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Assessing the effects of asthma attack simulation on cognitive, psychomotor, and affective learning in nursing students: a randomized controlled study

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ABSTRACT

Aims: Asthma is a global health problem. Nursing students, who play a key role in managing asthma attack, should be capable of recognising and responding to asthma symptoms. This research aimed to assess the repercussions of asthma attack simulation training on nursing students cognitive, psychomotor, and affective learning domains.

Methods: A randomised controlled trial was used in this study. Fourth-year nursing students with no prior simulation training experience were recruited. This research randomly divided participants into two distinct groups: a simulation group, consisting of 53 members, and a control group, with 62 members. Each group received 100 hours of standard training, and only the simulation group received 210 hours of asthma attack simulation training instruction based on Bloom's taxonomy the following day. A knowledge questionnaire was used to evaluate nursing students' cognitive learning on asthma attacks right after theoretical training and three months afterwards. The Objective Structured Clinical Examination was used as a standardised evaluation instrument to evaluate students' psychomotor learning, and the emotional learning, empathy, motivation, self-efficacy, and anxiety levels of nursing students were assessed using a Likert scale ranging from 1 to 10 three months after their theoretical training.

Results: Asthma attack cognitive, psychomotor, and emotional learning of nursing students in the Simulation group improved after the intervention compared to the control group (p<0.05).

Conclusion: Simulation-based training demonstrates potential efficacy in enhancing nursing students' cognitive, psychomotor, and affective learning related to asthma attacks.

Keywords: Asthma attack, education, learning, nursing students, simulation

INTRODUCTION

Asthma is a global health problem characterised by chronic airway inflammation that causes coughing, wheezing, shortness of breath, and chest tightness.[1] According to GINA (2017) and Asthma Diagnosis and Treatment Guide (2020), asthma is prevalent, impacting 334 million people worldwide and 3.5 million people in Turkey alone.[1,2] According to the Network (2014), an estimated 14% of the world's 2.2 billion children have asthma.[3] To address the global burden of asthma, nurses should be trained and knowledgeable in current asthma management requirements. As Hanson et al.[4] pointed out, the lack of understanding among nurses could negatively affect the effectiveness of asthma management. Their research found a link between nursing proficiency levels and recognising asthma symptoms and administering treatment on time. In addition, Harrington et al.[5] demonstrated that nurses play an essential role in reducing asthma symptoms. As a result, it is critical to adopt instructional approaches that support the development of this skill in the education of student nurses.

Simulation is the recreation of multiple tasks, relationships, phenomena, equipment, behaviour, or cognitive activities in real-world environments.[6] It provides students a risk-free and authentic learning environment to apply gained knowledge, explore possibilities, and improve psychomotor abilities in a safe setting.[7] Simulation-based education, which utilises high-fidelity models, has gained recognition in nursing education because it enhances the acquisition of knowledge, critical thinking, clinical skills, and performance.[8] Previous research has shown that high-fidelity simulation improves students' critical thinking abilities,[9] knowledge,[10] clinical reasoning,[8]

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and self-confidence while simultaneously reducing anxiety.[11,12] As a result, incorporating simulation-based training is critical, particularly in nursing education, which requires clinical competence.[13]

Nursing education should seek to accomplish high-level learning objectives to provide nurses with the ability to effectively prepare for asthma attack management. In this context, using Bloom's taxonomy, which emphasises achieving advanced learning goals, can be beneficial in developing simulation-based training and scenarios. Bloom's taxonomy thus enables learning outcomes at six levels, from the lowest level of recall to the highest level of knowledge formation and evaluation.

Previous research has shown that education planned with Bloom's taxonomy leads to high-level learning outcomes.[14,15] Bloom's taxonomy-based scenarios allows nursing students to use their educational, perceptual, and psychological learning experiences. It enables students to develop essential skills such as critical thinking, evaluation, problem-solving, decision-making, and data analysis. Using high-fidelity simulators in simulation scenarios provides nursing students safe, monitored environment to learn knowledge, skills, and reasoning.[16]

This study aimed to investigate the effectiveness of Bloom's taxonomy-structured simulation scenario in enhancing nursing students' comprehension of asthma attacks. High-fidelity simulation was employed to support nursing students in identifying asthma attacks symptoms, making informed treatment decisions according to asthma severity, and evaluating treatment outcomes. The primary objective was to assess the effects of simulation training on nursing students' cognitive, psychomotor, and affective learning outcomes related to asthma attacks.

METHODS

The study was carried out with the permission of by Bursa Uludağ University Faculty of Medicine Clinical Researches Ethics Committee (Date: 02.06.2021, Decision No: 2021-7/11). Oral consent was obtained from all volunteered students. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

H1: Simulation training improves cognitive learning in asthma attacks more than the control group.

H2: Simulation training improves psychomotor learning in asthma attacks more than the control group.

H3: The simulation training enhances the affective learning of asthma attacks to a greater extent than in the control group

Study Design and Participants

This study was an experimental (three-blind) design. Nursing students were randomly allocated to one of two groups in this study: Simulation Group (n=53) and Control Group (CG) (n=62). One hundred and thirty volunteer students formed the sample. The fourth-year nursing students (n=168) at a university in Bursa between July and November 2021 with no prior experience in simulation training were recruited and randomly assigned to one of two groups. Criteria for inclusion of nursing students: To take public health nursing courses. The sample size for the study was 53 individuals in each group (simulation group and control group) and 106 individuals in total for an effect size of 0.550 for the primary hypothesis with 0.80 power and 0.05 Type I error (G*Power Version 3.1.9.7 statistical software). The sample size was calculated using the study's results with a similar methodology to this study.[17] The investigators employed the medicres randomly assigned person-to-group software for student randomisation. In total, 165 students were randomly designated, with 65 in group A for simulation, and 65 in group B as the control.) (https://e-picos.com.tr/apps/calculation/rags).

Due to research dropouts, the study was completed with 115 students who participated in the simulation (n=53) and control (n=62) groups. Randomization was conducted after the initial assessment, so the instructor was unaware of the group assignments of the students during the initial assessment. The students were unaware of which group they belonged to.

Procedure

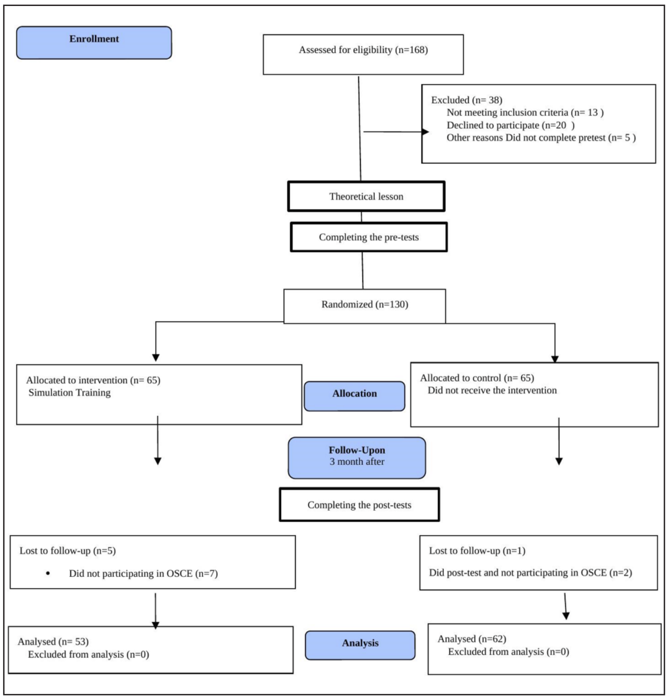

Figure 1. The flow diagram of the study

Theoretical Training

Asthma attacks management (pathophysiology, asthma attack symptoms, drug administration steps and drug effect evaluation) was theoretically given to nursing students who took the public health nursing module (50 minutes).

The researcher showed a video of three films to each nursing student. The first video describes the symptoms of asthma; the second video demonstrates mild, moderate, and severe asthma attacks; and the third video demonstrates the methods for administering a metered dose inhaler for an asthma attack and evaluating the medication's results. Each video lasted 10 minutes. After viewing the film, questions were answered for 20 minutes (50 minutes).

Completing The Pre-tests

Following the instruction, the asthma knowledge questionnaire and the Objective Structured Clinical Examination (OSCE) were used to assess pre-test knowledge and skills.

Randomisation

Nursing students who completed the knowledge test and the ability to apply an OSCE were divided into the simulation group (65) and control group (65) by a simple random sampling method.

Simulation Training Planning

The asthma attack simulation scenarios were formulated in accordance with Bloom's taxonomy and global clinical simulation benchmarks.[14,15,18]

- **The first level/stage (remember):** Recall the definition of asthma, clinical criteria and asthma attack classification, common asthma medications/ interventions, and asthma diagnostic tests.
- **The second level (understand):** Understand the clinical presentation spectrum by classifying the forms of asthma and their relationship to the underlying cause, for example, by classifying the severity of an asthma attack and changes in vital signs.
- **The third level (apply):** Utilise your expertise to identify the issue and implement the proper rapid response for each type of attack.
- **The fourth level (analyse):** Analyse the evidence for the best treatment techniques in various circumstances and use clinical outcomes to differentiate different asthma exacerbations.
- **The fifth level (evaluate):** Assess the validity of invasive monitoring and its impact on outcomes or short-acting beta-agonists, ipratropium bromide, and magnesium types.
- **The sixth level (create):** Update new information, such as new diagnostic measures or prognostic indicators.

A simulated training scenario involving a 17-year-old patient with allergic asthma was developed. Nursing students received instruction about the scenario. The script was sent the day before was stated that it would be taped. On a high-fidelity simulator (ARES), nursing students were asked to assess asthma attacks (diagnosis, diagnostic), intervention, and referral criteria. The instructor was a facilitator in each session, monitoring the nursing students' behaviour and responding as needed" A nursing student dedicated 55 minutes to the simulation, which consisted of nine iterations of a 5-minute briefing, a 10-minute simulation, and two 40-minute debriefing sessions. The overall simulation process took 210 minutes to complete.

The Briefing (5 Minutes)

The high-reality simulator was introduced to the nursing students. The objectives of the scenario, the expectations, and the role of the facilitator were all explained.

Goals

i. Nursing students' recognition and categorisation of asthma attack symptoms,
ii. Understanding asthma attacks according to the asthma class,
iii. Implementing the intervention based on the severity of asthma symptoms,
iv. Distinguish among asthma conditions utilising the asthma guideline,
v. Evaluation of the asthma intervention delivered in accordance with the asthma guidelines,
vi. New diagnostic measurements and information are being developed in order to validate new markers.

A Case Study

Ada, a 17-year-old woman, visits the outpatient clinic with symptoms of asthma and cough. Ada complains of continuous coughing and breathing difficulties to the attending nurse (voiced as a voiceover).

Expectations of nursing students based on the simulated scenario.

First Nursing Student

Step one: Nursing students' recognition and classification of asthma attack symptoms and diagnosis of an asthma attack (Level 1 of the Bloom Taxonomy).

Second Nursing Student

Step two: To understand clinical intervention in an asthma attack by classifying it according to the severity of the attack based on vital sign changes (Level 2 of the Bloom Taxonomy).

Third Nursing Student

Step three: To apply the intervention to the severity of the symptoms for each type of asthma attack (Level 3 of the Bloom Taxonomy).

Fourth Nursing Student

Step four: Analyse various asthma conditions in accordance with the asthma guide and distinguish between various asthma conditions (Level 4 of the Bloom Taxonomy).

Fifth Nursing student

Step five: Evaluation of the patient's response to the asthma intervention as suggested by the asthma guidelines (Level 5 of the Bloom Taxonomy).

Sixth Nursing Student

Step six: New diagnostic measurements provide new information for validating new markers (Level 6 of the Bloom Taxonomy).

Intervention

The high reality simulator has adapted the scenario to reflect the onset of mild, moderate, and severe asthma attacks. The case was read aloud, and the scenario was played out on the simulator. The nursing students were separated into two groups. Each scenario involved 6-7 nursing students, performed nine times for each nursing student to experience. As nursing students were engaging with the scenario, their peers in the debriefing room were concurrently analysing the performance of others in the scenario enactment.

When the nursing students arrived, the simulation started with a 5-minute briefing. The simulation's learning objectives, expectations, a brief scenario description, the protocol for each scenario phase, roles, outpatient room, High-fidelity simulator (ARES), and resources were all discussed. A break was provided when all nursing students in each group had finished the simulation. The trainer then conducted a 40-minute Defibring session, which was held in two Defibring sessions. In the debriefing session, the Gather, Analyse, Summarise (G.A.S.) method was used.19 The nursing students actively participated in a reflective discussion during the educational session, encompassing an assessment of their performance in the asthma attack simulation. Topics addressed included self-evaluations of strengths and weaknesses, identification of potential areas for improvement, peer evaluations, and subjective experiences throughout the educational intervention.

For the content validity of the intervention program curated by the investigator, the insights of nine experts were sought (comprising two chest specialists, five nurses, and two simulation specialists). With a scope valence index of 0.84 and the minimum scope valence ratio being 0.75, the findings affirm the content validity of the intervention program.

Post-test

An evaluation was carried out three months after the training to evaluate the nursing student's skills, their perceptions of the learning process, and their performance on the asthma knowledge test.

Data Collection

Knowledge Test

The researcher (N=1) developed the knowledge test by conducting a comprehensive literature review and seeking expert opinions from chest disease specialists(N=4) and nurses working in clinical settings (N=4). The test content encompassed various aspects, including identification of asthma attack symptoms (3 questions), drug selection decision-making (2 questions), comprehension of drug administration protocols (10 questions), and evaluation of treatment outcomes (5 questions). Each correct answer was assigned a score of 1, resulting in a maximum test score of 20 and a minimum score of 0 The analysis of knowledge pertaining to asthma care content retains its validity, as indicated by a scope valence index of 0.88 and the lowest scope valence ratio recorded at 0.75.

Asthma Attack Skills Assessment

The Objective Structured Clinical Examination (OSCE) assessed nursing students' ability to manage asthma attacks. The OSCE form comprised ten phases covering various aspects of asthma assessment and intervention. The form's content included students' ability to identify asthma (1 point), classify asthma (1 point), diagnose asthma (1 point), correctly diagnose an asthma attack (1 point), comprehend clinical interventions for asthma (1 point), implement asthma interventions effectively (1 point), recognise various types of asthma (1 point), evaluate the outcomes of asthma interventions on the patient (1 point), and make appropriate decisions regarding continuation (1point) or elimination of asthma interventions (1 point). The researcher assessed each step by assigning a rating of either successful (1) or unsuccessful (0). This evaluation yielded a minimum score of 0 and a maximum score of 10.

In order to establish the content validity of the OSCE form developed by the researcher, the perspectives of nine experts were gathered, consisting of two academic nurses, three clinical nurses, and four pulmonologists. The obtained metrics, with a scope valence index of 0.86 and a minimum scope valence ratio of 0.75, provide affirmation of the content validity of the OSCE form. The OSCE was evaluated by two standardized patients and conducted in two outpatient clinics to assess the students' performance.

Each clinic setting was allocated a researcher and a standardised patient (totalling two clinical settings). The researcher trained an instructor for the OSCE assessment of students. The instructor assisted students with their OSCE assessment. Each student was given two minutes to read the case and five minutes to accomplish the skill. The researcher examined the records to confirm that the OSCE forms completed for each nursing student were accurate. Throughout an internship, skills were assessed. The OSCE form was filled out immediately following the theoretical instruction at the simulation centre and three months later during the skill practice.

Students' Perception of the Process

The nursing students' perceptions of the standardised patient were evaluated based on four key parameters: motivation, critical thinking abilities, self-awareness, and empathy. For each parameter, students were required to use a Likert-type rating system ranging from 1 to 10.

Data Analysis

Data analysis was conducted using the SPSS 23 software package. The Mann-Whitney U test, Wilcoxon signed rank test, and Chi-square test were utilised for statistical data evaluation. Importantly, the statistical analysis was carried out in a blind manner, meaning the analyst did not know the group assignments of the nursing students.

RESULTS

The mean age of the students in the simulation group was 22.18±2.01 years, and the average age in the control group was 21.74±1.36 years. The proportion of female students in the groups was 70% and 80% (Table 1). Gender and age were similar between the groups.

Table 1. Descriptive characteristics of students in groups

Descriptive characteristics	Simulation group (n=53) n %	Control group (n=62) n %	Test statistics	p value
Age (mean±sd)	22.18± 2.01	21.74± 1.36	1435.50*	0.223
Gender				
Female	42 80	44 71	1.038**	0.308
Male	11 20	18 29		

Abbreviations: sd: standard deviation, * Mann-Whitney U Test, **Chi square test.

While the pre-test knowledge scores of the students in the simulation group were 7.24±2.15, the post-test knowledge scores were 14.27±2.91, and there was a statistically significant difference (p<0.05).

The post-test knowledge scores of the students in the simulation group were 6.95±2.08 higher than the pre-test knowledge scores of 12.52±3.06 (Table 2). (Table 2). There was a statistically significant difference between the groups in the pre-test and post-test knowledge scores (p<0.05) (Table 2).

Table 2. Average scores of students' knowledge and OSCE skill levels.

	Simulation group (n=53) mean±sd	Control group (n=62) mean±sd	Test statistics	p value
Cognitive				
Knowledge test (0-20)				
Pre-test	7.24±2.15	6.95±2.08	1509.50*	0.734
Post-test	14.27±2.91	12.52±3.06	1071.00*	0.001
Test Statistics p-value	-6.22 <0.001**			
Psychomotor				
OSCE (0-10)				
Pre-test	1.41±2.09	1.24±2.22	1495.50*	0.340
Post-test	7.16±1.92	6.04±1.73	1069.50*	0.001
Test Statistics p-value	-6.29 <0.001**			

Abbreviations: sd: standard deviation, *Mann-Whitney U Test, **Wilcoxon signed ranks test

While the pre-test skill scores of the students in the simulation group were 1.41±2.09, the post-test skill score was 7.16±1.92, and there was a statistically significant difference (p<0.05). While pre-test skill scores of the students in the control group were 1.24±2.22, their post-test skill scores were 6.04±1.73, and there was a statistically significant difference (p<0.05) (Table 2). There was a statistically significant difference between the groups in the pre-test and post-test skill scores (p<0.05) (Table 2).

The perceived motivation scores (7.24± 1.74), critical thinking scores (8.90± 1.06), empathy scores (8.0 5± 1.23), self-awareness scores (8.00± 1.19) of the students in the simulation group were higher than the perceived motivation scores (6.00±1.87), critical thinking scores (7.95±1.20), empathy scores (7.48±1.32), self-awareness scores (7.25±0.92) of the students in the control group (p<0.05) (Table 3).

Table 3. Evaluation of the perception of the Process by the students

Affective competences	Simulation group (n=53) mean±sd	Control group (n=62) mean±sd	Test statistics	p value
Motivation	7.24±1.74	6.00±1.87	1037.50*	0.001
Empathy	8.05±1.23	7.48±1.32	1183.50*	0.008
Critical thinking skill	8.90±1.06	7.95±1.20	874.00 *	<0.001
Self-awareness	8.00±1.19	7.25±0.92	1054.00*	0.001

Abbreviations: sd: standard deviation, *Mann-Whitney U Test

DISCUSSION

Cognitive learning (asthma knowledge scores), psychomotor learning (OSCE scores), and affective learning (perceived self-awareness, perceived motivation, perceived empathy, and critical thinking scores) scores of the simulation group were higher compared to the control group. Study results support our hypothesis.

This study found that simulation is a better method of teaching asthma attacks than control. Previous studies have found simulation to be effective for teaching the management of asthma exacerbations.[20,21] The simulation scenario prepared according to Bloom's taxonomy for the simulation group in this study provided nursing students with complete learning in cognitive, psychomotor and affective domains.

Nursing students in the simulation group had a higher level of knowledge, which we measured to determine cognitive competence in asthma attack management, compared to nursing students in the control group. We believe that this difference in the level of knowledge is due to the structure of the simulation scenario in line with Bloom's taxonomy, which allows for the synthesis of information and learning through the simulation experience. Furthermore, reflective thinking in the defibring part of the simulation training allowed nursing students to create knowledge.

The skill levels of administration, which we measured to determine psychomotor competence in asthma attack management, were higher in the simulation group compared to the control group. We believe that this difference is due to the structure of Bloom's taxonomy and simulation that enables holistic cognitive, psychomotor, and affective learning. This is because simulation sessions enable the integration of multiple information at cognitive, psychomotor, and sensory levels, thereby gaining the necessary competencies.[22]

Self-awareness, motivation, and empathy were higher in nursing students in the simulation group than in the control group. A similar study found that the simulation method is more motivating in learning bronchial asthma than the classical method.[23] These results show that perceived motivation is an essential factor positively affecting learning.[23] For this reason, the simulation should be included in nursing training.

In the study, Alamrani et al.[24] found that critical thinking skills in nursing students remained similar in the traditional and simulation group. Simulation with high reality increased nursing students' critical thinking skills.[9] In this study, the students' necessary thinking skills in the simulation group were higher than those in the control group. As a result, we think that the scenario prepared using Bloom's taxonomy increases critical thinking by allowing nursing students to experience asthma attacks with high reality simulation, make decisions in necessary conditions and be essential in notification sessions. The simulation teaches nursing students how to think in the face of an acute situation. It allows you to remember old information in an unexpected case and make new quick decisions to solve the problem.[25]

Limitations of the Study

One notable strength of this research lies in the construction of the simulation scenario, which aligns with Bloom's taxonomy and effectively promotes learning in the cognitive, psychomotor, and affective domains. This study shows the results of nursing students at a university. The small sample size of this study limits the generalisation of the findings. One of the other limitations of this study is to see the effect of cognitive, psychomotor and affective domain assessments, and they were measured three months after the training rather than immediately after the training. Meanwhile, both groups could not be influenced by other places.

CONCLUSION

Learning gains could be measured objectively thanks to the scenario prepared according to Bloom's taxonomy. The level of cognitive knowledge could be measured objectively with the knowledge test; the psychomotor level could be measured objectively with OSCE; and the affective level could be measured objectively by scoring students' motivation, empathy, and self-awareness. These three domains were measured in the acquisition of asthma attack proficiency and found simulation e more effective than control in learning asthma attack management, which is important in nursing. Nursing students determined that simulation is more motivating, increasing self-awareness, developing empathy, and gaining critical thinking skills compared to control. According to this study's conclusions, we suggest using simulation in nursing education in the future.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of by Bursa Uludağ University Faculty of Medicine Clinical Researches Ethics Committee (Date: 02.06.2021, Decision No: 2021-7/11).

Informed consent: Written consent was obtained from the patient participating in this study.

Referee Evaluation Process: Externally peer reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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