a high-fidelity simulated cardiovascular emergency scenario using the Laerdal SimMan in a university simulation center in the United States increased undergraduate athletic training students' self-efficacy scores.

Design: Cohort design with repeated measures.

Patients or Other Participants: Convenience sample of undergraduate athletic training students (n = 46) enrolled in a professional program at a National Collegiate Athletic Association Division I university in the Midwest.

Intervention(s): Participation in or observation of a high-fidelity cardiopulmonary resuscitation (CPR) simulation.

Main Outcome Measure(s): Self-efficacy scores before, immediately after, and 6 months after simulation.

Results: There was a significant main effect for the 3 repeated measures, with the scores steadily increasing significantly from pretest (mean = 7.60, SD = 1.13) to posttest (mean = 8.04, SD = 1.22, $P = .001$), then again from immediate posttest to the 6-month posttest (mean = 8.38, SD = 1.04, $P = .04$). Scores among the participants (mean = 8.21, SD = 1.03) were not significantly higher than scores among the observers (mean = 7.85, SD = 1.40). Scores at the 6-month follow-up posttest (mean = 8.38, SD = 1.04) significantly increased from the posttest immediately after the simulation ($P = .04$).

Conclusions: Participating in or observing high-fidelity CPR simulation is an effective method of providing deliberate practice opportunities for athletic training students to increase self-efficacy related to CPR techniques.

Key Words: CPR, teaching pedagogy, confidence

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Full Citation:
Paloncy KA, Georges L, Liggett AJ. A high-fidelity simulation is effective in improving athletic training students' self-efficacy with emergency cardiovascular care skills. *Athl Train Educ J.* 2019;14(2):108–116.

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KEY POINTS

- Due to the low incidence of cardiovascular emergencies within athletic training, students may not have the opportunity to practice these skills in a clinical environment during their education.
- Perceived self-efficacy is malleable and enhancement may improve clinical performance during cardiovascular emergencies by increasing efficiency expectations.
- High-fidelity cardiopulmonary resuscitation simulation is an effective method of providing deliberate practice opportunities for athletic training students to increase self-efficacy related to cardiopulmonary resuscitation techniques.

INTRODUCTION

Inherent in the profession of athletic training is the ability to manage on-the-field emergency events appropriately. One of these emergency events includes rarely occurring but high-risk (life-threatening to the patient) situations involving emergency cardiovascular care. Certified athletic trainers and athletic training students are required to maintain Emergency Cardiovascular Care (ECC) certification in order to practice as health care providers.[1] Typical ECC certification, often referred to as *basic life support* (BLS) consists of a course that includes passive lecture and one-time skill stations followed by successful completion of both a written examination and practical assessment using static or low-fidelity task-trainer models. The ECC certification courses may be offered by a variety of providers, but all approved athletic training–related providers adhere to the International Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.[1] The expectation after ECC certification is the ability of the provider to perform the correct sequence of interventions to provide initial management of cardiovascular emergencies.[2]

When cardiovascular emergency encounters do occur, they are considered high risk because the athlete's life is in jeopardy. In an investigation from 2003 to 2013 of the incidence and etiology of death in National Collegiate Athletic Association athletes, 514 of 4 242 519 student-athletes died.[3] In other terms, according to Van Camp et al,[4] the incidence of sudden cardiac death requiring emergency cardiovascular care in high school athletes is estimated to be from 1:100 000 to 1:200 000. According to Harmon et al,[3] second to accidents, medical causes accounted for 147 (29%) of these student-athlete deaths, 79 of those due to sudden cardiac death.

Due to the low incidence of cardiovascular emergencies within athletic training, students and professionals may not have the opportunity to practice these skills in a clinical environment during their education.[5] In addition, current practices of ECC training and assessment using low-fidelity equipment are not providing participants deliberate practice opportunities that mimic realistic conditions, which may affect initial skill development. Cardiovascular emergencies are rare clinical events that require competency with saving the life of a victim. Therefore, it is of particular concern for both initial training and skill retention that the athletic trainer and athletic training students develop both skill and confidence to manage these encounters.

Until recently, many medical and health professions including athletic training have assumed that competency attained through successful ECC certification would translate to clinical competence in lifesaving cardiovascular skills. However, recent studies offer evidence that cardiopulmonary resuscitation (CPR) performance both in and out of the hospital setting in the United States is deficient.[6,7] One study reported that during a code event within a hospital setting, physicians and nurses displayed poor adherence to the American Heart Association (AHA) guidelines during cardiovascular emergencies.[8] Within this study conducted at the University of Chicago in an academic teaching hospital, neither the depth nor the rate of chest compressions in BLS-trained internal medicine residents and nursing staff were of a quality to meet AHA guidelines.[8] In another study, Wik et al[9] studied 176 cases of out-of-hospital cardiovascular arrests treated by nurses and paramedics. Chest compressions were not delivered 48% of the time and approximately half the compressions (45% to 51%) were without adequate depth.[9] Both studies concluded that the health care providers trained with one-time skill stations and low-fidelity equipment were poorly prepared, practiced insufficiently, and lacked the confidence to manage cardiovascular emergencies that occurred at a low incidence in each of these settings.[9,10]

Efficiency expectation is defined as how confident an individual is of performing the necessary behavior to achieve a certain desired outcome.[11] The efficiency expectation can affect the amount of exertion and perseverance that an individual puts forth when an adverse reaction occurs. An example of this can be found in examining the confidence levels of health care providers in performing CPR on pediatric patients. Through a series of 3 case reports, Maibach et al[12] identified that clinicians were less likely to initiate and sustain ECC skills on pediatric patients when the clinicians felt they did not have adequate experience with this population. One case found that a pediatric internal medicine physician performed emergency management skills on a pediatric patient for just 10 minutes before pronouncing time of death, which is significantly less time than expected to discontinue treatment; the professional had done so due to a lack of self-confidence in the ability to perform these skills correctly.[12] It was concluded that when clinicians lack the self-confidence to perform a desired set of skills, they are less likely to exert the effort and to persevere in providing CPR to these patients.[12] Bandura[13] explains that if individuals have a high efficiency expectation, even in the face of adversity, they will likely judge themselves as more confident to perform certain skills and, therefore, are more likely to persist to reach a certain outcome. Therefore, outcome expectations are dependent upon efficiency expectations.[14]

Self-efficacy refers to beliefs in one's ability to perform a task (behavior), whereas *confidence* is a nondescript term that refers to the strength of belief but does not specify what the certainty is about. Self-confidence has been measured in previous athletic training simulation literature[5] but is used as a vague catchword referring to strength of belief rather than a construct embedded in a theoretical system. Advances within literature are best achieved by constructs that are fully rooted in theory; this pays dividends to operational guidelines such as self-efficacy which includes both an affirmation of capability level and the strength of that belief.[11,15]

Self-efficacy is a changeable attribute that may be enhanced through training.[11,15] Enhancing athletic training students' self-efficacy through high-fidelity simulation training may enhance their clinical performance during cardiovascular emergencies by increasing their efficiency expectations. Results of a multicenter study that included 300 physician assistant students over 14 accredited programs revealed that self-efficacy scores were a significant predictor of a student's clinical performances.[16] In another study, Wayne et al[8] conducted a follow-up survey with 40 internal medicine residents following ECC simulation-based training programs that provided participants with deliberate practice opportunities to respond to cardiovascular emergencies. It was reported that participants who had higher self-reported feelings of confidence after the simulation were also more likely to adhere to ECC guidelines in response to clinical cardiovascular emergencies.[8]

The *fidelity* (or realism) of a simulation is defined as the learner's ability to suspend reality and become immersed in an authentic scenario or replicated patient encounter; the higher the fidelity, the more likely it is to provide the learner with a realistic encounter.[17] Ranges of low-fidelity (task trainers, mannequins) to midfidelity (standardized patients) to high-fidelity (computerized instructor-controlled mannequins) simulations have been incorporated into the training of health care programs for decades.[5,18] In recent years, this has also included being incorporated into athletic training programs.[5,18] High-fidelity simulation can provide an ideal adjunct to clinical or real-world experience by providing a realistic and safe learning environment for the practice of low-incidence clinical encounters.[19,20] Though literature on many medical and health care professionals demonstrates high-fidelity simulation to be an effective mode of providing opportunities to develop self-efficacy, efficiency, and skill competency in low-incident events, studies within athletic training are limited. It is important to differentiate the unique nature of traditional athletic training settings as compared with the other professions studied because athletic training typically involves on-the-field management of ECC encounters, whereas literature on medical and health care professionals involves in-hospital ECC encounters with access to advanced equipment and on-site rapid response teams. Given the unique nature of athletic training settings, what is unknown is whether emergency cardiovascular high-fidelity simulation will result in increases in self-efficacy ratings for athletic training students. Management of ECC encounters in most athletic training settings is done outside of the hospital, with different equipment and other situational factors than those studied in other simulation literature; therefore, conclusions cannot be drawn with regard to athletic training. Given that levels of perceived self-efficacy are malleable and high-fidelity simulation can provide many positive outcomes, the purpose of this quantitative quasi-experimental study was to determine whether participation in a high-fidelity simulated cardiovascular emergency scenario using the Laerdal SimMan (Laerdal Medical, Wappingers Falls, NY) in a university simulation center in the United States increased undergraduate athletic training students' self-efficacy scores. Specifically related to the central research question in this cohort design with repeated measures study, the following 3 hypotheses were investigated:

- Hypothesis 1: Participation in or observation of a high-fidelity cardiovascular emergency simulation will increase self-efficacy among all participants and observers.
- Hypothesis 2: Those who participate in a high-fidelity cardiovascular emergency simulation will have higher self-efficacy scores than those who observe the simulation.
- Hypothesis 3: High-fidelity simulation effects on self-efficacy ratings will persist at 6 months after participation in or observation of a high-fidelity cardiovascular emergency simulation.

METHODS

Participants

After reading and signing the informed consent form, the convenience sample of undergraduate athletic training students ($N = 46$) enrolled in a professional program completed the study. Almost half the participants in the study (47.8%) were second-year students ($n = 22$) who had completed 3 semesters in the professional athletic training program. The remaining 52.2% of the study participants comprised third-year athletic training students ($n = 24$) who had completed 5 semesters in the professional athletic training program. The majority of participants were women (65.2%, $n = 30$). Ages of the participants ranged from 19 to 31 years, with the majority of participants aged 20 years (34.8%, $n = 16$) or 21 years (41.3%, $n = 19$). The majority of participants had between 1 and 3 years of BLS certification (71.8%, $n = 33$), with 21.7% ($n = 10$) of participants holding additional certifications as a lifeguard or emergency medical technician. The 10 who held additional certifications were not excluded from the study because all of these students had all previously held these certifications and none were actively working in these other areas during their time in the athletic training program or the study. The majority of participants (95.7%, $n = 44$) had not been part of a real-life cardiovascular emergency experience where they had to perform CPR skills such as chest compressions or ventilations. The 2 students who reported being a part of a real-life cardiovascular emergency experience did not have a hands-on role in chest compressions or ventilations and either were observers or hands-off assistants; therefore, they were included within the current study. Finally, approximately half the participants (52.2%, $n = 24$) had never participated in a high-fidelity CPR simulation before this experience, whereas the remaining ($n = 22$) participants reported participating in 1 high-fidelity CPR simulation before the current experience. The students who had participated in a high-fidelity CPR simulation had done so as part of a previous clinical practicum course requirement 1 year before the study. Finally, none of the

Table 1. Demographic Descriptions of Athletic Training Students (N = 46)

Variable	Frequency	Percentage
Level in program		
Second year	22	47.8
Third year	24	52.2
Sex		
Male	16	34.8
Female	30	65.2
Age, y		
19	2	4.3
20	16	34.8
21	19	41.3
22	4	8.7
23	2	4.3
25	2	4.3
31	1	2.2
Years basic life support certified		
1	11	23.9
2	9	19.6
3	13	28.3
4	5	10.9
5	2	4.3
6	3	6.5
7	1	2.2
8	1	2.2
9	1	2.2
Additional certifications		
Yes	10	21.7
No	36	78.3
Real-life encounter		
Yes	2[a]	4.3
No	44	95.7
Previous simulation exposure		
Yes	22	47.8
No	24	52.2

[a] Observers only as indicated in the earlier article text.

students who participated in this study completed an ECC certification or recertification course during the 6 months before the final posttest. A complete list of descriptive demographics may be viewed in Table 1.

Procedures

This study was approved by the institutional review board at the institution where data were collected. Participants self-selected into groups of 4 on the basis of available times posted, and they reported as a group to the simulation center the day of the study. Groups of 4 were further divided into pairs when they reported to the simulation center by randomly drawing a color that represented a group: participation or observation. According to their group assignment, they either participated in or observed a high-fidelity emergency cardiovascular simulation using the Laerdal SimMan. All participants (both groups) completed the demographic intake form and the Emergency Cardiac Care Appraisal Inventory (ECCAI) survey that served as the pretest self-efficacy score. Two cardiovascular emergency scenarios were used in this study. The investigator alternated use of the scenarios equally throughout the groups. The simulation scenario began with the 2 observers in the room with the mannequin and the 2 participants outside of the room. The observers were given specific instructions by the principal investigator that they were to not intervene in any way in the scenario and could not respond if the participants asked them to physically do something. While standing outside of the simulation room and not able to view the mannequin (victim), the 2 participants were read an opening sentence describing the background of the scenario. After the background statement, the 2 participants were told to proceed into the simulation room to respond to the victim.

When the participants entered the room with the mannequin, the principal investigator took position in an adjacent control room. From the control room the investigator manipulated physiological responses of the mannequin from the computer and observed the participants' actions through audio and video. The scenarios each took from 10 to 15 minutes to complete. Included in each of the scenarios was a cardiovascular emergency where the victim became pulseless and lifeless, requiring a response of CPR from the participant(s).

Following the conclusion of the simulation scenario, the group of 4 (participants and observers) participated in an instructor-led debriefing session that lasted 15 to 20 minutes. The instructor-led debriefing included a discussion of what the participants did well, why they made the treatment decisions they did, what went poorly, and what may lead to better outcomes in similar future clinical encounters. An important goal of the debriefing is to provide students with an objective reality based on the actions they performed in an honest but supportive manner. For example, the depth of compressions that the participant demonstrated as compared with the required depth to adequately circulate blood in a victim may be discussed. Both the participants and observers participated in the debriefing discussion. Immediately after the debriefing, all participants (participation and observation group) completed the ECCAI survey that served as the first posttest self-efficacy score in this cohort design with repeated measures study. The participants were then thanked for their time and dismissed from the simulation center.

Six months after completion of the simulation scenario, all participants (participation and observation group) again completed the ECCAI survey that served as the second posttest self-efficacy score over time. In highly critical events such as emergency cardiovascular care, emotions and stress can influence actions and reactions.[20] It takes time to assimilate the actions and learning of this type of experience.[21] Previous literature identifies that CPR-related learning outcomes are able to be retained for up to 1 year after high-fidelity simulation.[6,20] Therefore, we believed the posttest measurement of self-efficacy administered 6 months after the simulation would provide more accurate insight into the student's true assessment of self-efficacy over time. After completion of this second posttest survey, participants were thanked for their time and told their participation in the study was complete.

Instrument

Perceived self-efficacy in performing emergency cardiovascular care was measured using the ECCAI survey instrument.

The instrument contains 20 questions, each measured on an 11-point Likert scale. The total mean scores for the instrument range from 0 to 10. The same instrument was used for both pretest and posttest measurements. This survey instrument was developed by the primary investigator using Bandura's[22] published guide for constructing self-efficacy scales. All 20 questions focus on task components that are required to respond to an emergency cardiovascular event. Because these initial-level task components lend strength to an individual's self-regulatory measure of efficiency expectation in the face of challenge within an encounter, the current study was used to establish evidence that athletic training students have the self-efficacy to believe they can perform the tasks necessary to successfully execute CPR on a victim. We were deliberate in constructing this survey under strict published guidelines on self-efficacy in order to gather validated information on degrees of confidence in performing ECC-defined skills. Previous literature within athletic training[5] and many other health care disciplines focuses on overall confidence with the ECC response (not specific skills within the response) and are not specific to an assessment of the degree of confidence an individual has in relation to executing specific ECC skills.[19,21] Instead, previous research within athletic training focuses on a more vague assessment of ECC confidence that does not use self-efficacy guidelines to assess specific tasks within an encounter. The current study allows for stronger conclusions to be drawn regarding self-efficacy as it relates to efficiency expectations and performance expectations. Questions on the ECCAI survey assessed the degree of confidence an individual felt with skills related to ECC. Examples of questions are "Recognize the factors associated with cardiovascular emergencies" and "Complete an initial assessment within 15 seconds of arriving on the scene of an emergency." Higher-level self-regulatory efficiency expectations, or a measure of whether athletic training students have the self-efficacy to continue the behavior in the face of challenges or adversity (such as breaking a rib or a delay in emergency medical services response), can be evaluated in future studies once the initial task efficiency level and self-efficacy has been established.

The ECCAI survey instrument was examined for face validity by a panel of experts (N = 6) who all had greater than 10 years of teaching experience in athletic training education and were all emergency cardiac care instructors for more than 10 years. Several slight modifications were made to the survey instrument on the basis of their feedback.

Using a 6-point Likert scale ranging from 0 to 5, the same panel of experts (N = 6) examined the questions for content validity, responding to how useful and appropriate each question rated. Essential scores were identified as 4 and 5 and coded as 1 in the data analysis. Nonessential scores from the experts (0, 1, 2, 3) were coded as a 0 in the data analysis. The content validity index was calculated at 0.93. Using Lawshe's[23] content validity index table with a level of significance set to a P value of .05, the content validity was recorded as CV(6) = 0.800, $P < .05$; thus, it can be judged as having excellent content validity.

Reliability of the ECCAI survey instrument was determined by running a Cronbach α on a sample of athletic training alumni (N = 27) to determine the internal consistency or average correlation of the items in the survey instrument.

Table 2. Demographic Descriptions of Mean ECCAI Survey Results

Measure	Group	Mean ± SD	n
Total pretest	Participation	7.72 ± 0.98	24
	Observation	7.47 ± 1.27	22
	Total	7.60 ± 1.13	46
Total immediate posttest	Participation	8.21 ± 1.03	24
	Observation	7.85 ± 1.40	22
	Total	8.04 ± 1.22	46
Total 6-mo posttest	Participation	8.46 ± 0.89	24
	Observation	8.29 ± 1.19	22
	Total	8.38 ± 1.04	46

Abbreviation: ECCAI, Emergency Cardiac Care Appraisal Inventory.

Tavakol and Dennick[24] state acceptable values of α range from 0.70 to 0.95. Anything lower than 0.70 is likely interpreted as poor interrelatedness between items and an α value above 0.95 is a sign of redundancy. The overarching α for the whole instrument was calculated at the value of 0.95, which suggests the instrument is highly reliable.

Data Analysis

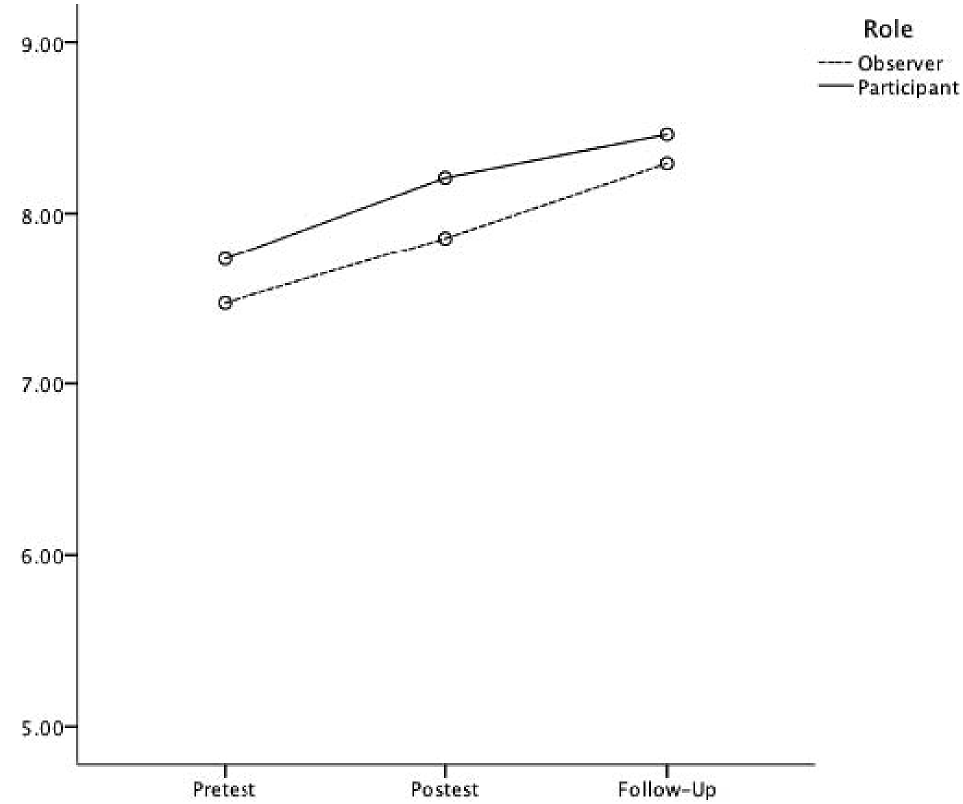
Responses from the ECCAI survey instrument were recorded and analyzed in the IBM SPSS Statistical Package for Windows (version 21; IBM Corp, Armonk, NY). Following the recommendations of Tabachnick and Fidell[25] on how to analyze multivariate statistics, data were screened for accuracy, missing data, univariate outliers, and normality. No violations to the assumptions about the data were found.

The program G*Power[26] was used to conduct a sensitivity power analysis. Using the setting for the F test family, specifically repeated measures analysis of variance (ANOVA) between factors, and given that there were 46 students in the cohort, 2 groups, 3 repeated measurements, minimum $r = 0.472$ among repeated measures, with $\alpha = 0.05$, and power at 95%, we could detect effect size of Cohen $f = .4375$. Using Cohen's[27(p276)] formula $\eta^2 = \frac{f^2}{(1+f^2)}$, the Cohen f converted to an η^2 value of 0.16. Cohen's conventions for interpreting partial η^2 effect size in a repeated measure ANOVA are as follows: 0.02 is a small, 0.13 is a medium, and 0.26 is a large effect size. The value of 0.16 places this study at a medium to large effect size.

Responses to the 20-question ECCAI survey were totaled for each participant's pretest, immediate posttest, and 6-month posttest, and the mean scores were calculated and compared between the 2 groups: participation and observation. Descriptive statistics for total mean values are reflected in Table 2. A general linear model repeated measures ANOVA (pretest, immediate posttest, 6-month posttest) with a between-subjects factor (participation versus observation) was used to compare the mean scores. After the significant ANOVA tests, post hoc tests were conducted using the Tukey honestly significant difference (HSD) test to compare mean differences within groups.

Hypothesis 1: Overall Simulation Efficacy. A 3 × 2 repeated measures ANOVA (Measure: Pretest, Immediate

Figure. Participation and observation groups comparison.



Posttest, 6-Month Posttest × Group: participant versus observer) was used to test Hypothesis 1, followed by a series of Tukey HSD post hoc analyses to identify the location of mean differences.

Hypothesis 2: Participation and Observation Effects. A 3 × 2 repeated measures ANOVA (Measure: Pretest, Immediate Posttest, 6-Month Posttest × Group: participant versus observer) was used to test Hypothesis 2 followed by a Levene Test of Equality of Error Variances with significance at the 0.01 level recommended by Tabachnick and Fidell,[25] which assessed the homogeneity of variance for the between-subjects factor.

Hypothesis 3: Persistence of Effects. The same 3 × 2 repeated measures ANOVA used to test the first 2 hypotheses were also used to test Hypothesis 3, followed by a series of Tukey HSD post hoc analyses to identify individual mean differences.

RESULTS

Hypothesis 1 stated that participation in or observation of a high-fidelity cardiovascular emergency simulation will increase self-efficacy among all participants and observers. There was a significant main effect for the 3 repeated measures ($F_{2,43} = 12.73$, $P < .001$, $\eta^2_p = 0.37$), with the scores steadily increasing significantly from pretest (mean = 7.60, SD = 1.13) to immediate posttest (mean = 8.04, SD = 1.22, $P = .001$), then again from immediate posttest to the 6-month posttest (mean = 8.38, SD = 1.04, $P = .04$). Hypothesis 1 was supported.

Hypothesis 2 stated that those who participated in a high-fidelity cardiovascular emergency simulation would have higher self-efficacy scores than those who observed the simulation. There was not a significant between-subjects main effect for group ($F_{1,44} = 0.83$, $P = .37$, $\eta^2_p = 0.018$). Scores among the participants (mean = 8.21, SD = 1.03) were not significantly higher than scores among the observers (mean = 7.85, SD = 1.40). It is clear from the overall nonsignificant group effect that there were no differences between groups (participant or observation) at any of the levels (pretest, immediate posttest, and 6-month posttest). Therefore, it was not necessary to conduct follow-up post hoc analyses to evaluate mean differences between groups. Hypothesis 2 was not supported and is represented in the Figure. The Levene test of equality of error variances was not significant at the .01 level ($F_{1,44} = 3.56$, $P = .07$), indicating that the assumption of homogeneity of variance had been met for the between-subjects factor.

Hypothesis 3 stated that high-fidelity simulation effects on self-efficacy ratings would persist at 6 months after participation in or observation of a high-fidelity cardiovascular emergency simulation. As noted previously, there was a significant main effect for the 3 repeated measures ($F_{2,43} = 12.73$, $P < .001$, $\eta^2_p = 0.37$). The Tukey HSD post hoc analyses revealed that scores at the 6-month follow-up posttest (mean = 8.38, SD = 1.04) significantly increased from the posttest immediately after the simulation to the 6-month follow-up posttest ($P = .04$). Therefore, there was a significant increase in the self-efficacy rating from the immediate posttest to the 6-month follow-up posttest. Hypothesis 3 was supported.

Other than progression in the professional athletic training program, the only other descriptive difference between these 2 groups is that the group of third-year athletic training students had participated in 1 high-fidelity simulation more than 1 year before the study. Given the inclusion criteria justifications, it was important to demonstrate that there were no differences in the levels of the students due to prior simulation experience. Therefore, in order to better understand the nature of the increase from immediate posttest to 6-month follow up, a post hoc analysis was conducted using a 2 × 2 repeated measures ANOVA (total score from immediate posttest to 6-month posttest) with a between-subjects factor (second-year versus third-year students) to determine whether the first time an individual completes a high-fidelity simulation it has more of an impact over time than subsequent encounters in a simulation lab. As was expected based on the previous analysis, there was a significant main effect for change in total score from immediate posttest to follow-up ($F_{1,44} = 4.84$, $P = .04$, $\eta^2_p = 0.09$), but there was not a significant interaction for year in athletic training between second-year students (mean = 8.67, SD = 0.95) and third-year students (mean = 8.12, SD = 1.06) on the posttest ($F_{1,44} = 0.081$, $P = .79$, $\eta^2_p = 0.002$), indicating that neither cohorts of students significantly differed from posttest to follow-up and difference had no impact on the perceptions of self-efficacy.

DISCUSSION

An increase in perceived self-efficacy after a high-fidelity simulation is consistent with findings reported in anesthesia,[14] nursing,[21] surgical training,[28] and emergency medicine.[2] The current study provides evidence that the perceived self-efficacy of athletic training students who participate in or observe a high-fidelity cardiovascular simulation increases over time.

The current study provides evidence that there is no difference in self-efficacy gains between athletic training students who participate in a high-fidelity simulation and those who observe one; both groups' self-efficacy increased. This finding is consistent with the literature providing evidence of the positive learning opportunities for the observer role in a high-fidelity simulation.[29,30] For example, in a multi-site study of 908 nursing students, Jeffries and Rizzolo[30] studied the effects of knowledge, performance, confidence with performing skills, and satisfaction with the learning strategy (simulation-based learning). In this pretest-posttest experimental design focused on nursing postoperative and postpartum clinical skills, the researchers found that after a high-fidelity simulation there was no difference between the participant and observer roles in student learning outcomes related to confidence and satisfaction.

Hober and Bonnel[29] evaluated strategies to engage nursing student observers (N = 23) in a high-fidelity simulation. Through qualitative interviews, this study found that providing observers an opportunity to conceptualize the learning experience, capture the big picture, and connect with the team (all achieved in the debriefing after the simulation) allowed those in the observer role to feel engaged and valued as a team member. Other studies[31,32] supported the benefits in increased self-confidence, clinical proficiency, and patient safety for students in the observer role when they are actively engaged in viewing the simulation and the subsequent debriefing. In fact, the debriefing immediately after a simulation has been identified to be the most important contribution to learning from the scenario for both participants and observers.[5,31,32]

The current study supports the incorporation of annual cardiovascular emergency simulation in professional athletic training programs. In a comparison of low-fidelity and high-fidelity CPR training over time, Hoadley[33] found those who participated in high-fidelity training had a significant increase in self-confidence that was retained over time (6 months) as compared with those who participated in low-fidelity training. In addition, within the group that participated in a high-fidelity simulation, the current study found that not only was the perceived self-efficacy of athletic training students maintained over a 6-month time period, but it actually increased over this time as compared with immediately postsimulation.[33] The current study supports the recommendation that when feasible, annual high-fidelity CPR simulation should be integrated into professional athletic training programs. Evidence suggests this will have a positive effect on the perceived self-efficacy of athletic training students that will increase over time.[33]

The use of high-fidelity simulation is a way to provide medical and health care students with deliberate practice opportunities for low-incident, high-risk events such as cardiovascular emergencies.[8,34] The current study supports the literature given that cardiovascular emergencies are rare within traditional athletic training practice settings, and therefore, students lack the clinical experience opportunities for this skill.[5] One advantage of high-fidelity simulation as compared with low-fidelity task training is that it strives to provide participants with a safe and realistic environment to practice clinical skills. It is evident through the effects on self-efficacy that athletic training students in the current study were able to sufficiently suspend reality and become immersed in the simulation scenario. This is significant because it provides support for the use of this educational tool as an effective method of providing deliberate practice opportunities for athletic training students to improve their skill and increase self-efficacy related to CPR techniques.

LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

It is important to note that whereas the current study demonstrated a significant increase in self-efficacy after high-fidelity simulation, the self-efficacy of athletic training students was rather high to begin with, shifting from about a 7 to an 8 on an 11-point scale. It is possible that the athletic training students rated their self-efficacy relatively high on the pretest because the scale asked about their efficiency expectations related to the tasks required to respond to a cardiac emergency. Efficiency expectations related to the higher-level self-regulatory analysis was not measured in the present study. Self-regulatory expectations would measure a student's self-efficacy related to continuing treatment in the face of challenges and adversity such as the feeling of breaking the patient's rib or a delay in emergency medical services to respond to the scene.[11] Perhaps if the ECCAI scale asked students to evaluate their self-efficacy related to these self-regulatory components rather than strictly tasks required for response, they would have rated their presimulation self-efficacy levels lower than they did in the current study.

The self-efficacy gains after participation in a high-fidelity simulation were assessed in this research study at 6 months after simulation to determine whether self-efficacy gains would be maintained over time. Post hoc analyses within the current study revealed that from posttest (immediately after participation in a high-fidelity simulation) to follow-up 6 months later, there were no differences between the second-year students and third-year athletic training students after the training. Other than progression in the professional athletic training program, the only other descriptive difference between these 2 groups is that the third-year athletic training student group had previously participated in 1 high-fidelity CPR simulation more than 1 year before the study. It would be interesting to explore whether year within the athletic training program (for example, first year versus fourth year) or multiple previous experiences in the simulation lab would have an impact on perceptions of self-efficacy. Multiple experiences may raise self-efficacy scores or these levels could eventually plateau and show no difference among those who have multiple experiences. This idea should be further explored in future studies and should also include certified athletic trainers with varying years of clinical experiences.

Though it makes sense that self-efficacy would increase over a short time after simulation, if the ECC skills are not performed in a clinical environment, eventually the self-efficacy of the athletic training student would plateau or decrease. Simply put, over time, and without opportunity for deliberate practice of this skill, participants will be less confident in their abilities to perform ECC skills in an actual clinical encounter. The current study provides evidence that perceived self-efficacy increases up to 6 months after a high-fidelity simulation. However, future studies should explore where the peak of self-efficacy appears and how long after 6 months postsimulation the perceptions of self-efficacy plateau or decrease.

The current study determined that high-fidelity simulation increased the self-efficacy of athletic training students related to their efficiency expectations on perceptions of ability to perform tasks within responding to a cardiac emergency. However, it did not compare that increase to the low-fidelity simulation that is currently used for training. Because the low-fidelity equipment is designed to provide learners with a mode of practicing BLS tasks such as chest compressions and delivering a breath, it would be interesting to investigate in future studies whether there was a difference between low-fidelity and high-fidelity simulation in self-efficacy for task-related expectations.

In addition, this study was based on the theory that self-efficacy facilitates knowledge and clinical performance.[13] Now that it has been established that high-fidelity simulation increases the perceived self-efficacy of athletic training students, future research should investigate effects on knowledge and performance of BLS skills. Replicating the study with the examination of clinical competence for the participants' skills may provide information concerning the degree to which self-efficacy affects performance. Though self-efficacy mediates clinical performance, participants feeling they are able to do something (confidence) is not the same as actually effectively performing that skill; therefore, a study that measures both would be a valuable contribution to the literature.

The current study used a cohort design with repeated measures. Replicating the study using an independent, randomly selected control group that does not participate in or observe a high-fidelity simulation would minimize the internal validity threats of the current study and improve the strength of the study findings. The control group either could have no participation in a simulation or could use the same BLS scenario but perform the simulation on a low-fidelity task trainer.

Finally, much of the previous literature cited measured self-efficacy over a 1-year time period.[35,36] Future studies such include additional longitudinal measurements to include one year so a determination may be made about how long the gains in self-efficacy may be expected in athletic training students who participate in a high-fidelity simulation.

CONCLUSIONS

The aim of this study was to design an evidence-based solution to provide deliberate practice opportunities to athletic training students that would result in increased perceived self-efficacy relating to emergency cardiovascular care. This was achieved through providing athletic training students with an opportunity to participate in or observe a high-fidelity cardiovascular emergency simulation scenario. Through a quantitative quasi-experimental study design, it was found that both participation in and observation of a high-fidelity simulation significantly increases the self-efficacy of athletic training students from before and immediately after simulation. In addition, there was a significant increase in perceived self-efficacy of athletic training students 6 months after completion of a high-fidelity ECC simulation. It can be concluded that high-fidelity simulation has a significant positive effect on self-efficacy over time for athletic training students.

On the basis of the results of this study, it is recommended that when feasible, annual high-fidelity cardiovascular emergency simulation be incorporated into professional athletic training programs. The current study demonstrated that the self-efficacy of athletic training students related to cardiovascular emergency skills improves after high-fidelity simulation. Self-efficacy facilitates knowledge and clinical performance.[37] If an athletic training student lacks self-efficacy for cardiovascular emergency management, there would be a concern that the student may not apply certain skills or hesitate before providing treatment due to lacking the self-efficacy for cardiovascular emergency management. This could adversely affect patient outcomes. It is evident through the outcomes of the current study that the use of this educational tool is an effective method of providing deliberate practice opportunities for athletic training students to improve their skill and increase self-efficacy related to CPR techniques.

Acknowledgments

We wish to acknowledge Dr Todd Daniel at RStats Institute for his assistance with statistical analysis.

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