Original Article

The Effects of Virtual-Augmented Reality Training on Anxiety among Operating Room Students Attending Coronary Artery Bypass Graft Surgery

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ABSTRACT

Background: Operating room (OR) students experience varying levels of anxiety during their internship program in the OR. Educational technology has the potential for reducing anxiety. **Objectives:** This study aimed at assessing the effects of training based on virtual-augmented reality (VAR) on anxiety among OR students attending coronary artery bypass graft (CABG) surgery. **Methods:** This randomized controlled trial was conducted in 2020. Thirty-six OR students were conveniently recruited and randomly allocated to an intervention (n = 18) and a control (n = 18) group. Participants in the control group received conventional training, whereas their counterparts in the intervention group received VAR training through watching a 360-degree VAR video of CABG surgery in addition to conventional training. The State-Trait Anxiety Inventory was used for anxiety assessment in both groups at three time points, namely before entering the OR on the first day of the internship program, after entering the OR but before scrub, and on the last day of the program. The data were analyzed through the independent-samples t test, the Chi-square test, and the repeated-measures analysis of variance. **Results:** There was no significant difference between the intervention and the control groups regarding the pretest mean scores of state anxiety (40.61 ± 7.63 vs. 41.59 ± 5.09; P = 0.66) and trait anxiety (39.17 ± 7.39 vs. 39.29 ± 6.05; P = 0.96). However, the mean scores of state and trait anxiety in the intervention group were significantly less than the control group at both the first posttest (33.17 ± 6.16 vs. 45.06 ± 8.69 and 33.56 ± 6.19 vs. 42.59 ± 6.62; P < 0.001) and the second posttest (32.39 ± 4.62 vs. 42.35 ± 6.14 and 32.94 ± 5.20 vs. 41.0 ± 5.58; P < 0.001). **Conclusion:** VAR training is effective in significantly reducing anxiety among OR students attending CABG surgery.

KEYWORDS: *Anxiety, Augmented reality, Cardiac surgery, Virtual reality*

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Introduction

The OR students receive a large part of their education in clinical settings, particularly in the OR.[1,2] The apprenticeship model, known as the Halsted's model, is one of the basic training methods for these students. In this model, OR students acquire surgical skills through actual practice in the OR.[3,4] The OR is the best environment for practical training, and it provides students with the opportunity to gain real-life professional experiences. However, practical training in the OR poses some challenges and limitations, such as the presence of a large number of students in a small environment, high levels of stress due to the unpredictability of surgical conditions, disturbed concentration, patient safety concerns, and non-repeatability of surgical procedures.[5-7] These challenges and limitations reduce training effectiveness and increase students' anxiety and stress.[8]

Anxiety is an inner emotion that is characterized by a state of turmoil and a feeling of unease, leading to dysfunction and poor decision making.[9] Some massive surgical procedures, such as CABG surgery, are associated with high levels of responsibility for OR students, provide limited opportunity and time for learning, and, hence, cause OR students high levels of anxiety.[10] Unmanaged anxiety among students can negatively affect their learning, learning outcomes, performance, and patient care.[11] Therefore, strategies are needed to reduce their anxiety, improve their clinical skills, and enhance their satisfaction before they attend a patient's bedside in clinical settings.[8,12]

An important strategy for reducing anxiety among OR students is virtual training. Virtual training can provide students with excellent learning opportunities, particularly during the current pandemic of coronavirus disease 2019,[13] which has suspended many university classes and internship programs.[14] One of the methods for virtual training is VAR, which consists of virtual reality (VR) and augmented reality (AR).[8,15,16] The VR is a simulated three-dimensional environment or image created using special electronic devices. It provides students with the opportunity to imagine physical presence in a nonphysical world.[17] The VR was introduced by Jaron Lanier in 1987 and was first used in health care in the early 1990s to visualize complex medical data during surgeries and perform preoperative planning.[18]

In AR, computer-generated models or virtual information, such as images, videos, texts, and audio, are superimposed on real images and videos in order to enhance users' perceptions of their physical surroundings.[19] In other words, AR technology integrates virtual objects into the real world to improve learners' skills, such as critical thinking.[20] The term "AR" was introduced by Tim Caudell in 1990.[21]

The results of previous studies into the effects of VR and AR are contradictory. For example, a study showed that VR exposure training significantly reduced performance anxiety among musicians.[22] Similarly, a study revealed that VR significantly reduced anxiety among dental patients during dental procedures.[23] Moreover, a study showed that VR and counterstimulation had significant effects on dental anxiety among children undergoing pulpectomy.[24] Contrarily, a study on 11 patients with combat-related posttraumatic stress disorder revealed that there was no significant difference between the effects of VR exposure therapy and control exposure therapy.[25] Another study showed that human-based anesthesia simulator training caused acute stress and anxiety for nursing students.[26]

The contradictory results of previous studies into the effects of VR and AR highlight the importance of further studies in order to produce more conclusive evidence in this area. Moreover, to the best of our knowledge, the effects of these methods had not yet been assessed on anxiety among OR students during CABG surgery. Therefore, the present study was conducted to address these gaps.

Objectives

This study aimed at assessing the effects of VAR training on anxiety among OR students attending CABG surgery.

Methods

This single-blind randomized clinical trial was conducted on 36 undergraduate eight-semester OR students who attended their internship program in Shahid Chamran hospital from February to August 2020. This hospital is a leading teaching hospital in Isfahan, Iran. Inclusion criteria were having passed the theoretical course on Cardiac Surgery Technology and no history of hospitalization for anxiety disorders. Exclusion criteria were voluntary withdrawal from the study for any reason, failure to watch the VAR video in the intervention group, and the development of serious stress and anxiety during the study. Sampling was performed conveniently.

Participants were randomly allocated to a control (n = 18) and an intervention (n = 18) group. Randomization was done based on the last digit of the participants' student number. Accordingly, participants with an odd digit at the end of their student number

were allocated to the control group, and those with an even digit at the end of their student number were allocated to the intervention group. Sample size was determined based on the findings of an earlier study that examined the effect of a mobile VR device on anxiety in university students and reported that post-intervention mean anxiety in the intervention and control groups was 33.5 ± 9.1 and 44.0 ± 13.0, respectively.[9] Then, using the formula for the comparison of two means, and with a type I error of 0.05, a type II error of 0.2, an S_1 of 9.1, an S_2 of 13.0, a μ_1 of 33.5, and a μ_2 of 44.0, the sample size was calculated at 18 per group.

Data collection instruments

Data were collected by using a demographic questionnaire (with items on age and gender) and Spielberger State-Trait Anxiety Inventory (STAI). The 40-item STAI consists of 20 items in a state anxiety subscale and 20 items in a trait anxiety subscale. The state anxiety subscale measures the level of temporary anxiety in response to a specific situation or stressor, such as exams or job interviews. However, the trait anxiety subscale of STAI assesses the general and long-term level of anxiety. Items are rated on a four-point Likert scale. For the items of the state anxiety subscale, respondents are asked to rate their feelings at the present moment using the following scale: "Not at all" (scored 1), "Somewhat" (scored 2), "Moderately so" (scored 3), and "Very much so" (scored 4). For trait anxiety items, they are asked to rate the frequency of their general feelings using the following scale: "Almost never" (scored 1), "Sometimes" (scored 2), "Often" (scored 3), and "Almost always" (scored 4). Consequently, the possible total score of each subscale is 20–80, with higher scores showing higher levels of anxiety.[27] In the present study, state anxiety scores were interpreted as follows: 20–31: mild anxiety; 32–42: moderate anxiety; 43–53: higher than moderate anxiety; 54–64: relatively severe anxiety; 65–75: severe anxiety; and 76–80: very severe anxiety. Trait anxiety scores were also interpreted as follows: 20–31: mild anxiety; 32–42: lower than moderate anxiety; 43–52: higher than moderate anxiety; 53–62: relatively severe anxiety; 63–72: severe anxiety; and 73–80: very severe anxiety. STAI has acceptable consistency in assessing the essential qualities of anxiety, namely nervousness, tension, apprehension, and worry. A former study reported that the Cronbach's alpha values of the inventory were 0.93 for the state anxiety subscale and 0.92 for the trait anxiety subscale.[27] Two other studies in Iran also reported a Cronbach's alpha of 0.94 and confirmed the acceptable validity and reliability of the inventory.[28,29]

Intervention

Participants in the control group were oriented to the OR environment just by receiving information from their instructor. Their counterparts in the intervention group received the same information from their instructor plus VAR-based training through a 360-degree instructional video. The video content was about CABG surgery, relevant surgical instruments, and cardiopulmonary bypass pump and it was developed through reviewing OR textbooks, such as *Berry and Kohn's Operating Room Techniques*, and consulting a cardiovascular surgeon. Professional cameras were used to create a high-resolution video of a CABG surgery. Besides, a 360-degree panoramic camera was used to record all activities in OR. The camera simultaneously records all directions and creates a 360-degree video. The video of the surgery was later added to the 360-degree video. Moreover, textual data on cardiopulmonary bypass pump and audio commentaries on surgical procedure were added to the 360-degree video. The total length of the video was 21 minutes. The Gear 360 and the Adobe After Effects software were used for editing the video and adding AR content to it. Twelve VR head-mounted displays were used for presenting the video, and a VR media player application compatible with Android and iOS was installed on the mobile phones of participants in the intervention group. Participants in the intervention group watched the 360-degree video before scrub on the first day of their eight-day internship program in the CABG OR. The head-mounted display provided participants with the opportunity to move their heads around and look in different directions to see the different parts of OR. While watching the surgery, they could also listen to AR audio commentaries and read textual data about the names and the functions of the different components of the cardiopulmonary bypass pump and instruments on the surgical table.

Participants in the intervention group completed STAI before entering OR on the first day of their internship program, immediately after watching the video, and at the end of the program. Their counterparts in the control group also completed the inventory before entering OR on the first day of their internship program, before scrub on the first day of the program, and at the end of the program. Participants in both groups completed STAI in a large room in the study setting under the supervision of the first author.

Ethical considerations

The Ethics Committee of Isfahan University of Medical Sciences, Isfahan, Iran, approved the study (code: IR.MUI.RESEARCH.REC.1398.661). Besides, the

study was registered in the Iranian Registry of Clinical Trials (code: IRCT20150715023216N6). The authorities of the study setting were informed about the study, and study participants were ensured of the confidential management of their data. Study findings were provided to the authorities of the study setting as well as the authorities of the Faculty of Nursing and Midwifery of Isfahan University of Medical Sciences, Isfahan, Iran.

Data analysis

Data were analyzed through the SPSS software (v. 16.0, IBM Corp., Armonk, New York, USA). The Shapiro-Wilk test showed the normality of the main quantitative variables. The independent-samples *t* and the Chi-square tests were used for between-group comparisons regarding participants' age and gender. Moreover, the independent-samples *t* test and the repeated-measures analysis of variance were used to compare the groups regarding the mean scores of anxiety at different measurement time points. *P* values less than 0.05 were considered statistically significant. The statistician who performed statistical analyses was blind to the study groups.

Results

In total, 18 students were recruited to the study. One participant was excluded from the control group due to voluntary withdrawal before the pretest, and the study was completed with 17 participants in the control group and 18 participants in the intervention group [Figure 1]. Participants' age was in the range of 21–25 years, and they were mostly female (52.9%). The independent-samples *t* and the Chi-square tests revealed no statistically significant difference between the intervention and the control groups regarding participants' age and gender ($P > 0.05$) [Table 1].

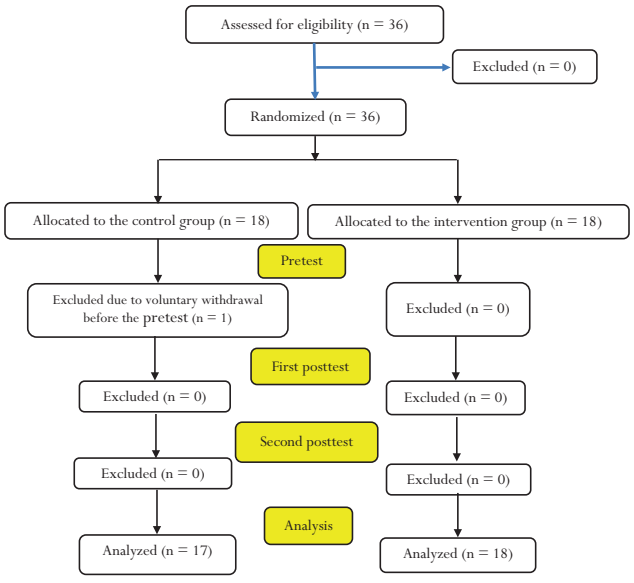

Figure 1: The CONSORT flow diagram of the study

The pretest mean score of state anxiety was 40.61 ± 7.63 in the intervention group and 41.59 ± 5.09 in the control group, with no statistically significant between-group difference based on the results of the independent-samples *t* test ($P = 0.66$). However, the mean score of state anxiety in the intervention group was significantly less than the control group at both the first posttest (33.17 ± 6.16 vs. 45.06 ± 8.69, $P < 0.001$) and the second posttest (32.39 ± 4.62 vs. 42.35 ± 6.14; $P < 0.001$). However, the pretest mean score of trait anxiety in the intervention and the control groups was, respectively, 39.17 ± 7.39 and 39.29 ± 6.05, with no significant between-group difference ($P = 0.96$). Nonetheless, the mean score of trait anxiety in the intervention group was significantly less than the control group at both the first posttest (33.56 ± 6.19 vs. 42.59 ± 6.62; $P < 0.001$) and the second posttest (32.94 ± 5.20 vs. 41.0 ± 5.58; $P < 0.001$) [Table 2].

In repeated-measures analysis for the state anxiety scores, Mauchly's test was nonsignificant, showing that the assumption of sphericity has been met (χ^2 [2] = 4.67; $P = 0.096$). Then, the Sphericity Assumed test of within-subjects effects indicated that the difference between the means was statistically significant, indicating that over time, the intervention significantly decreased the state anxiety among the participants (F[2,66] = 7.024, $P = 0.002$). Moreover, a significant interaction was observed between time and the mean anxiety scores ($F = 17.12$, df = 2, $P = 0.001$). Considering the observed interaction, the *t* test was used to conduct pairwise comparisons between the two groups at the three time points. The results revealed that the mean scores of the two groups were significantly different at the second ($P < 0.001$) and the third ($P < 0.001$) measurement time points [Table 2].

The repeated-measures analysis for the trait anxiety scores also showed that the Mauchly's was nonsignificant, showing that the assumption of sphericity has been met (χ^2 [2] = 3.847; $P = 0.146$). Consequently, the Sphericity Assumed test of within-subjects effects was used and revealed that the difference between the means was statistically significant. In other words, over time, the intervention significantly decreased the state anxiety among the participants (F[2,66] = 3.20, $P = 0.047$). As a significant interaction was observed between time and the mean anxiety scores ($F = 14.96$, df = 2, $P = 0.001$), the *t* test was used for pairwise comparisons between the two groups at the three measurement time points. The results revealed that the mean state anxiety of the two groups

Table 1: Between-group comparisons respecting participants' age and gender

Characteristics	Groups (mean ± SD) or N (%)		*P* value
	Intervention	Control	
Age (year)	22.39 ± 0.98	22.53 ± 0.62	0.62[a]
Gender			0.89[b]
Male	8 (44.4)	8 (47.1)	
Female	10 (55.6)	9 (52.9)	

SD = standard deviation. [a]The results of the independent-sample *t* test; [b]The results of the Chi-square test

Table 2: Within- and between-group comparisons respecting the mean scores of state and trait anxiety

Variable/time	Group (mean ± SD)		*P* value[a]	*P* value[b]	*P* value[c]
	Control	Intervention			
State anxiety				0.002	0.001
Pretest	41.59 ± 5.09	40.61 ± 7.63	0.66		
First posttest	45.06 ± 8.69	33.17 ± 6.16	<0.001		
Second posttest	42.35 ± 6.14	32.39 ± 4.62	<0.001		
Trait anxiety				0.047	0.001
Pretest	39.29 ± 6.05	39.17 ± 7.39	0.96		
First posttest	42.59 ± 6.62	33.56 ± 6.19	<0.001		
Second posttest	41 ± 5.58	32.94 ± 5.20	<0.001		

SD = standard deviation. [a]The results of the independent-sample *t* test; [b]Test of within subjects effects; [c]Interaction between time and group

was significantly different at the second ($P < 0.001$) and the third ($P < 0.001$) time points [Table 2].

The least significant difference post hoc test revealed that in the intervention group, the mean scores of state and trait anxiety at both posttests were significantly less than their corresponding pretest values ($P < 0.05$), whereas the differences between the first and the second posttests were not significant ($P > 0.05$) [Table 3].

Discussion

Findings showed that at baseline, participants had moderate anxiety. This finding is attributable to many different factors, such as age, family backgrounds, social status, personality traits, and stressful internship environment.

The study findings also showed that the mean scores of state and trait anxiety in the intervention group were significantly less than the control group at both posttests. This is in line with many different studies that reported the positive effects of VR on anxiety. For instance, a study showed that immersive VR significantly reduced state anxiety among first-year occupational therapy students preparing for objective structured clinical examinations.[30] Two other studies found that VR had significant positive effects on anxiety among university students[9] and pediatric nursing students.[31] Similarly, a study reported that VR can be effective in providing students with an imaginary safe environment and thereby, treating their public speaking anxiety, which is a highly prevalent condition among students.[32] Moreover, a study revealed that simulation was effective in significantly reducing anxiety.[33] Two other studies also highlighted that VR allows students to be in a controlled and safe virtual environment.[9,34] Studies on patients with different health problems also confirmed the positive effects of VR. For instance, two studies showed that VR-based interventions significantly reduced anxiety among women with breast cancer[35] and among patients with prostate cancer receiving radiation therapy.[36] A study also showed that high-fidelity human simulation significantly decreased anxiety among nursing students before clinical attendance and interaction with a mentally ill patient.[37] It seems that VR reduces students' anxiety and improves their clinical skills by giving them a feeling of serenity and improving their self-confidence.

Contrary to our findings, some earlier studies reported the insignificant effects of VR-based interventions on anxiety. For example, a study showed that VR was not effective in significantly reducing anxiety among adult male patients undergoing cystoscopy.[38] Moreover, a study reported that video- and booklet-based education had no significant effects on preoperative state anxiety among the candidates for CABG.[39] Two studies on nursing students also reported the insignificant effects of high-fidelity human simulation on stress[40] and anxiety.[41] Similarly, a study showed

Table 3: The results of the least significant difference post hoc test for pairwise comparisons in the intervention group

Time	Anxiety(*P* value)	
	State	Trait
Pretest vs. first posttest	>0.001	0.002
First posttest vs. second posttest	>0.001	0.002
First posttest vs. second posttest	0.53	0.62

that simulation-based training had no significant effects on anxiety among OR students during their internship program.[8] These contradictory results are attributable to the differences among studies regarding their sample sizes and the characteristics of their samples or interventions. For example, some studies were conducted on students, whereas some others were conducted on patients.

This study had some limitations. One limitation was that although we attempted to control the effects of potential stressors in OR, some unknown stressors might have affected the level of participants' anxiety. Another limitation of the study was its small sample size, though we recruited all eight-semester OR students in the study setting.

Conclusion

This study concludes that VAR training is effective in significantly reducing anxiety among OR students attending CABG surgery. Therefore, VAR-based training interventions are recommended for managing the stress induced by attendance at CABG surgery among these students. Moreover, studies with larger samples of students in different hospital settings are recommended to produce firmer evidence regarding the effects of VAR training.

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Conflict of interest

There are no conflicts of interest.

References

1. Allcoat D, von Mühlenen A. Learning in virtual reality: Effects on performance, emotion and engagement. Res Learn Tech 2018;26:2140.
2. Zarifsanaiey N, Amini M, Saadat F. A comparison of educational strategies for the acquisition of nursing student's performance and critical thinking: Simulation-based training vs. integrated training (simulation and critical thinking strategies). BMC Med Educ 2016;16:294.
3. Pelargos PE, Nagasawa DT, Lagman C, Tenn S, Demos JV, Lee SJ, *et al*. Utilizing virtual and augmented reality for educational and clinical enhancements in neurosurgery. J Clin Neurosci 2017;35:1-4.
4. Amir-Alavi C, Dadgaran I, Aghajanzadeh M, Alavi S, Dehghan A, Nemati M, *et al*. Comparison of the effectiveness of web based bronchoscopy simulator versus traditional education on knowledge of tracheobronchial anatomy of anesthesia residents. Res Med Educ 2016;8:52-60.
5. Baker CJ, Sinha R, Sullivan ME. Development of a cardiac surgery simulation curriculum: From needs assessment results to practical implementation. J Thorac Cardiovasc Surg 2012;144:7-16.
6. Feins RH, Burkhart HM, Conte JV, Coore DN, Fann JI, Hicks GL Jr, *et al*. Simulation-based training in cardiac surgery. Ann Thorac Surg 2017;103:312-21.
7. Cobbett S, Snelgrove-Clarke E. Virtual versus face-to-face clinical simulation in relation to student knowledge, anxiety, and self-confidence in maternal-newborn nursing: A randomized controlled trial. Nurse Educ Today 2016;45:179-84.
8. Mohammadi G, Tourdeh M, Ebrahimian A. Effect of simulation-based training method on the psychological health promotion in operating room students during the educational internship. J Educ Health Promot 2019;8:172.
9. Camara DR, Hicks RE. Using virtual reality to reduce state anxiety and stress in university students: An experiment. GSTF J Psych 2020;4:2-21.
10. Wilson HK, Feins RH. Simulation in cardiothoracic surgery. Comprehensive Healthcare Simulation: Surgery and Surgical Subspecialties. Springer; 2019. p. 263-74.
11. Hutchinson TL, Janiszewski Goodin H. Nursing student anxiety as a context for teaching/learning. J Holist Nurs 2013;31:19-24.
12. Terzioğlu F, Yücel Ç, Koç G, Şimşek Ş, Yaşar BN, Şahan FU, *et al*. A new strategy in nursing education: From hybrid simulation to clinical practice. Nurse Educ Today 2016;39:104-8.
13. Wilcha RJ. Effectiveness of virtual medical teaching during the COVID-19 crisis: Systematic review. JMIR Med Educ 2020;6:e20963.
14. Rouby JJ, Monsel A, Ehrmann S, Bouglé A, Laterre PF. The INHALE trial: Multiple reasons for a negative result. Lancet Infect Dis 2020;20:778-9.
15. Fernandez M. Augmented virtual reality: How to improve education systems. High Learn Res Commun 2017;7:1-15.
16. Moro C, Štromberga Z, Raikos A, Stirling A. The effectiveness of virtual and augmented reality in health sciences and medical anatomy. Anat Sci Educ 2017;10:549-59.
17. Ott M, Freina L. A literature review on immersive virtual reality in education: State of the art and perspectives. The International Scientific Conference elearning and Software for Education, Institute for Educational Technology, CNR, Genova, Italy. 2015;1:133-41.
18. Kim Y, Kim H, Kim YO. Virtual reality and augmented reality in plastic surgery: A review. Arch Plast Surg 2017;44:179-87.
19. Yuen SC-Y, Yaoyuneyong G, Johnson E. Augmented reality: An overview and five directions for AR in education. J Educ Tech Develop Exch 2011;4:119-40.

20. Akçayır M, Akçayır G. Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educ Res Rev 2017;20:1-11.
21. Barsom EZ, Graafland M, Schijven MP. Systematic review on the effectiveness of augmented reality applications in medical training. Surg Endosc 2016;30:4174-83.
22. Bissonnette J, Dubé F, Provencher MD, Moreno Sala MT. Virtual reality exposure training for musicians: Its effect on performance anxiety and quality. Med Probl Perform Art 2015;30:169-77.
23. Wiederhold MD, Gao K, Wiederhold BK. Clinical use of virtual reality distraction system to reduce anxiety and pain in dental procedures. Cyberpsychol Behav Soc Netw 2014;17:359-65.
24. Nunna M, Dasaraju RK, Kamatham R, Mallineni SK, Nuvvula S. Comparative evaluation of virtual reality distraction and counter-stimulation on dental anxiety and pain perception in children. J Dent Anesth Pain Med 2019;19:277-88.
25. McLay RN, Baird A, Webb-Murphy J, Deal W, Tran L, Anson H, *et al*. A randomized, head-to-head study of virtual reality exposure therapy for posttraumatic stress disorder. Cyberpsychol Behav Soc Netw 2017;20:218-24.
26. McKay KA, Buen JE, Bohan KJ, Maye JP. Determining the relationship of acute stress, anxiety, and salivary alpha-amylase level with performance of student nurse anesthetists during human-based anesthesia simulator training. Aana J 2010;78:301-9.
27. Fountoulakis KN, Papadopoulou M, Kleanthous S, Papadopoulou A, Bizeli V, Nimatoudis I, *et al*. Reliability and psychometric properties of the Greek translation of the state-trait anxiety inventory form Y: Preliminary data. Ann Gen Psychiatry 2006;5:2.
28. Dehghan-Nayeri N, Adib-Hajbaghery M. Effects of progressive relaxation on anxiety and quality of life in female students: A non-randomized controlled trial. Complement Ther Med 2011;19:194-200.
29. Niknejad R, Mirmohammad-Sadeghi M, Akbari M, Ghadami A. Effects of an orientation tour on preoperative anxiety in candidates for coronary artery bypass grafting: A randomized clinical trial. ARYA Atheroscler 2019;15:154-60.
30. Concannon BJ, Esmail S, Roduta Roberts M. Immersive virtual reality for the reduction of state anxiety in clinical interview exams: Prospective cohort study. JMIR Serious Games 2020;8:e18313.
31. Halloran DA. Examining the Effect of Virtual Simulation on Anxiety Experienced by Pediatric Nursing Students. Capella University. Ann Arbor, MI: ProQuest LLC; 2017.
32. Hinojo-Lucena FJ, Aznar-Díaz I, Cáceres-Reche MP, Trujillo-Torres JM, Romero-Rodríguez JM. Virtual reality treatment for public speaking anxiety in students. Advancements and results in personalized medicine. J Pers Med 2020;10:14.
33. Gore T, Hunt CW, Parker F, Raines KH. The effects of simulated clinical experiences on anxiety: Nursing students' perspectives. Clin Simulat Nurs 2011;7:e175-e80.
34. Jenson CE, Forsyth DM. Virtual reality simulation: Using three-dimensional technology to teach nursing students. Comput Inform Nurs 2012;30:312-8; quiz 319-20.
35. Bani Mohammad E, Ahmad M. Virtual reality as a distraction technique for pain and anxiety among patients with breast cancer: A randomized control trial. Palliat Support Care 2019;17:29-34.
36. Marquess M, Johnston SP, Williams NL, Giordano C, Leiby BE, Hurwitz MD, *et al*. A pilot study to determine if the use of a virtual reality education module reduces anxiety and increases comprehension in patients receiving radiation therapy. J Radiat Oncol 2017;6:317-22.
37. Szpak J, Kameg K. Simulation decreases nursing student anxiety prior to communication with mentally ill patients. Clin Simulat Nurs 2013;9:e13-e9.
38. Walker MR, Kallingal GJ, Musser JE, Folen R, Stetz MC, Clark JY. Treatment efficacy of virtual reality distraction in the reduction of pain and anxiety during cystoscopy. Mil Med 2014;179:891-6.
39. Moemeni L, Najaf Yarandi A, Haghani H. Comparative study of the effects of education using VCD and booklet in two different times on pre-operative anxiety. Iran J Nurs 2009;21:81-93.
40. Cantrell ML, Meyer SL, Mosack V. Effects of simulation on nursing student stress: An integrative review. J Nurs Educ 2017;56:139-44.
41. Megel ME, Black J, Clark L, Carstens P, Jenkins LD, Promes J, *et al*. Effect of high-fidelity simulation on pediatric nursing students' anxiety. Clin Simulat Nurs 2012;8:e419-e28.