Original Article

The Effects of Role Play Simulation and Demonstration on Pediatric Peripheral Venous Catheter Insertion Skill among Nursing Students: A Three Group Experimental Study

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Abstract

Background: The short course of baccalaureate nursing program and overcrowding of clinical settings restrict the development of pediatric peripheral venous catheter (PVC) insertion skill among nursing students. Therefore, better teaching strategies are needed. **Objectives:** The aim of this study was to compare the effects of role play simulation and demonstration on pediatric PVC insertion skill among nursing students. **Methods:** In this three-group experimental study, 46 nursing students were selected from Tabriz University of Medical Sciences, Tabriz, Iran, randomly allocated to a control, a role play simulation, or a demonstration group. Initially, all students received information about pediatric PVC insertion through lecture. Then, their skill was assessed using a child mannequin in a skill lab by a thirty-item rating scale. Then, participants in the simulation and the demonstration groups received training about this skill through simulation or demonstration teaching methods. After 3 weeks, their skill was reassessed. Data were analyzed using the Wilcoxon and Kruskal–Wallis tests. **Results:** The baseline total scores of PVC insertion skill were 17.66 ± 7.46, 14.93 ± 6.64, and 16.92 ± 10.38 and after intervention changed to 20.66 ± 5.65, 33.81 ± 6.86, and 41.14 ± 7.67 in the control, role play simulation, and demonstration groups, respectively. There was a statistically significant increase of skill in simulation and demonstration groups ($P < 0.001$), whereas the increase in the control group was insignificant ($P = 0.09$). There was no significant difference between role play simulation and demonstration groups ($P > 0.05$). **Conclusion:** Both role play simulation and demonstration significantly improve pediatric PVC insertion skill among nursing students. These teaching methods are recommended for developing nursing skills.

Keywords: *Demonstration, Nursing student, Pediatric nursing, Role play*

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Introduction

Peripheral venous catheter (PVC) insertion is a common nursing procedure.[1] PVC insertion for children is a really challenging and difficult procedure due to children's small and fragile vessels and the associated great pain and horror for them.[1,2] Thus, nursing students need to receive quality theoretical and practical training about PVC insertion for children to develop their skills in this area. However, there are limited learning opportunities for nursing students to develop their clinical skills and experience in the clinical setting.[3]

There are different methods for teaching clinical skills to nursing students. One of these methods is role play simulation. This method provides students with great opportunity for skill development in a safe and fear-free environment and helps them get ready for actual clinical practice.[4] A meta-analysis showed that simulation-based nursing education has positive effects on all cognitive, emotional, and psychomotor aspects of learning.[5] Studies also reported that simulation is effective in significantly improving nursing students' knowledge and self-confidence in pediatric PVC insertion, nurses' knowledge and skills in pediatric PVC insertion, nursing students' skill in adult intramuscular injection, and medication administration.[3,4,6-8]

Demonstration is another method traditionally used to teach clinical nursing skills.[9] While simulation is a student-centered method for teaching, demonstration is a teacher-centered method.[10] Moreover, compared with simulation, demonstration is less time-consuming and less costly.[4]

Most studies into the effects of different teaching methods on PVC insertion skill were conducted on adult patients and hence, there are limited studies on teaching pediatric PVC insertion. Also in Iran, clinical skills on children, such as PVC insertion, are not taught in all skill labs of faculties, and there is no opportunity for teaching and practicing such skills in the clinical setting for all students. Moreover, such skills are among the most important and sensitive skills that students need to acquire during their 4-year nursing education.

Therefore, this study was conducted in line with other studies to teach and enhance nursing skills such as PVC insertion in skill labs. In this study, we also compared role play simulation and demonstration teaching methods and evaluated their effectiveness so that each faculty could choose one of these two methods based on their circumstances and limitations.

Objectives

This study aimed to compare the effects of role play simulation and demonstration on pediatric PVC insertion skill among baccalaureate nursing students.

Methods

Design and participants

This three-group experimental study was conducted in May 2012 in Tabriz Faculty of Nursing and Midwifery, Tabriz, Iran. Research community was baccalaureate nursing students from fifth and sixth semesters. Nursing students at this level have passed or are passing the theoretical Sick Child Pediatric Nursing course. Participants were 24 fifth-semesters and 22 sixth-semesters based on available sampling. Inclusion criteria were agreement for participation in the study and no previous experience of inserting pediatric PVC either in skill lab or clinical settings. Participants who did not regularly attend intervention sessions or failed to take pretest or posttest were excluded from the study. An online random number generator was used with simple random method to allocate the 24 fifth-semester and the 22 sixth-semester students to three groups, namely a simulation (n = eight fifth-semester and eight sixth-semester students), a demonstration (n = eight and seven students), and a control (n = eight and seven students) group.

Data Collection Instruments

Data were collected using a personal characteristics questionnaire and a rating scale for PVC insertion skill assessment. The personal characteristics questionnaire included items on participants' personal characteristics such as age, gender, academic semester, and grade point average. The PVC insertion skill assessment rating scale was developed based on the steps of the pediatric PVC insertion skill introduced in the third edition of the *Pediatric Nursing Procedures* textbook.[2] Then, two pediatric nurses revised the scale to conform its items to the available equipment for PVC insertion in clinical settings in Iran. The thirty items of this scale were arranged in a logical order so that it provided a step-by-step instruction for pediatric PVC insertion. The items were scored 2 ("excellent practice"), 1 ("moderate practice"), or 0 ("needs more practice"). If students completed each step in a timely and accurate manner and in a correct sequence, they obtained 2 points per item. However, if they performed the steps properly but not in a timely manner or in the correct sequence, they obtained 1 point per item. Moreover, if they missed a step or did not correctly perform it, they obtained a 0 point. Consequently, the total score of the scale could range from 0 to 60.

The face and the content validity of the study instruments were assessed by nine nursing faculty members (including five with Master's degree in pediatric nursing, two PhD candidates in nursing, and two assistant professors in nursing). The instruments were revised based on their comments. For inter-rater reliability assessment, two examiners simultaneously used the PVC insertion skill rating scale for eight nursing students while they individually practiced the pediatric PVC insertion skill on a child mannequin. The inter-rater correlation coefficient was 0.89.

The child mannequin used in this study had the basilic, the cephalic, and a dorsal hand vein in the upper limb as well as the saphenous vein and a dorsal foot vein in the lower limb. During PVC insertion, if the needle was properly inserted into the vein, the red fluid in the mannequin vessels entered the needle and reached its end point, showing correct placement of the needle tip; otherwise, the needle was considered to be inserted incorrectly.

Intervention

Initially, a 15-min lecture with PowerPoint presentation was held for all students in each semester about pediatric PVC insertion, its necessary equipment, and its steps. After that, each student was asked to practice pediatric PVC insertion skill on a child mannequin in the skill lab of Tabriz Faculty of Nursing and Midwifery, Tabriz, Iran, and his/her baseline PVC insertion skill was assessed using the PVC insertion rating scale.

Participants in the simulation group were provided with pediatric PVC insertion training through role play simulation. Accordingly, each two students were invited to the skill lab, were informed about learning objectives and necessary equipment, and were provided with a written simulation scenario about a child with severe dehydration who needed a venous catheter to receive fluid and electrolytes. The scenario included explanations about the environment, conditions, expectations, and roles. One of the students had to insert a venous catheter for the child mannequin and establish proper communication with the child's parents in 25 min; meanwhile, the other student observed and wrote notes about his/her colleague's performance. Then, the second student practiced the skill within 25 min and the first student observed and wrote notes about his/her performance. Throughout their performance, their instructor (the corresponding author) observed them and wrote notes about their PVC insertion and communication with parents. At the end, a 20-min question-and-answer session was held with the two students, in which they expressed their personal feelings about simulation and PVC insertion, provided feedback to each other, and received feedback from their instructor.

In the demonstration group, the same instructor initially provided students with information about learning objectives and necessary equipment and then, demonstrated the pediatric PVC insertion technique for them on the same child mannequin in the skill lab within 20 min. After that, each student individually practiced the skill under instructor's supervision and received her necessary feedback within 25 min. Students in the control group solely received routine theoretical training about pediatric PVC insertion through a lecture.

To prevent among-group information leakage, all students were ensured that the aim of the study was to evaluate the effects of two teaching methods, not to evaluate their performance. Moreover, they were asked to avoid speaking with each other about the teaching methods. In addition, they did not access the child mannequin except during pretest, teaching, and posttest sessions. Three weeks after the end of the study interventions, each student was asked to demonstrate the pediatric PVC insertion skill within 15 min and the instructor assessed his/her performance using the rating scale.

Ethical considerations

This study has the approvals of the Institutional Review Board and the Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran (approval code: TUOMS.REC.1391.914), and was registered in the Iranian Registry of Clinical Trials (code: IRCT20120478315N4). At the beginning of the study, the participants were informed about the aims, advantages, and disadvantages of the study; their freedom to voluntarily withdraw from the study; and the confidential management of their data. Moreover, they were ensured that withdrawal from the study would not affect their final course mark. At the end of the study, participants in the control group were provided with demonstration-based education about pediatric PVC insertion. All participants provided written informed consent for participation.

Data analysis

The data were analyzed using the SPSS software version 13 (SPSS Inc., Chicago, IL, USA). The normality of the numerical data was assessed using the Kolmogorov–Smirnov test. Measures such as frequency, mean, standard deviation, and 95% confidence interval were used for data description. Moreover, the Wilcoxon and the Kruskal–Wallis tests were used for within- and between-group comparisons, respectively. Statistical significance level was set at <0.05.

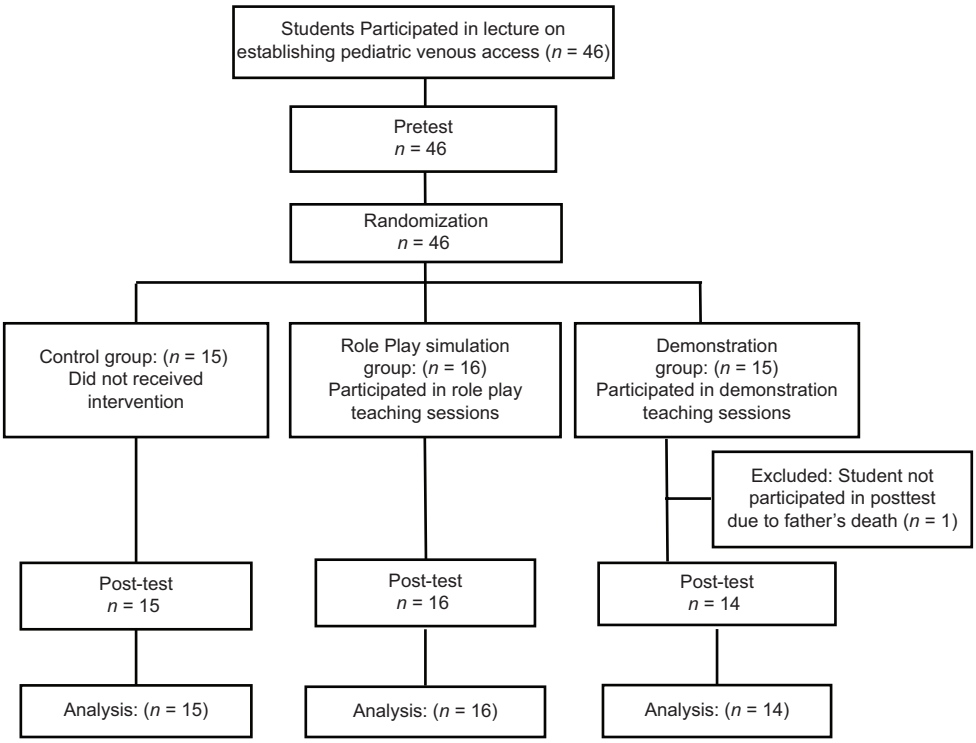

Figure 1: Flowchart of the study

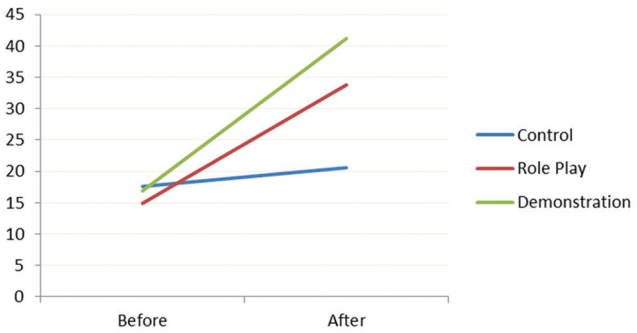

Figure 2: The pretest and the posttest total score of pediatric peripheral venous catheter insertion skill in the study groups

Results

In total, 46 students (24 fifth-semester and 22 sixth-semester students) participated in this study. One student was excluded from the demonstration group due to her father's death [Figure 1]. There were no significant differences among groups respecting participants' age, gender, academic semester, and grade point average [$P > 0.05$; Table 1].

Participants' PVC insertion skill significantly improved in the simulation and the demonstration groups ($P < 0.001$) but did not significantly change in the control group [$P = 0.09$; Table 2]. Moreover, although there was no statistically significant among-group difference respecting baseline PVC insertion skill total score ($P = 0.6$), the difference among the groups respecting the posttest PVC insertion skill total score was statistically significant ($P < 0.001$). However, the difference between the demonstration and the simulation groups was not statistically significant [$P > 0.05$; Table 2 and Figure 2].

Discussion

The findings showed that both demonstration and role play simulation significantly improved pediatric PVC insertion skill among nursing students, but no significant difference was found between these two methods. A former study on nurses assessed the effects of skill training through PowerPoint presentation, movie presentation, mannequin-based exercise, and question-and-answering and found that this combined intervention was effective in improving nurses' pediatric PVC insertion skill. However, that study lacked a control group.[7] Similarly, a randomized controlled trial on nursing students compared the effects of PVC insertion skill training through a 12-min video and 1-h skill exercise using a mannequin and showed no significant difference between the two teaching methods.[11] Although not on nursing students or in PVC insertion, an earlier study examined the effects of face-to-face and video-based education methods and reported that both methods significantly improve inhaler use in patients, even though the effect of the face-to-face method was comparatively greater, which was attributed to the direct interactions between learner and trainer.[12] Moreover, a study found that simulation was effective in significantly improving nurses' knowledge, competence,

Table 1: Between-group comparisons respecting participants' personal characteristics

Characteristics	Group			*P*
	Control	Simulation	Demonstration	
Age (years)[a]	21.41 ± 0.66	21.75 ± 0.75	22.33 ± 1.32	0.16[c]
Gender[b]				
Female	10	10	9	0.97[d]
Male	5	6	5	
Academic semester[b]				
Fifth	8	8	8	0.92[d]
Sixth	7	8	6	
Grade point average[a]	16.25 ± 1.05	16.50 ± 0.90	15.77 ± 1.21	0.22[c]

[a]Data are presented as mean±SD, [b]Data are presented as frequency; [c]Kruskal–Wallis test, [d]Chi-square. SD: Standard deviation

Table 2: Within- and between-group comparisons respecting participants' total score of pediatric peripheral venous catheter insertion skill

Outcomes	Group	Time		*P*[a]
		Before	After	
Pediatric PVC insertion skill	Control			
	Mean ± SD	17.66 ± 7.46	20.66 ± 5.65	0.09
	95% CI	13.53-21.79	17.53-23.79	
	Mean rank	25.63	9.47	
	Simulation			<0.001
	Mean ± SD	14.93 ± 6.64	33.81 ± 6.86	
	95% CI	11.39-18.48	30.15-37.46	
	Mean rank	21.03	25.56	
	Demonstration			<0.001
	Means	16.92 ± 10.38	41.14 ± 7.67	
	95% CI	10.93-22.92	36.71-45.57	
	Mean rank	22.43	34.57	
	P[b]	0.6	<0.001	-
Pretest-posttest mean difference of pediatric PVC insertion skill	Control			
	Mean ± SD		3 ± 6.53	
	95% CI		−0.61-6.61	
	Mean rank		11.43	
	Simulation			
	Mean ± SD		18.87 ± 10.15	
	95% CI		13.46-24.28	
	Mean rank		27.09	
	Demonstration			
	Mean ± SD		24.21 ± 14.38	
	95% CI		15.91-32.51	
	Mean rank		30.71	
	P[b]		<0.001	

[a]The Wilcoxon test, [b]The Kruskal–Wallis test. SD: Standard deviation, CI: Confidence interval, PVC: Peripheral venous catheter

and self-confidence regarding adult PVC insertion.[13] However, a two-group trial found no significant difference between scenario-based role play training and traditional mannequin-based training on adult intramuscular injection skill among baccalaureate nursing students.[4] Nurses can use either of these two methods or both for education of patients about inhaler use.

Pediatric PVC insertion is a difficult and challenging nursing psychomotor skill and necessitates adequate training, practice, and feedback.[14] However, nursing students usually do not acquire the necessary skills in this area.[15] The high number of students in the clinical setting, the lack of skilled teachers, and the lack of clinical training time are some of the factors that prevent students from achieving the necessary training in this skill.[16,17] Therefore, it is possible to compensate the students' skill weakness in this field by using appropriate teaching methods that can be used in clinical skills centers. As our results illustrated, both simulation and

demonstration can be useful for teaching the pediatric PVC insertion skill.

This study had some limitation such as low sample size and no blindness. Therefore, studies with larger samples and more rigorous methodology are needed to produce more evidence regarding the effects of demonstration and role play simulation on pediatric PVC insertion skill in nursing students.

Conclusion

This study concludes that both demonstration and role play simulation are similarly effective in improving pediatric PVC insertion skill among baccalaureate nursing students. Therefore, these teaching methods are recommended for teaching pediatric nursing psychomotor skills to nursing students in the skill lab. Of course, further studies are still needed to determine the effects of demonstration and role play simulation on other pediatric nursing skills such as resuscitation, medication administration, and intramuscular injection in nursing students and staff nurses.

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Conflicts of interest

There are no conflicts of interest.

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