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Original Article

Effect of Smartphone-based Education on Students' Skills in Managing Traumatized Patients: Pre-Test and Post-Test Design with a Control Group

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Abstract

Background: Given the undeniable role of nurses in caring for traumatic patients, the best method for teaching skills to nursing students should be selected.
Objectives: This study aimed to examine the effect of smartphone-based education on the clinical skills of undergraduate nursing students when confronting with traumatic patients.
Methods: This study was conducted on 82 nursing students. The students in both intervention and control groups were evaluated using the National Registry of Emergency Medical Technicians' Skills Sheets for trauma skills before and one month after the intervention.
Results: The mean post-test score in nine clinical skills of trauma in the intervention group (113.26±11.39, t=18.715, p<0.001) was significantly higher than those of the control group (52.92±13.23, t=3.352, p=0.002). The effect of intervention on the clinical skills of trauma was greater than 0.7, indicating that the smartphone software had a high effect on improving each skill.
Conclusion: The smartphone-based education programs can be used as an accessible and easy method for education of nursing students.

Keywords: Mobile application, Students, Smartphone, Nursing education, Trauma.

Introduction

Trauma creates a critical condition.[1] Injuries and their immeasurable consequences irrevocably affect the patients directly and their relative and the society indirectly. It has been estimated that about 14000 people are affected by trauma every day.[2] Complications of trauma are the main causes of death,[3] and nurses have a main role to prevent them.[4] Nursing care in trauma aims to reduce physical complications and mortality in patients.[5,6,7,8]

Care provided by novice nurses in trauma situations is not as high-quality as that of experienced nurses.[9] Nursing education programs can improve the skills of nurses for the provision of care in trauma situations.[10] Appropriate evaluation of patients with trauma and recognition of life-threatening conditions can prevent disabilities.[11] The combination of traditional and modern education methods using computer and media can improve the education outcomes.[12] Proper education helps healthcare providers offer a strong safety management system, which can improve students' understandings of threats in trauma patients.[13] Educational programs should be evaluated to maintain nurses' competence.[12] Also, appropriate theoretical and practical training programs are required to improve nursing students' skills and self-esteem in clinical settings.[14-16] In addition to the face-to-face training methods, modern training methods have been recommended to improve the effectiveness of education.[17,18]

In the 21st century, nursing education is affected by educational technologies such as hybrid learning, simulation, and e-learning,[19] which encourage active learning.[10] Students use information and communication technologies as an important part of their educational process.[10,20] In this regard, mobile learning (m-learning) is commonly used.[21] Smartphone educational software can improve the development of self-efficacy and clinical skills in nursing students.[15]

Mobile education programs include guidelines for medicines' use [22] and simulation of airway care [23] It has been

reported that these methods are effective in the education of nursing students,[24] and improving active and long-term education of the skills.[25] Portability and easy communication have led to the widespread use of the smartphone phones for educating healthcare providers.[26] The smartphones can increase students' influence on reasoning, innovation, and critical thinking. It allows them to access information, facilitate any time/any place learning, reduce their stress and increase their self-esteem.[27] It can be used to teach the practicable strategies such as teamwork and time management for the management of patients with trauma conditions.[28]

It is essential to integrate the information and communication technologies (ICT) into nursing education programs.[29] Proper performance of nursing care in trauma patients is necessary to increase the quality of care and patient safety. In this regard, developing more attractive and effective training methods is required for teaching the clinical nursing skills. Until now, limited studies are available on the use of mobile software for teaching nursing skills in Iran, especially in trauma patients.

Objectives

Therefore, the present study was conducted to investigate the effect of smartphone-based software education methods on the clinical skills of nursing students regarding trauma care in undergraduate nursing students.

Materials and Methods

Study design

This study was conducted with a pretest-posttest design and a control group in 2018 after obtaining permissions from the Ethics Committee of Iran University of Medical Sciences (code: IR.IUMS.FMD.REC 1396.9511706001). Also, the study protocol was registered under the code of IRCT20180310039018N1 on Iranian Registry of clinical trials. The researcher presented a detailed description of the method and its objectives to the students. If they were willing to participate in the research, they were asked to sign a written informed consent form. None of the researchers were taking part in the presentation of lecturer and evaluation of trauma education that might affect data collection and analysis.

Participants

A census method was used to recruit undergraduate nursing students in the 7th semester of education. Inclusion criteria included: getting a minimum score of 12 out of 20 from the theoretical course of emergency nursing, lack of prior education on trauma care using smartphone software, and having an Android operating system on the smartphone. Exclusion criteria were: no participation in any stage of clinical evaluation or the use of educational software for education based on user registration records in the software. Out of 117 students, 82 students were enrolled and randomly classified into intervention and control groups through sorting the students' internship period as 8-10 students per group. Internship groups were written on pieces of paper and the first selections were classified into the intervention group and the other were classified as the control group. The research process was conducted based on the Consort flow diagram as shown in (Figure-1).

Education intervention

The software was designed by a programming engineer.[30] The educational content in the form of text, video, and images was designed under the Android operating system consisting of 9 skills for handling traumatized patients. In order to prevent access to the educational content by the control group, a code was used by each student in the intervention group to log in and download the software. The independence in the operation and application of software was considered a benefit of this educational software.[31] First, the elements of the software were outlined and then undergone development. At each stage of the software development, it was evaluated by an expert panel and 10 students, which their comments were collected through interviews and applied to develop the final version. After designing the software, it was evaluated by three programing engineers in terms of practicality and usability, and some modifications were conducted based on their opinions. The final version also was given to 10 students and asked them to share their perspectives regarding ambiguities in the use of the software.[30]

Both groups received education regarding the most common clinical skills to manage patients with trauma. They were educated using a 30-minute session to use the software through lectures and practical exercises, and their questions were answered. A Telegram® group was also developed and the software installation link was provided for participants. The software installation method was fully explained to the students in the intervention group and their questions were answered. To prevent data disclosure, the students in the

intervention group were asked to use the software only by themselves and do not share it to others. The researcher reminded the students to use the software in the course of education through the Telegram group. The intervention group used the software for one month. After collecting data, the software was also shared with the students in the control group.

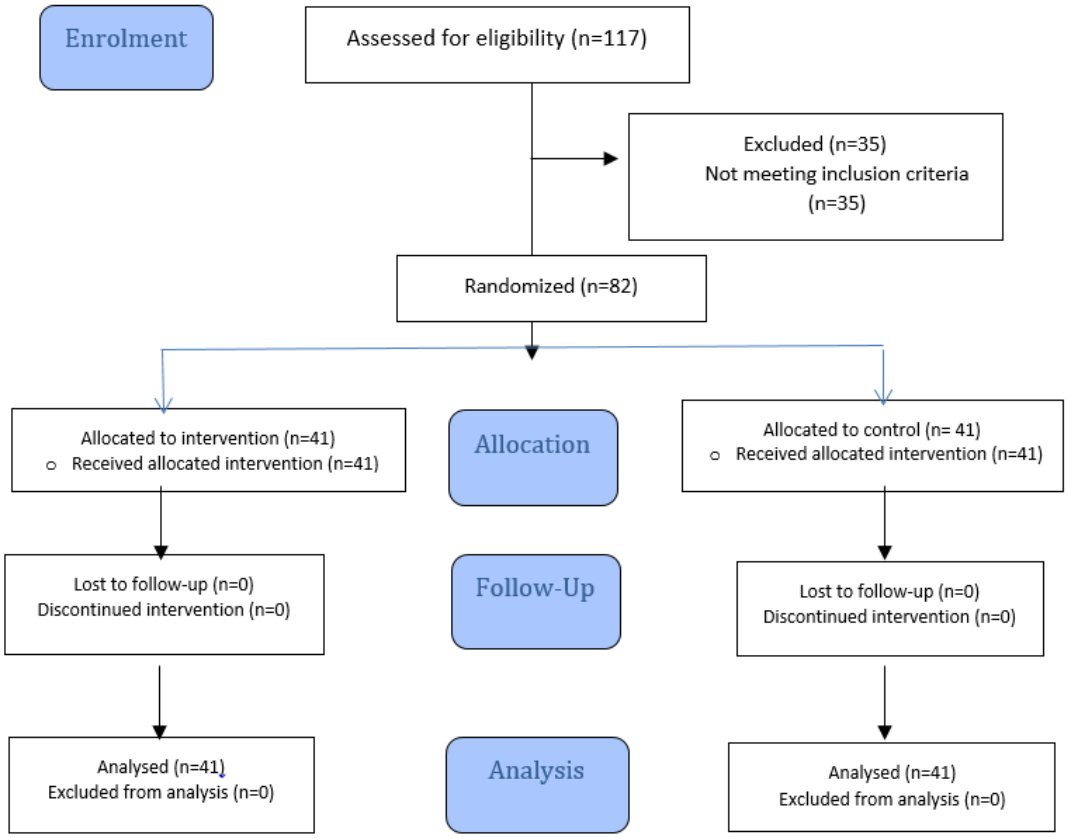

Figure-1. The research process based on the Consort Flow diagram

Date collection

A demographic data form and a standard trauma clinical assessment checklist were used for data collection. The demographic information form was filled out by the groups before the intervention. The skill assessment checklist was designed by the National Registry of Emergency Medical Technicians Skills Sheets.[31, 32] It consisted of several questions regarding examining traumatic patient, embedding oral and pharyngeal airway and nasopharyngeal and suctioning, controlling bleeding and shock treatment, use of tensile splint, restricting the movement of the spine in supine position, restricting the movement of the spine in the sitting position, reducing the movement of damaged bone, reducing the motion of injured joints, ventilation and oral intubation. In this checklist, evaluation of each skill was scored from 0 (lack of skill or making mistakes) to 1 (correct skill). The score of each skill was separately calculated and the total score range was from 0 to 149 with a higher score representing more skills.

Content validity of the checklist was assessed by a panel of experts. In order to determine the reliability, the interrater reliability method was used and 10 students were examined by two evaluators simultaneously and in parallel. The correlation coefficient was 0.898. Before the study and after one month, the students' performance was evaluated using the Objective Structured Clinical Skills Assessment (OSCE) in 9 stations in the clinical center. Data collection was conducted using a checklist by educated and anonymous evaluators. In each group, one volunteer was appointed as the representative for coordinating the time. In a 30-minute session, the researcher described the evaluation method to all students in the groups. The duration of performing each skill was reported to be 7 min and after performing every skill, the evaluation station was returned to the initial condition by a research assistant. Each skill was evaluated at a station by an evaluator. The evaluation stations were consisted of 9 trauma

care skills. Each station was designed for a scenario where students performed relevant skills after reading the station scenario. The researchers provided 9 clinical skills scenarios regarding trauma care using a literature review and available resources including books, scholarly journals, authoritative internet sites, and relevant research. Content validity of the scenarios was confirmed by an expert panel.

Data analysis

The Kolmogorov-Smirnov test was used to examine the normal distribution of variables. The Chi-square and Fisher exact tests were used to examine the homogeneity of qualitative variables. The independent t-test was used for comparing quantitative variables between the groups. Furthermore, the paired t-test was used for the intra-group comparison of variables. The Pearson correlation coefficient was used to find the relationship between the use of software and skill score in the intervention group. To measure the effect of intervention, the Cohen effect size was calculated. Data analysis was performed via the SPSS V.16 software and the significance level was $p<0.05$.

Results

In this study, 82 undergraduate nursing students participated. The groups were homogeneous in terms of demographic variables (Table-1).

Table-1. Demographic characteristics of students in the groups (n=82)

Variables	Variable levels	Control group (n=41)	Intervention group (n=41)	P value
Age (year)	20-21	5 (12.2)	10 (24.4)	0.113
	22-23	29 (70.7)	26 (63.4)	
	>24	7 (17.1)	5 (12.2)	
	Mean ± SD	23.04±2.27	22.36±1.49	
Gender	Female	29 (70.7)	24 (58.5)	0.248
	Male	12 (29.3)	17 (41.5)	
Smartphone-based education in the past	Yes	5 (12.2)	7 (17.1)	0.532
	No	36 (87.8)	34 (82.9)	
Work experience in the emergency department	Yes	7 (17.1)	3 (7.3)	0.177
	No	34 (82.9)	38(92.7)	
Work experience in the hospital	Yes	24 (58.5)	29 (70.7)	0.248
	No	17 (41.5)	12 (29.3)	
Course passed	Mean ± SD	116.04±28.48	115.73±7.62	0.178
Theoretical score of medical emergency courses	Mean ± SD	18.30±0.97	17.81±1.05	0.957

The groups were homogeneous in terms of clinical skills to confront patients with trauma before the intervention. Also, the related scores in the intervention and control groups were low in comparison to the general mean score of the required skills, indicating the need for education in the both groups.

The mean scores of pre-test and post-test management skills, use of splint traction, limiting movement of the patient's spine in the prone position, ventilation and orotracheal intubation and total skills in the control group showed statistically significant differences, as the post-test scores were lower than that of pre-test scores. In the post-test, the control group showed a slight increase in some skills including the use of splint traction, restriction of patients' movement in the prone position, and restriction of the patient's movement in sitting position compared to the pre-test scores (Table-2). The post-test scores in the intervention group showed a statistically significant increase in all skills compared to the pre-test scores. The mean scores of post-test in all skills and the total score were significantly different in both groups as the mean score in the intervention group was higher than that of the control group. Also, the effect of the intervention on all skills and the total value was greater than 0.7, indicating the high impact of the intervention on enhancing the students' skills (Table-2). A statistically significant difference was observed in the mean scores of changes of clinical skills and total scores in both groups ($p<0.05$), as the score growth in the intervention group was greater than of the control group (Table-2). Also, the mean

score of the use of software was 8.56±2.53 with a range of 3-13. The frequency of the use of software per day by the majority of students was (6-10 times) 61.0%, (>10 times) 21.9%, and (3-5 times) 17.1%. The Pearson correlation coefficient indicated a direct and significant relationship between the frequency of software use and the score of skills (r=0.428, p=0.005). Specifically, the coefficient of determination was 0.18, indicating that these two variables showed a common variance of 18%. There was also a direct and significant relationship between the frequency of software use and the total score of exposure to traumatized individuals (r=0.447, p=0.003). The coefficient of determination was reported to be 0.20, indicating that the two variables had a common variance of 20%.

Discussion

The scores of skills increased in the intervention group after the education program. The effect of intervention on all clinical skills and total score was more than 0.7. Hence, the online educational methods are considered complementary traditional approaches and can improve the students' clinical skills. The students spend less time in the library and spend most of their time with a mobile device.[33] Therefore, the use of mobile technology enhances their knowledge and skills, which is independent of time and space.[34,35] Distance education using the smartphone software is an appropriate strategy for learning and teaching nursing education, which focuses on the completion of traditional education.[36] It facilitates watching videos and accessing evidence-based resources.[37] The effectiveness of this educational intervention is attributed to its attractiveness.[38] Smartphone applications can enhance long-term learning of skills in undergraduate students.[25] Various studies indicated students' satisfaction with the use of such methods compared to traditional methods of teaching.[39]

In the present study, the use of the smartphone-based educational software improved the performance of the students to confront with traumatized individuals. In another study, significant improvements in the clinical skills of undergraduate nursing students in four domains of vital signs, intravenous injection, gastric lavage, and endotracheal suction after the education via the smartphone software were reported.[15] In another study, the knowledge and clinical skills of urinary catheterization in undergraduate nursing students in the intervention group after the use of the educational video was significantly enhanced compared to the control group.[24] After education using the computer software in the intervention group, techniques of nursing students increased significantly compared to the control group.[39] In another study, this learning method was used to educate the long-term care skills of obstetrics and gynecology, which led to an increase in the students' knowledge and care skills.[40] The results of these studies are in consistent with those of the current study and confirm the effect of smartphone-based education on students' clinical skills in dealing with traumatized individuals. In another study, the education of airway insertion using the smartphone software strengthened the skill of medical interns in airway deployment.[23] Therefore, learning based on the smartphone software can enhance learners' skills, as students can continually use this educational method.

In this study, the software use increased the students' skills for the management of traumatized patients. Nursing students were motivated to use mobile-based education that can improve their academic performance.[41] Developing applications is appealing, and hence increase the tendency of students to improve their skills use by using the software.

Before the intervention, the students' skills were low compared to the general mean score of skills for handling traumatic patients, indicating the need for more effective education to address educational shortcomings and enhance the level of their clinical skills. Similarly, another study showed that the clinical skills of medical emergency students to provide care to traumatized patients were sub-optimal.[42]

In addition, a study in Australia showed that nurses had little knowledge and skills for managing emergencies and crises.[43] A reduction in the score of clinical skills in the control group occurred within one month after the study. The current education has not been able to meet the educational expectations required to improve the students' clinical skills. Therefore, educational methods with a longer persistence are needed for teaching clinical skills.

In the control group, a slight increase was observed in some skills in post-test compared to pre-test, which could be due to the students' access to textbooks and educational materials.

Table-2. Comparison of the mean scores of clinical skills in the groups before and after the intervention (n=82)

Skills (score range)	Groups	Control		Intervention		Test results	Effect size (95% CI)
		Minimum-Maximum	Mean±SD	Minimum-Maximum	Mean±SD		
Management of trauma (0-43)	Pre-test	1-43	18.00±12.83	3-42	19.02±12.22	t=0.370, p=0.712	
	Post-test	2-12	5.02±2.39	14-43	29.12±8.95	t=16.640, p<0.001	3.67(2.96,4.38)
	Test results	t=6.923, p<0.001		t=6.178, p<0.001			
	Changes	-12.97±12.00		10.09±10.46		t=9.27, p<0.001	
Preparation of oral-pharyngeal and nasopharyngeal airway and suction (0-13)	Pre-test	0-12	6.12±2.85	2-11	6.14±2.09	t=0.044, p=0.965	
	Post-test	0-12	6.53±2.57	9-13	11.41±1.09	t=11.181, p<0.001	2.46(1.89,3.04)
	Test results	t=1.054, p=0.298		t=14.448, p<0.001			
	Changes	0.41±2.51		5.26±2.33		t= 9.04, p<0.001	
Bleeding control and treating shock (0-7)	Pre-test	0-7	3.63±1.57	1-7	3.41±1.48	t=0.649, p=0.518	
	Post-test	0-7	4.00±1.54	3-7	5.46±1.14	t=4.868, p<0.001	1.07(0.61,1.53)
	Test results	t=1.333, p=0.190		t=7.224, p<0.001			
	Changes	0.31±1.75		2.04±1.81		t=4.26, p<0.001	
Using traction splints (0-14)	Pre-test	0-11	3.36±2.77	0-9	2.82±2.37	t=0.941, p=0.350	
	Post-test	1-8	4.68±2.03	4-14	9.97±2.21	t=11.268,p<0.001	2.48(1.91,3.06)
	Test results	t=2.923, p=0.006		t=14.786, p<0.001			
	Changes	1.37±2.88		7.14±3.09		t=8.82, p<0.001	
Restricting the movement of the patient's spine in prone position (0-14)	Pre-test	0-9	3.14±2.01	1-8	3.07±2.07	t=2.132, p=0.536	
	Post-test	0-11	5.29±2.88	5-14	10.48±1.74	t=9.866, p<0.001	1.98(1.45,2.51)
	Test results	t=4.617, p<0.001		t=16.102, p<0.001			
	Changes	2.21±3.07		6.51±2.58		t=6.83, p<0.001	
Restricting the movement of the patient's spine in sitting position (0-12)	Pre-test	0-8	3.14±2.01	0-7	3.07±2.07	t=0.162, p=0.872	
	Post-test	0-10	4.60±2.03	5-12	8.70±1.56	t=10.208,p<0.001	2.25 (1.7,2.81)
	Test result	t=3.703, p=0.001		t=13/796, p<0.001			
	Changes	1.46±2.53		5.63±2.61		t=7.33, p<0.001	
Restricting the movement of damaged long bone (0-10)	pre-test	0-9	6.09±2.21	3-10	7.21±1.82	t=2.506, p=0.014	
	Post-test	2-10	6.82±2.25	6-10	8.68±1.23	t=4.614, p<0.001	1.01(0.55,1.47)
	Test results	t=1.607, p=0.116		t=4.049, p<0.001			
	Changes	0.21±2.23		1.46±2.31		t=2.57, p=0.012	
Restricting the movement of dameged joints (0-9)	Pre-test	2-9	6.07±1.99	2-10	6.34±1.86	t=0.629, p=0.531	
	Post-test	1-9	6.29±1.96	6-9	7.78±1.01	t=4.309, p<0.001	0.95(0.49,1.41)
	Test results	t=0.630, p=0.532		t=4.468, p<0.001			
	Changes	0.21±2.23		1.43±2.06		t=2.57, p=0.012	
Ventilation and orotracheal intubation (0-27)	Pre-test	0-26	14.56±6.46	6-25	17.21±4.71	t=2.126, p=0.037	
	Post-test	0-25	10.02±5.76	12-26	21.63±2.90	t=11.517,p<0.001	2.54(1.96,3.12)
	Test results	t=4.517, p<0.001		t=6.581, p<0.001			
	Changes	-4.53±4.43		4.41±4.29		t=7.41, p<0.001	
Total (0-149)	Pre-test	12-114	64.43±23.21	38-101	69.19±17.78	t=1.041, p=0.301	
	Post-test	7-80	52.92±13.23	82-135	113.26±11.93	t=21.658,p<0.001	4.78(3.93,5.64)
	Test results	t=3.352, p=0.002		t=18.715, p<0.001			
	Changes	-11.51±22.64		44.07±15.07		t=13.08, p<0.001	

Limitations

There was a poor cooperation of the students with the two stages of the OSCE. At each meeting, the students were welcomed and they were awarded a certificate of participation in the education program. In this study, the effect of intervention was investigated over three months, which should be increased in future studies. Since the use of educational software requires the availability of an Android smartphone, the same software for other operating systems should be provided. The management of patients with trauma requires an active participation by students to learn how to do teamwork for managing patient care. In this study, the software design was not interactive, which needs further consideration by future researchers.

Conclusions

The new software-based education improved the clinical skills of students to confront with traumatized patients. The use of this new educational method can improve teaching and learning, and provides high quality and safe care. The smartphone-based education allows the students to gain experience of critical and emergency conditions without the probability of harming patients. Since nurses are often the first responders in clinical emergencies, they need regular, periodic, and accessible education to manage traumatized patients using a smartphone-based approach and update their knowledge and skills. Given the importance of trauma care, trauma team members must acquire sufficient knowledge and ability to promote effective teamwork and enhance quality of care.

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Authors' Contribution

All authors pass the four criteria for authorship contribution based on the International Committee of Medical Journal Editors (ICMJE) recommendations.

Conflict of Interests

There is no conflict of interest.

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