Comparing the effects of jigsaw and lecture-based education on nurses' attitudes and screening competency toward delirium in the intensive care units: A randomized controlled trial

Seyede Mohadese Nabizade[1], Neda Sanaie[2], Fatemeh Monjazebi[2], Malihe Nasiri[3], Mehrnoosh Azizi[4], Seyede Motahare Nabizade[5]

[1]Student Research Committee, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [2]Department of Medical Surgical Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [3]Department of Pediatric, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [4]Department of Medical Surgical Nursing, Clinical Research Development Unit (CRDU) of Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [5]Department of Medical Surgical Nursing, Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, Iran

Address for correspondence:
Dr. Neda Sanaie, Vali-Asr Avenue, Cross of Vali-Asr and Hashemi Rafsanjani Highway, Opposite to Rajaee Heart Hospital, Tehran, Iran.
E-mail: nedasanaie@ymail.com

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Abstract:

BACKGROUND: Hospitalization in the ICU is closely related to unwanted complications, including delirium. This condition generally occurs in the form of acute changes in mental status, and frequent fluctuation courses. As delirium can be potentially prevented, providing appropriate education to nurses to deal with its associated risk factors and properly managing it seems to be imperative.

MATERIALS AND METHODS: A randomized clinical trial with two parallel groups was done in two referral educational hospitals. In total, 75 ICU nurses were included. The nurses were randomly divided into, the jigsaw (Group A; $n = 37$) and lecture (Group B; $n = 38$). Group A was then taught based on the jigsaw approach during four sessions of 30–40 minutes, and Group B received lecture-based education for two sessions of 45–60 minutes. To collect the data, a demographic information form, the Nurse Attitude Survey, and the Nursing Delirium Screening Scale were completed at the pre-test stage and four weeks later as post-tests.

RESULTS: There was a significant difference in the mean scores of nurses' attitudes and delirium diagnosis before and after the intervention in the study groups ($P < 0.001$). Both approaches were accordingly effective in two variables attitudes and diagnosis but the trend of changes in the mean scores of such attitudes in Group A was higher than that in Group B ($P < 0.001$).

CONCLUSION: Compared to the common methods of education, the cooperative ones, such as the jigsaw approach, were found to be more effective in enhancing nurses' attitudes to delirium and increasing their competency to screen it.

Keywords:

Attitude to health, cooperative learning, delirium, intensive care units, jigsaw, lecture method

Introduction

The intensive care units (ICUs) are among the central components of health care facilities wherein patients with life-threatening diseases are generally hospitalized.[1] ICUs also have a key role in restoring health to critically ill patients through providing advanced healthcare services, exploiting modern medical equipment, recruiting experienced and qualified personnel, and making multidisciplinary team decisions.[1,2] Hospitalization in the ICUs can be thus accompanied by some significant complications among patients, including neuropsychiatric syndromes such as delirium.[3-5]

Delirium represents a collection of major neurocognitive disorders that largely occur as acute changes in mental status, frequent fluctuation courses, inattention, and confused thinking.[6] It is also one of the most common neuropsychiatric syndromes seen in the ICUs.[7] Up to now, the exact etiology and pathophysiology of this disease have not been established even though it is typically associated with high mortality rates, cognitive decline, dementia, poor performance, negative consequences such as prolonged stays in hospital, reduced physical function, high health care costs, and discomfort in patients and their families.[8,9] Delirium diagnosis in the ICUs remains unnoticed in most cases,[10] although its early diagnosis, along with appropriate and timely treatment, shortens the length of stay in hospital, improves physical and mental conditions in patients, and reduces health care costs.[11]

Physicians are primarily responsible for managing delirium diagnosis; however, given the changes in its symptoms, the ICU nurses are assumed to be best suited for doing timely screening and notifying physicians as they spend much time at the patient's bedside.[4] The major barriers facing delirium diagnosis by nurses are limited time, poor attitudes toward care for patients with this disorder, no knowledge about delirium and tools for its diagnosis, difficulty in evaluating intubated patients and those under sedation, lack of feedback about one's performance, insufficient support, communication challenges, and concerns related to workload in the ICUs.[12-14] Given this, it is of utmost importance for nurses to gain adequate knowledge about delirium and modify their attitudes toward this condition to quickly diagnose its signs and symptoms. Therefore, educational programs are needed to improve their competency in the proper evaluation and management of delirium.[15]

Managers create the necessary motivation in employees by choosing the appropriate leadership style and guiding them to achieve organizational goals. They can influence the empowerment of their personnel by using effective management and leadership skills, along with new collaborative educational methods, thus facilitating the achievement of the organization's goals.[16] Management is the engine of development and development depends on the work group and organization that needs effective management. The appropriate behavioral model of managers in any organization creates strong morale and motivation in employees, increasing their satisfaction with their jobs and careers. The role of nursing managers in the development of human resources, especially the specialized staff providing care, is very vital, and their duty is to create conditions where employees can perform their duties with a strong spirit, healthy body, and work well-being.[17]

Different ways have been developed so far to provide education for this purpose. At present, the methods of education have been grouped into two general categories, traditional and modern.[18] One of the most common techniques in traditional education is the lecture-based one,[19] extensively applied in medical education.[20] Although lectures are known as simple, fast, and inexpensive ways to present various subjects to groups of learners,[21] they rarely provide good opportunities for critical thinking, which is crucial in the learning process.[20] For that reason, lecture-based education may not always be appreciated by learners.[22]

Innovation and transformation in medical education are some of the critical missions and commendable actions of the Ministry of Health in the field of education. A review of these measures can identify shortcomings and problems, and pave the way for success, and progress in future programs.[23] To expand the existing capacities and then boost educational feedback and evaluations, it is therefore essential to develop and adopt novel approaches in clinical education for nurses,[24] including those based on cooperative learning strategies, particularly the jigsaw method[25,26] which was first presented by Arnson in 1978.[27] Jigsaw-based education is accordingly an interactive approach to help learners achieve the common goal of learning in small groups through strategies of themselves and other members of the group,[28] It offers several advantages, such as reducing fatigue, boosting self-confidence and motivation, encouraging participation, Improving knowledge retention, increasing understanding during learning, making learning permanent, establishing communication skills, and enhancing group quality and performance.[29,30] To date, the jigsaw learning strategy has been practiced in other fields of education, but its application in medical education has been in use for less than a decade. Most learners respect it as a valuable experience for learning actively, sharing ideas, thinking critically, and developing problem-solving skills.[26,31,32]

The novelty of this study is that the use of the jigsaw approach for nurse education has been very limited. Moreover, no study in Iran has, up to now, been conducted on the effectiveness of jigsaw as a cooperative learning strategy among nurses and their attitudes toward delirium, to the best of the author's knowledge. In addition, the implementation of this method met with significant satisfaction from nurses and nurse managers, which is one of the key indicators of the effectiveness of education. The objective of this study was to determine whether jigsaw education is superior to standard methods of education regarding nurses' attitudes toward delirium (first outcome) and screening competency (second outcome) in the ICUs. The conceptual framework of this research is shown in the form of a figure [Figure 1].
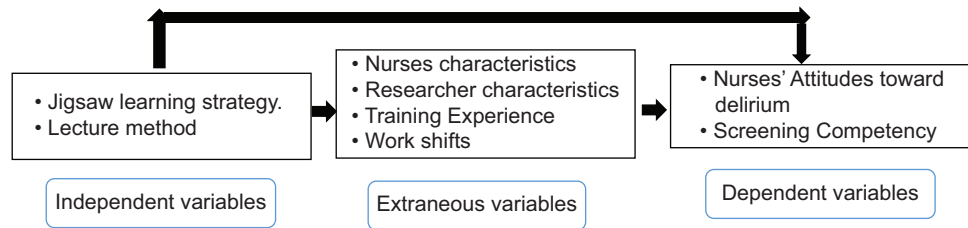
Figure 1: Conceptual framework

Materials and Methods

Study design and setting
This study was conducted in 2023 using a single-blind, parallel-group, randomized clinical trial (RCT) as the research design. At first, two referral teaching hospitals affiliated to Shahid Beheshti University of Medical Sciences, Tehran, Iran, with general ICUs, were selected, and then one hospital was randomly selected for jigsaw education (Group A) and the other for lecture-based intervention (Group B). In this way, both groups were separated to avoid the exchange of information during the intervention. The content of the educational program about delirium and the data collection tools were the same in both groups, but the approaches to its implementation were different.

Study participants and sampling
This study was performed at Shahid Beheshti University of Medical Sciences, Tehran, Iran, at two affiliated hospitals. The sample size was also estimated using G*Power (ver. 3.1.9.4).[33] A statistical test was further exploited to compare the mean difference of both independent groups and then the sample size with $\alpha = 0.005$ and test power = 0.90 was estimated to be 37 individuals in each group, with reference.[34] Considering the 10% sample attrition, 40 nurses and 80 participants in total were finally included.

Inclusion criteria
The inclusion criteria were holding at least a Bachelor's degree in Nursing, having a minimum of one year of clinical work experience in the ICUs, and attending no educational programs related to delirium during the last year.

Exclusion criteria
The exclusion criteria were leaving the ICUs before completing the study for some reason, not completing the questionnaires in their entirety, and missing more than one session of the educational program.

Participants
In total, 80 eligible nurses participated in this study. Of these, 40 individuals were placed in Group A for jigsaw education and 40 people were allocated to Group B to receive a lecture-based intervention. Upon obtaining informed consent from the participants, they completed the research tools at the pre-test stage. Of note, three participants in Group A (namely, two individuals for being absent in the educational program sessions and one case for not completing the post-test stage) and two participants in Group B (i.e. one for missing the educational program sessions and one case for not completing the post-test stage) were excluded from the study, and finally, 37 nurses in Group A and 38 in Group B were considered for the final analysis, Figure 2 (Consort Flowchart).

Randomization and blinding
Out of five referral teaching hospitals affiliated to Shahid Beheshti University of Medical Sciences, Tehran, Iran, equipped with general ICUs, two cases were randomly selected, and then a simple random sampling of the coin-flip type was performed. One hospital was thus selected to provide jigsaw education (Group A) and the other to present lecture-based intervention (Group B). This study was also single-blind in terms of the participants.

Data collection tools and technique
In this study, three tools, including a demographic information form, the Nurse Attitude Survey (NAS),[35] and the Nursing Delirium Screening Scale (Nus-DESC)[36] were utilized as follows.

Demographic information form
This questionnaire examined the individual characteristics of the study samples and contained items about gender, age, occupation and specific position, educational attainment, work experience, work experience in the ICUs, and passing an educational program about delirium.

Nurse attitude survey (NAS)
This tool was adapted from a thesis fulfilled by Hagerling (2015) at Colorado State University,[35] which consisted of 36 statements with a five-point Likert-type scale (from *strongly disagree* to *strongly agree*) and four domains describing knowledge, competency and self-confidence (items no. 1–15), ability to diagnose and understand consequences (items no. 16–25), desire to
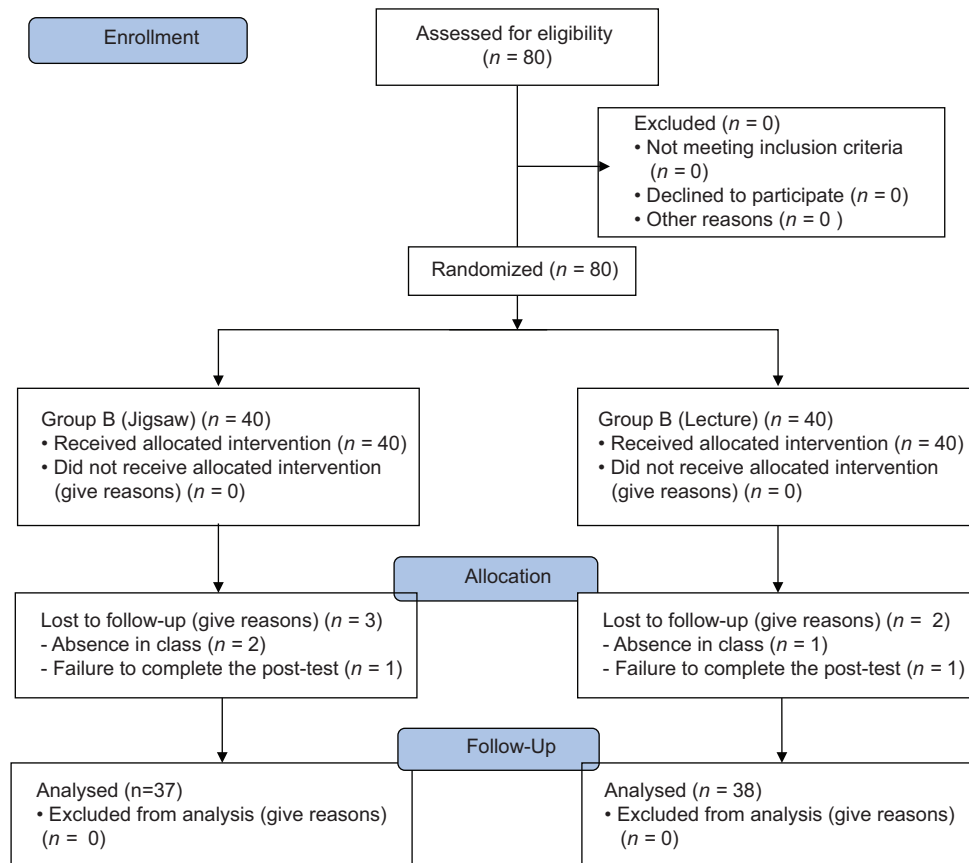
Figure 2: CONSORT flow diagram

know more (items no. 26–28), and care burden (items no. 29–36). The minimum and maximum scores in this questionnaire were 36 and 180, respectively. As well, the range of scores in all domains was based on 1–5. The validity and reliability of this tool had previously been investigated by Gholizadeh *et al*. (2018)[37] in Iran. To determine the internal consistency and repeatability of this questionnaire, Cronbach's alpha coefficient and test-retest method were also used, in that order; and then, the concordance between the answers on both occasions was reported as 0.87 using the Pearson correlation coefficient. Moreover, its reliability was checked through the internal consistency method, and its Cronbach's alpha coefficient was found to be 0.87 in total, and 0.75, 0.79, 0.76, and 0.87 for the domains of knowledge, ability to diagnose and understand consequences, desire to know more, and care burden, respectively. In the present study, this tool was provided to 10 experts, and their comments were applied to correct it. The modifications were such that items no. 2, 7, 8, 11, 12, 14, 17, 19, 22, 24–27, and 30–32 were completed in terms of their composition, and item no. 4 was reduced into three separate cases. Also, 17 items (items no. 5, 6, 9, 10, 13, 15, 18, 20, 21, 23, 28, and 33–36) remained unchanged. Notably, the total number of statements did not change, and 36 cases were considered. The reliability of the

given tool was further measured in this study by the internal consistency method, whose Cronbach's alpha coefficient was 0.89 in total and 0.79, 0.81, 0.79, and 0.88 in the domains of knowledge, ability to diagnose and understand consequences, desire to know more, and care burden, in that order.

Nursing Delirium Screening Scale (Nu-DESC)

The Nu-DESC was developed by Gaudreau *et al*. (2005)[36] for delirium diagnosis by nurses. This tool had five dimensions, including disorientation, inappropriate behavior, improper communication, illusions/hallucinations, and psychomotor retardation. Based on the patient's conditions, a score of 0–2 could be received for each dimension, wherein 0 meant no symptom, 1 referred to a moderate condition, and 2 was associated with a severe condition. If the patient's score was over 2, with a sensitivity of 85.7% and a specificity of 86.8%, it suggested the possibility of delirium and the need for intervention. The time to complete this tool was approximately 1 minute per patient with a sensitivity range of 32-100% and a specificity of 79-98%. After translating this tool into Persian, its face, criterion, and content validity were further examined in Keykha *et al*. (2021).[38] The construct validity was then determined using factor analysis. The content validity ratio (CVR)

for the Persian version of the tool was also 0.96 and the content validity index (CVI) of the items was 0.97. Further, the receiver operating characteristic (ROC) curve with the area under the curve (AUC) of 0.98 showed the high accuracy of the tool in diagnosing delirium. At the cut-off point above 2, the sensitivity was 92.8% and specificity was 91.7%. The internal correlation of the tool based on Cronbach's alpha coefficient was 0.99. Moreover, the reliability was obtained as 0.99%, using the internal correlation of its items with Cronbach's alpha coefficient. Moreover, the Guttman split-half coefficient was used to find the reliability of the tool items. The correlation coefficient between both halves of the tool was 0.85. Considering that each patient was evaluated separately by two nurses via the Nu-DESC, the intraclass correlation coefficient (ICC) was calculated to describe the stability of the inter-rater scoring, with a value of 0.75, a confidence interval of 0.70–0.80, and $F = 0.000$, so there was adequate inter-rater reliability.

Research process

Before commencing the educational program, its content was prepared and submitted to nine specialists (three nursing faculty members, two anesthesiologists, two psychiatrists, and two neurologists), and its content, including pamphlets, PowerPoint slides, and pictures, was modified. After entering the study setting, the research tools were completed by the participants at the pre-test stage during one session. Upon completing the demographic information form, the Nurse Attitude Survey (NAS) was administered to reflect on the nurses' attitudes toward delirium. To examine their competency to screen and diagnose delirium, three clinical scenarios were provided to each nurse, each one reporting patients with a specific history and clinical conditions separately (The clinical scenario included the explanation of a patient hospitalized in the ICU, and at the end of each scenario, the nurses were asked about the type of delirium, its cause, severity, and how to diagnose it.). The nurse could thus score them based on the described characteristics via the Nursing Delirium Screening Scale (Nus-DESC) (all clinical scenarios were planned with reference to real and inpatient case reports published in high-quality journals, whose content had already been approved by anesthesiologists). The nurses completed the questionnaire based on the clinical cases and a score was given to each scenario. Then, the number of correct cases provided by each nurse was determined. Afterward, the main interventions, viz., the jigsaw approach as the cooperative learning strategy and lecture-based education, were completed for both groups. It is noteworthy that the content of the educational program provided to the study groups was the same and contained the definition of delirium, different types of delirium specifically in the ICUs, the etiology of delirium, signs and symptoms, preventive interventions, as well as the early diagnosis of this disorder and its treatment. This content was only presented through lectures or jigsaw. In this way, Group A received jigsaw as a cooperative training strategy in four sessions, each one lasting 30-40 minutes in groups of five nurses (eight groups of five). To implement this approach, only one session was held for each group during the week, with reference to nurses' shifts and their convenience to participate in the educational program, as it was not possible for all 40 people to attend each session. Following coordination with the ICU and obtaining the consent of the nurses and their work shifts, there were four groups every day attending the same sessions until the end of the program (every week on Saturday or Sunday for four weeks). The second four groups were also present as a routine on the next day of the week (Tuesday or Wednesday for four weeks). To follow up the education process, the researcher communicated with each group via a messenger agreed upon by all members, and the educational content of the previous session was sent as tips within one week until the next session. In total, the interventions lasted about six weeks. In each session, the nurses were informed about the topics and the group members studied the desired ones according to the PowerPoint slides and the educational videos. After each session, one group leader was selected for each group (four group leaders were thus selected in each session and were present until the session's completion). The educational content was provided to them through the researcher, and then the designated heads formed a panel of experts, reviewed the educational topics cooperatively and analyzed the concepts of the topics comprehensively, and mastered the main components of the topics in the presence of the researcher. Next, they returned to their group and presented the concepts to the members, and some discussions were held between the members of each group. It is noteworthy that, the researcher tried to guide the groups and conclude. At the end of each session, all the participants gave feedback on the content, and in case of any ambiguity, they asked their questions and answered them with the participation of all the group members. In the lecture-based group, the materials were presented by lectures during two sessions of 45-60 minutes (the interval between each session was one week). Four weeks after the interventions, the NAS and the Nus-DESC were completed in two groups and the attitude scores were compared. Regarding their competency to screen delirium, the same clinical scenarios as before were provided to both groups, and the scores given to each scenario and the comparison of the number of correct cases before and after the intervention were examined. One clinical scenario and its associated questions are given in box 1. For each clinical scenario, five questions were asked to evaluate the screening competency accordingly. The first question, which was about the nurses' competency to screen

delirium, was considered for scoring purposes, and the next four questions were raised to assess the education process.

Ethical considerations

This study received approval from the Research Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran, with the ethics code no. IR.SBMU. PHARMACY.REC.1401.231. After explaining the study objectives to the participants, informed consent was also obtained. They were further assured that not participating in the study or withdrawing from it would not affect their job performance in hospitals. This study was registered by the Iranian Registry of Clinical Trials with the code no. IRCT20230301057573N1.

Results

In total, there were 75 participants in this study, including 37 and 38 nurses in Group A and Group B, respectively.

Demographic characteristics

The Chi-square test and independent-samples t-test results did not establish any significant difference in terms of the demographic characteristics between both groups, which suggested their homogeneity [Table 1].

Attitudes toward delirium

Comparing the mean and standard deviation (SD) values of the total score of NAS ($t = 0.636$, $P = 0.527$) and its four domains, including knowledge, competency, and self-confidence ($t = 0.09$, $P = 0.929$); ability to diagnose and understand consequences ($t = 1.642$, $P = 0.105$); the desire to know more ($t = -0.969$, $P = 0.336$); and care burden ($t = 0.58$, $P = 0.564$) did not show a significant difference between the two groups before the intervention. After the implementation of the intervention, comparing the mean scores of the total NAS ($t = 7.369$, $P < 0.001$) and all its four domains, viz., knowledge, competency, and self-confidence ($t = 2.307$, $P = 0.024$); ability to diagnose and understand consequences ($t = 7.092$, $P < 0.001$); the desire to know more ($t = 2.324$, $P = 0.023$); and care burden ($t = 7.86$, $P < 0.001$) revealed that such values in Group A were significantly higher than those

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Box 1: A clinical scenario

A 70-year-old woman with a history of diabetes and hypertension was admitted to the department of infectious diseases in the hospital following the diagnosis of pneumonia, and was immediately treated with Ceftriaxone and Meropenem. After the aggravation of lethargy, fever, and respiratory distress, she was transferred to the ICU and intubated due to disturbance in Atrial blood gas (ABG) and hypoxia-induced therapy resistance, and particularly ineffective breathing pattern, but she was disconnected from the device after four days with the partial improvement of her condition, turbidity reduction in the chest radiograph and leukocytosis and better blood ABG. During mechanical ventilation, some sedatives, including Dexmedetomidine, Fentanyl, Midazolam, Ketamine, and Melatonin were prescribed for the patient. From the morning of the fifth day (viz., the next day of disconnection from the device), she felt periodically disorientated (especially in the evenings) and restless, but cooperated with the nurse in an acceptable manner, and the nurse did not face no cooperation in her care. All through her hospitalization, no hallucinations were also reported, and she maintained a good relationship with the surrounding environment, but some unrelated conversations for more than a few hours during the treatment period were seen, whose occurrence had some fluctuations. Over time, such hallucinations disappeared, and when the patient was asked once again, she answered correctly and did not remember her previous answer.

Questions

1. Does the patient suffer from the ICU-induced delirium syndrome?
2. What is of interest to you in the patient's behavior, if delirium is diagnosed?
3. How do you assess the severity of delirium, if diagnosed?
4. What type of delirium is it, if diagnosed?
5. What do you think is the cause of the patient's behavioral and cognitive fluctuations, if delirium is not diagnosed?

Table 1: Comparing demographic characteristics between study groups before intervention

Demographic information of participants		Jigsaw group n=37		Lecture group n=38		χ^2	P
		Number	Percent	Number	Percent		
Gender	Male	12	32/4	14	36/8	0/161	0/809
	Female	25	67/6	24	63/2		
Education	Bachelor	33	89/2	30	78/9	1/463	0/346
	Master of Science	4	10/8	8	21/1		
Shift work	Morning	14	37/8	9	23/7	6/822	0/161
	Night	4	10/8	4	10/5		
	Morning and Evening	3	8/1	3	7/9		
	In circulation	16	43/2	22	57/9		
Other information		Jigsaw group		Lecture group		Independent sample t-test	P
		Mean	SD	Mean	SD		
Age		36/35	8/51	32/86	7/57	1/872	0/065
Work experience		12/78	8/45	9/40	6/87	1/900	0/061
Work experience in ICU		6/27	6/29	4/55	3/18	1/496	0/139

SD: Standard deviation

in Group B [Table 2]. The mean difference in all four domains of the NAS before and after the intervention in Group A was also greater than Group B, which was significant in all domains [Table 3]. However, the paired-sample *t*-test results demonstrated a significant difference in both groups (*P* < 0.05) in the mean scores of the total NAS and all four domains before and after the intervention [Table 2]. Furthermore, the jigsaw approach more significantly improved nurses' attitudes toward delirium in the ICUs.

Delirium diagnosis

Comparing the mean and SD values of delirium diagnosis before the intervention indicated no significant difference between both groups (*t* = 0.456, *P* = 0.643). After the intervention, the mean score of delirium diagnosis (*t* = 2.864, *P* = 0.005) in Group A was significantly higher than that in Group B. The independent-sample *t*-test results then in showed that the mean difference before and after delirium diagnosis was greater in Group A than Group B, which was significant (*t* = 3.349, *P* = 0.001). However, the paired-samples *t*-test outcomes indicated that the mean scores of delirium diagnosis before and after the intervention were significantly different in both groups (*P* < 0.05) [Table 4]. In spite of this, the jigsaw learning strategy had a greater effect on competency to diagnose delirium by the ICU nurses.

Table 2: Comparing mean scores of attitudes toward delirium before and after intervention in study groups

Variable	Group	Pre test mean (SD)	Post test mean (SD)	Paired *t*-test	*P*
Knowledge, competency and self-confidence	Jigsaw	48/10 (3/74)	54/67 (4/69)	−10/304	*P*<0/001
	Lecture	48/02 (4/14)	52/02 (5/22)	−6/503	*P*<0/001
	Independent *t*-test	0/090	2/307		
	P	0/929	0/024		
Ability to diagnose and understand consequences	Jigsaw	32/45 (2/67)	42/05 (2/62)	−19/308	*P*<0/001
	Lecture	31/34 (3/19)	36/13 (4/36)	−7/813	*P*<0/001
	Independent *t*-test	1/642	7/092		
	P	0/105	*P*<0/001		
Desire to know more	Jigsaw	11/45 (1/70)	13/05 (0/97)	−4/617	*P*<0/001
	Lecture	11/86 (1/93)	12/31 (1/67)	−2/743	0/009
	Independent *t*-test	−0/969	2/324		
	P	0/336	0/023		
Care burden	Jigsaw	23/56 (3/50)	35/02 (3/61)	−14/813	*P*<0/001
	Lecture	23/10 (3/39)	26/31 (5/71)	−4/936	*P*<0/001
	Independent *t*-test	0/580	7/864		
	P	0/564	*P*<0/001		
Total attitude score	Jigsaw	115/59 (7/86)	144/51 (6/58)	−23/865	*P*<0/001
	Lecture	114/34 (9/11)	126/78 (13/38)	−8/618	*P*<0/001
	Independent *t*-test	0/636	7/369		
	P	0/527	*P*<0/001		

Table 3: Trend of changes in mean and SD scores of attitudes toward delirium in study groups

Variable	Jigsaw group		Lecture group		Independent *t*-test		
	Mean	SD	Mean	SD	*P*	df	*t*
Knowledge, competency and self-confidence	6/56	3/87	4/00	3/79	0/005	73	2/900
Ability to diagnose and understand consequences	9/59	3/02	4/78	3/77	*P*<0/001	73	6/071
Desire to know more	1/59	2/10	0/44	1/00	*P*=0/003	73	3/029
Care burden	11/45	4/70	3/21	3/98	*P*<0/001	73	8/198

Table 4: Comparing delirium diagnosis scores before and after intervention in study groups and the trend of changes in their mean scores

Variable	Group	Pre test mean (SD)	Post test mean (SD)	Paired *t*-test	*P*
Diagnosis of delirium	Jigsaw	3/05 (2/12)	4/27 (1/32)	-4/014	*P*<0/001
	Lecture	2/81 (2/31)	3/00 (2/35)	-2/488	0/017
	Independent *t* test	0/456	2/864	0/005	
		P	0/643		

Jigsaw Trend of changes (Mean and SD)	Lecture Trend of changes (Mean and SD)	Independent *t*-test	df	*P*
1/21 (1/84)	0/18 (0/45)	2/349	73	0/001

The study results suggested that, accordingly, the jigsaw approach was effective in increasing the scores of attitudes toward delirium and screening competency more than traditional methods, such as lectures. At present, the conventional nursing education is lecture-based, which involves passive learning, and learners often undergo a gap between what they learn in classrooms and what they need to practice in clinical settings. Therefore, choosing the most appropriate educational approaches is of utmost importance in clinical fields such as nursing, wherein interaction is significant. This considerably boosts the attractiveness and effectiveness of education.

Discussion

Jigsaw learning revolves around innovative teaching approaches that treat nurses as active participants nurturing essential skills such as problem-solving and critical thinking.[39] The first finding of the current research showed that the jigsaw cooperative learning strategy; was effective as compared to traditional education in enhancing attitudes toward delirium among nurses in the ICUs.

Most Indian ICU nurses showed poor, limited knowledge and attitude about the causes, prevalence rates, and symptoms of delirium as well as its screening tools and pharmacological and non-pharmacological management. Nearly all nurses believed that they had not received any education about delirium screening and management and expressed their desire to know more about it.[9] This was similar to the results of the present study; the level of nurses' attitudes towards the signs and symptoms of delirium in the ICU was weak and the use of new collaborative methods of education had an effect on improving their attitude, and was accompanied by the satisfaction and active participation of the nurses. Furthermore, Lange *et al.* (2023)[40] found that, there is an urgent need to educate nurses about delirium and to make delirium assessment obligatory in clinical practice, and the attitude and performance of the majority of nurses about delirium were not satisfactory, and even no relationship existed between the knowledge and practice scores in nurses. Therefore, there was a considerable need for continuous education to broaden their knowledge, attitudes, and practical skills regarding delirium.

Ramoo *et al.*[41] reported that education could significantly increase nurses' knowledge and attitudes about delirium screening. This could potentially result in better performance in terms of delirium management and promote the ICU patient care services. As a result, continuous efforts were needed to boost and maintain the knowledge of nurses working in the ICUs. Abd El Aliem *et al.*[26] have similarly shown a statistically significant difference between groups with jigsaw and lecture education in terms of learning achievements immediately after the intervention, and a statistically significant difference was observed between both groups in the follow-up. In addition, the students in the jigsaw group showed more positive attitudes toward learning strategies than those having lecture-based education.

The second result of the present research indicated that the jigsaw method, in comparison to the lecture method, has had a greater impact on the screening competency of delirium in nurses. In this regard, Blevins and DeGennaro provided evidence that a multifaceted educational intervention for delirium screening among the ICU nurses could augment their knowledge and diagnosis skills.[42] Alhalaiqa *et al.*[43] also established that an educational program for delirium had expanded performance, self-efficacy, and delirium diagnosis competency in ICU nurses. Based on this and the results of the present study, improving the attitude is the underlying factor for increasing the ability of nurses to screen for delirium. Zhao *et al.*[44] correspondingly discovered that educational interventions could foster nurses' knowledge and understanding of delirium as well as their self-confidence. These interventions also led to better compliance with delirium screening and management protocols, thereby enriching documentation accuracy and clinical outcomes. Researchers believe that active learning leads to the enhancement of positive emotions and the reduction of negative emotions in learners, ultimately resulting in better learning of scientific content.

Multimodal knowledge translation was an effective method to improve the ICU nurses' understanding of delirium and perceptions of screening tools, which could also lead to regular delirium diagnosis in their assessments. Delirium screening could correspondingly help in faster delirium diagnosis. Continuous education was thus needed for the advancement of knowledge.[7] Ewens *et al.*[45] concluded that an interprofessional approach to delirium education is effective in not only increasing awareness of the factors associated with this syndrome but also increasing the use of a delirium assessment tool and the use of a multifaceted educational program could help develop nurses' knowledge about delirium and their understanding of its diagnosis.

A review and meta-analysis by Shakerian *et al.* (2020),[46] including a comparison of the jigsaw approach with other methods, further established that the jigsaw learning strategy had rarely been utilized in medical education. Considering the effect of this approach on cognitive and non-cognitive skills, cooperative learning strategies needed to be developed in the medical education system. It seems that cooperative learning causes the nurses's mastery over the learning content since he/she bears the responsibility of teaching the other group

members, and thus would do their best to gain mastery over the content so that he/she would not fail in their educational responsibility. Therefore, nurses find the opportunity to explain what they have learned to others and help each other in doing their tasks. A systematic study likewise indicated that the jigsaw approach was effective in upgrading learners' knowledge and skills. This also increased their motivation to learn and accelerated deep learning, enjoyable learning, academic success, self-confidence, updated information, and interpersonal communication. Thus, eliminating the weaknesses of the jigsaw approach could have positive effects on the knowledge and academic performance of learners in the educational system.[39] In this regard, Bagheri *et al.*[32] found that the jigsaw learning strategy provided a high level of learning and the maximum opportunity for learning, professional development, and clinical competence, and they recommended the necessity of using this collaborative approach in hospital clinical education in the effectiveness of the learning program, which was one of the most important reasons for conducting the present research. Besides, Sanaie *et al.*,[47] in their study in Iran, comparing the effects of lecture-based education and jigsaw learning strategy on self-regulated learning and academic motivation of nursing students, reported that the scores of self-regulated learning and academic motivation in the group taught by jigsaw had been significantly different from the lecture-based one.

In contrast, a few studies have yielded different results, indicating that the jigsaw method was not more advantageous in terms of effectiveness when compared to lecture education. Unlike the results of this study and many others mentioned earlier, a study in Iran on the satisfaction of nursing students with the jigsaw method and lecture revealed no significant difference between the two methods.[48] Although its exact cause is unknown to us, it seems that many factors, including the educational content, quality of educational space and equipment, the difference of utilized questionnaire, and the receiving group can be among the factors that may have influenced the research results. The results of Tayebi and Aghabarari 's study[49] showed that the use of jigsaw method in nursing education is not effective; they cite disadvantages such as ineffective involvement, inadequate teacher supervision, unnecessary content, lack of final summarization, time-consumption, and the need for continuous formative evaluation during content presentation in jigsaw.

In view of that, the ICU nurses did not have enough knowledge regarding delirium and competency to diagnose and screen it at an early stage. Improving knowledge in the field of delirium and using screening tools for its early diagnosis could thus lead to better performance in the ICU nurses, boost the proper management of delirium upon its occurrence, and help provide better care. Choosing the educational approaches, particularly the novel ones such as the jigsaw learning strategy, could, therefore, significantly improve nurses' knowledge and then raise their motivation for learning.

Limitations
The highlighted barriers in this study were: scattered and limited information of the nurses regarding active and effective teaching methods, limited cooperation of the hospital in holding the class, lack of knowledge and time management, and lack of suitable workshops on new approaches in hospitals.

In this research, considering the nurses' work shifts and despite all efforts not to hold the educational program sessions after them due to their fatigue, some sessions were purposely not held at this time, so the nurses' fatigue could affect the study results. Nevertheless, there was considerable effort to control this limitation to some extent, by providing a break during the educational program sessions, reducing the session time, and encouraging more participation by group members. Another limitation of the present study was the small number of studies in the field of medical education, especially in nursing education, which were also highly heterogeneous. This indicates that in the medical education in Iran, cooperative learning methods are not yet well-established. Due to the small number of studies in this regard, the results should be interpreted cautiously.

Conclusion

The cooperative learning method, unlike other novel teaching methods, is not very costly. Meanwhile, the use of this method alongside other conventional methods, such as lectures, can provide a suitable atmosphere for learning. The study results highlighted the need for further education to improve attitudes toward delirium and the competency to diagnose it by the ICU nurses. The study results indicated that the jigsaw learning strategy was more effective in improving attitudes toward delirium and competency to screen it in the ICUs among nurses as compared to the lecture-based education. In-service educational programs should thus be continuously conducted to update the knowledge and practice of the ICU nurses regarding delirium diagnosis and prevention. Therefore, providing educational content through novel methods, such as the jigsaw approach, seems to be necessary for such nurses. It is also suggested to carry out more research on the effectiveness of the jigsaw approach as a cooperative learning strategy in nursing education and to develop a suitable strategic

plan for the nurses working in the ICUs based on their results. The policymakers of health, as well as managers of educational-clinical centers, are also recommended to pay more attention to active teaching methods such as cooperative learning, which are necessary for face-to-face interaction to enhance the level of efficiency of the mentioned method.

Conflicts of interest
There are no conflicts of interest.

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