ISSN: 2961-1989
Academia Research Journal (ARJ)
A Multidisciplinary Peer-Reviewed Research Journal, Indexed in NepJOL
Volume: 4 Issue: 2, Year 2025

Effectiveness of Simulation-Based Training on Pediatric Advanced Life Support (PALS) Knowledge and Skills among B.Sc. Nursing Students

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DOI: *https://doi.org/10.3126/academia.v4i2.82949*

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Article History: Received: Feb. 10, 2025 Revised: June 02, 2025 Received: July. 20, 2025

Abstract

Pediatric emergencies, particularly respiratory failure and shock, are leading causes of cardiopulmonary arrest in children and require rapid, skilled intervention. Pediatric Advanced Life Support (PALS) training equips healthcare providers with the knowledge and skills necessary for effective pediatric resuscitation. This study evaluated the effectiveness of simulation-based PALS training on the knowledge and skills of B.Sc. Nursing fourth-year students in Moradabad, Uttar Pradesh. A quantitative pre-test/post-test control group design was employed, involving 80 participants equally divided into experimental and control groups. The experimental group underwent three days of simulation-based PALS training, while the control group received no intervention during the study period. Data were collected using a demographic questionnaire, a 26-item knowledge questionnaire, and a 25-item skills checklist, with established validity and high reliability (knowledge tool $\alpha = 0.89$, skills checklist $\alpha = 0.97$). Results showed a significant improvement in the experimental group's mean knowledge score from 7.15 to 15.50 ($p < 0.001$) and mean skills score from 3.20 to 20.78 ($p < 0.001$), whereas the control group showed no significant changes. Post-test comparisons revealed the experimental group outperformed the control group in both knowledge (mean difference = 6.65) and skills (mean difference = 16.03) at $p < 0.001$. No demographic variables were significantly associated with knowledge scores, though parents' education was significantly related to skills scores. The findings confirm that simulation-based PALS training is highly effective in enhancing both cognitive and psychomotor competencies in nursing students, supporting its integration into undergraduate nursing curricula to improve preparedness for pediatric emergencies.

Keywords: Pediatric Advanced Life Support, simulation training, nursing education, B.Sc. Nursing students, high-fidelity simulation

Introduction

Raising children in the 21st century is more challenging than ever before. Children are central to the nation's present and future, and parents, grandparents, and caregivers work tirelessly to ensure their health, well-being, and opportunities for realizing their full potential. Yet pediatric populations remain highly susceptible to acute, life-threatening conditions such as respiratory failure and shock, which are the primary causes of cardiopulmonary arrest in children (American Heart Association [AHA], 2015).

These conditions often progress in a predictable pattern, offering a limited window for early intervention before irreversible deterioration occurs.

Globally, pediatric cardiac arrest is a significant public health concern. In the United States alone, approximately 16,000 children experience cardiac arrest annually, with infants under one year comprising the largest proportion (Wier, 2013). Such emergencies require specialized assessment, rapid decision-making, and coordinated intervention to reduce mortality and morbidity.

Pediatric Advanced Life Support (PALS), developed by the AHA, provides a systematic, evidence-based approach to recognizing and managing respiratory and circulatory emergencies in children before, during, and after cardiac arrest. Since the first PALS guidelines in 1987, updates in 2005, 2011, and 2015 have refined algorithms and incorporated the latest scientific evidence to improve survival outcomes. The PALS curriculum typically spans two days, focusing on rapid patient assessment, categorization, decisive action, and effective team coordination during resuscitation.

Simulation-based education has gained prominence as an essential method in healthcare training. It enables learners to engage in realistic, high-pressure scenarios within a safe environment, supporting both cognitive and psychomotor skill development without risk to patients (Lin & Cheng, 2015). For nurses — often the first responders to pediatric emergencies in hospital settings — simulation training enhances the ability to recognize early warning signs, initiate life-saving interventions, and activate appropriate response systems (de Lima et al., 2009).

Problem Statement

Despite the availability of structured protocols such as PALS, healthcare providers — particularly nursing students and newly graduated nurses — may lack the necessary competence and confidence to manage pediatric emergencies effectively. Limited exposure to high-acuity situations during clinical training, compounded by the rarity of certain pediatric emergencies, often results in skill decay and knowledge gaps. Given nurses' pivotal role in initiating resuscitative efforts, there is a pressing need for training strategies that effectively build and sustain PALS-related competencies. This study investigates whether simulation-based PALS training significantly enhances the knowledge and skills of B.Sc. Nursing fourth-year students in selected nursing colleges of Moradabad, Uttar Pradesh.

Purpose of the Study

The purpose of this study is to determine the effectiveness of simulation-based PALS training in improving both the knowledge and procedural skills of B.Sc. Nursing fourth-year students. Enhanced competence in recognizing pediatric emergencies and acting decisively has the potential to improve patient outcomes in clinical practice.

Simulation in Clinical Education

Simulation is recognized as an effective instructional method to enhance healthcare professionals' preparedness for rare, high-risk events. Eman El Allah et al. (2017) demonstrated that high-fidelity simulation (SimMan) produced greater improvements in nursing students' CPR knowledge and skills compared to traditional manikin-based instruction. Zavotsky et al. (2016) found that simulation-based training increased confidence across novice and experienced providers in

recognizing and managing cardiac arrest. Stellflug (2015) showed that simulation enhanced PALS knowledge, procedural skills, and self-efficacy among rural healthcare professionals, while Cortegiani et al. (2015) confirmed its benefits in teamwork, communication, and algorithm mastery. Lin and Cheng (2015) emphasized structured practice and feedback as essential for maximizing learning outcomes.

PALS-Specific Training Effectiveness

`Waisman et al. (2005) reported significant gains in pediatric resuscitation knowledge and satisfaction among healthcare providers completing PALS courses. Mills et al. (2012) found that high-fidelity simulation improved pediatric residents' procedural proficiency and comfort in real-life scenarios. Gerard et al. (2011) demonstrated sustained psychomotor performance improvements in family medicine residents following PALS simulation. Kendirli et al. (2011) linked PALS training to increased intubation success among pediatric residents. Ouseph et al. (2015) observed strong adherence to standardized resuscitation protocols following simulation-based training for nurses.

Collectively, these studies affirm that simulation-based PALS training substantially enhances both cognitive and psychomotor competencies, boosts confidence, and improves team coordination in pediatric emergencies. However, without regular reinforcement, skill decay remains a concern, underscoring the importance of periodic retraining. This study contributes to this growing evidence base by evaluating such training in the context of Indian undergraduate nursing education.

Objectives of the Study

1. To assess the effectiveness of simulation on knowledge regarding PALS among B.Sc. Nursing fourth-year students in the experimental group compared to the control group.
2. To assess the effectiveness of simulation on skills regarding PALS among B.Sc. Nursing fourth-year students in the experimental group compared to the control group.
3. To determine the association between knowledge regarding PALS and selected demographic characteristics of B.Sc. Nursing fourth-year students.
4. To determine the association between skills regarding PALS and selected demographic characteristics of B.Sc. Nursing fourth-year students.

Hypotheses

The following hypotheses were tested at a 0.05 level of significance:

- **H_1:** There will be a significant difference between mean pre-test and post-test scores of knowledge regarding PALS in the experimental group compared to the control group.
- **H_2:** There will be a significant difference between mean pre-test and post-test scores of skills regarding PALS in the experimental group compared to the control group.
- **H_3:** There will be an association between the level of knowledge regarding PALS and selected demographic characteristics of B.Sc. Nursing fourth-year students.
- **H_4:** There will be an association between the level of skills regarding PALS and selected demographic characteristics of B.Sc. Nursing fourth-year students.

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Variables

- Independent Variable: Simulation-based PALS training.
- Dependent Variables: Knowledge and skills regarding PALS.
- Demographic Variables**:** Age, gender, socioeconomic status, parents' occupation, parents' educational status, and previous hospital exposure.

Delimitations

This study was delimited to:

- B.Sc. Nursing fourth-year students from Teerthanker Mahaveer College of Nursing and Teerthanker Parsavnath School of Nursing, Moradabad, Uttar Pradesh.

Methodology

Research Approach

This study adopted a quantitative research approach to determine the effectiveness of simulation-based Pediatric Advanced Life Support (PALS) training on the knowledge and skills of B.Sc. Nursing fourth-year students. The quantitative approach was selected because it facilitates objective measurement, statistical analysis, and comparison of pre- and post-intervention outcomes. By employing structured instruments and standardized procedures, the study aimed to generate reliable, generalizable findings.

Research Design

A pre-test/post-test control group design was used. Participants were assigned into two groups:

- Experimental group — received simulation-based PALS training.
- Control group — did not receive the simulation intervention during the study period.

Both groups underwent a pre-test to assess baseline knowledge and skills, followed by a post-test after the intervention period. This design allowed for direct comparison between groups and assessment of changes within groups over time.

Research Setting

The study was conducted at Teerthanker Mahaveer College of Nursing and Teerthanker Parsavnath School of Nursing, located in Moradabad, Uttar Pradesh, India. These institutions offer undergraduate nursing programs and have the necessary infrastructure to conduct simulation-based training, including skill laboratories equipped with manikins and audiovisual facilities.

Population and Sampling

ISSN: 2961-1989
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Target Population

The target population comprised B.Sc. Nursing fourth-year students enrolled in the above-mentioned institutions.

Accessible Population

The accessible population included only those students who were available during the data collection period, met the inclusion criteria, and consented to participate.

Sample Size

A total of 80 students participated, with 40 students in the experimental group and 40 students in the control group.

Sampling Technique

A purposive sampling technique was employed to select participants who met specific criteria relevant to the study objectives.

Sampling Criteria

Inclusion Criteria

- B.Sc. Nursing fourth-year students from the selected colleges.
- Students present during the data collection period.
- Students willing to participate and provide informed consent.

Exclusion Criteria

- Students who had previously undergone PALS training.

Research Variables

- Independent Variable: Simulation-based PALS training.
- Dependent Variables: Knowledge and skills regarding PALS.
- Demographic Variables: Age, gender, parents' education level, parents' occupation, and prior exposure to PALS.

Tools and Instruments

Three structured tools were developed and validated for data collection:

1. Demographic Data Sheet — collected participant characteristics, including age, gender, parents' educational level, parents' occupation, and previous exposure to PALS.
2. PALS Knowledge Questionnaire — comprised 26 multiple-choice items. Each correct answer was scored 1 and incorrect answers scored 0.

- Scoring Interpretation:
  - 1–9: Poor knowledge
  - 10–18: Average knowledge
  - 19–26: Good knowledge

3. PALS Skills Checklist — included 25 skill items related to pediatric resuscitation procedures. Each correctly performed step was awarded 1 point; incorrect or omitted steps received 0 points.
   - Scoring Interpretation:
     - 1–8: Poor skills
     - 9–16: Average skills
     - 17–25: Good skills

Validity of Instruments

Content validity was established through expert review. Seven professionals — comprising nursing educators, clinical nursing experts, and simulation specialists — evaluated the tools for relevance, clarity, and comprehensiveness. Modifications were made according to their feedback before finalization.

Reliability of Instruments

- Knowledge Tool: Reliability was established using the test–retest method with Karl Pearson's correlation coefficient, yielding r = 0.80, indicating high stability. Internal consistency was confirmed with Cronbach's alpha = 0.89.
- Skills Checklist: Reliability was assessed through the inter-rater method, with r = 0.94, demonstrating excellent agreement between raters. Internal consistency was also high (Cronbach's alpha = 0.97).

Pilot Study

A pilot study was conducted from 9th to 14th October 2017 on 10 B.Sc. Nursing students (5 in the experimental group and 5 in the control group) from the selected institutions. The objectives were to test the feasibility of the methodology, identify potential procedural issues, and refine the tools. No major difficulties were encountered, and the study proceeded as planned.

Ethical Considerations

Prior to data collection, the following ethical approvals and permissions were obtained:

- Administrative approval from the Dean of Teerthanker Mahaveer University, Moradabad.
- Institutional Ethical and Research Committee clearance.
- Permission from principals of the participating colleges for pre-testing, pilot study, and main study.
- Informed written consent from all participants after explaining the study's purpose and ensuring confidentiality.

ISSN: 2961-1989
Academia Research Journal (ARJ)
A Multidisciplinary Peer-Reviewed Research Journal, Indexed in NepJOL
Volume: 4 Issue: 2, Year 2025

Participants were assured that their responses would remain anonymous, data would be used solely for research purposes, and participation was voluntary, with the right to withdraw at any stage.

Data Collection Procedure

Data collection took place from 20th November to 6th December 2017 in the following sequence:

1. Pre-test: Both groups completed the knowledge questionnaire and skills checklist assessment.
2. Intervention: The experimental group was divided into two subgroups of 20 students each. Over three days, they participated in six simulation training sessions on PALS, which included skill demonstrations, practice sessions, and scenario-based simulations with debriefing. The control group received no intervention during this period.
3. Post-test: Both groups were reassessed using the same instruments to measure changes in knowledge and skills.

Plan for Data Analysis

Data were analyzed using SPSS version 20. Both descriptive and inferential statistics were applied:

- Descriptive Statistics: Frequency, percentage, mean, and standard deviation for demographic variables, knowledge scores, and skills scores.
- Inferential Statistics:
    - Paired t-test for within-group comparisons (pre-test vs. post-test).
    - Independent t-test for between-group comparisons.
    - Chi-square test for association between knowledge/skills levels and demographic variables.

The significance level was set at $p < 0.05$ for all statistical tests.

Results and Discussion

The statistical analysis of data collected from 80 B.Sc. Nursing fourth-year students (40 in the experimental group and 40 in the control group) are evaluated for the the effectiveness of simulation-based Pediatric Advanced Life Support (PALS) training.

1. Demographic Characteristics of Participants

The frequency and percentage distribution of demographic variables for both experimental and control groups, including age, gender, parents' education, parents' occupation, and previous exposure to PALS are presented in the following table 1.

ISSN: 2961-1989
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Volume: 4 Issue: 2, Year 2025

Table 1
Demographic Characteristics of B.Sc. Nursing Fourth-Year Students in Experimental and Control Groups (N = 80)

Demographic Variable	Category	Experimental Group n (%)	Control Group n (%)
Age	Less than 22 years	9 (22.5)	0 (0.0)
	22 years	27 (67.5)	40 (100.0)
	More than 22 years	4 (10.0)	0 (0.0)
Gender	Male	14 (35.0)	8 (20.0)
	Female	26 (65.0)	32 (80.0)
Parents' Education	Primary	4 (10.0)	4 (10.0)
	Secondary	4 (10.0)	7 (17.5)
	Intermediate	10 (25.0)	15 (37.5)
	Bachelor and above	22 (55.0)	12 (30.0)
Parents' Occupation	Private	12 (30.0)	5 (12.5)
	Public	17 (42.5)	11 (27.5)
	Self-employed	9 (22.5)	22 (55.0)
	Homemaker	2 (5.0)	2 (5.0)
Previous Exposure to PALS	Yes	0 (0.0)	0 (0.0)
	No	40 (100.0)	40 (100.0)

Most participants in the experimental group (67.5%) and all in the control group (100%) were 22 years old. Females comprised the majority in both groups, consistent with the gender distribution in nursing programs. In the experimental group, over half of the students' parents had a bachelor's degree or higher, whereas in the control group, most parents had an intermediate-level education. Public sector employment was most common among experimental group parents, while self-employment predominated in the control group. Notably, none of the participants in either group had previous PALS training, ensuring uniform baseline exposure.
These demographic distributions are consistent with Stellflug's (2015) findings that most PALS participants are female nursing students in their early twenties.

Effectiveness of Simulation on Knowledge within Groups

Table 2 compares pre-test and post-test mean knowledge scores for both experimental and control groups.

ISSN: 2961-1989
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Volume: 4 Issue: 2, Year 2025

Table 2
Comparison of Pre-Test and Post-Test Knowledge Scores within Experimental and Control Groups (N = 80)

Group	Test	Mean ± SD	Mean Difference	t-value (p)
Experimental	Pre-test	7.15 ± 2.28	8.35	6.99 (.000)*
	Post-test	15.50 ± 1.95		
Control	Pre-test	9.00 ± 2.71	-0.15	0.757 (NS)
	Post-test	8.85 ± 3.68		

*p < 0.05; NS = Not significant

The experimental group's mean knowledge score increased significantly from 7.15 to 15.50 following simulation-based training (p < 0.001), while the control group showed a slight, non-significant decline. This indicates that simulation-based PALS training was highly effective in improving theoretical knowledge. These results align with Cortegiani et al. (2015), who reported significant gains in advanced life support knowledge when simulation was combined with didactic teaching.

3. Effectiveness of Simulation on Knowledge between Groups

Table 3 compares post-test knowledge scores between the experimental and control groups.

Table 3
Comparison of Post-Test Knowledge Scores between Experimental and Control Groups (N = 80)

Group	Mean ± SD	Mean Difference	t-value (p)
Experimental	15.50 ± 1.95	6.65	9.50 (.000)*
Control	8.85 ± 3.68		

p < 0.05

The experimental group outperformed the control group by an average of 6.65 points in post-test knowledge scores (p < 0.001). This substantial difference reinforces the positive effect of simulation-based training over standard instruction alone. The findings mirror those of Waisman et al. (2005), who documented significant knowledge improvements among healthcare providers after PALS training.

4. Effectiveness of Simulation on Skills within Groups

Table 4 presents pre-test and post-test skill score comparisons for each group.

ISSN: 2961-1989
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Volume: 4 Issue: 2, Year 2025

Table 4
Comparison of Pre-Test and Post-Test Skills Scores within Experimental and Control Groups (N = 80)

Group	Test	Mean ± SD	Mean Difference	t-value (p)
Experimental	Pre-test	3.20 ± 2.54	17.58	13.85 (.000)*
	Post-test	20.78 ± 3.14		
Control	Pre-test	4.50 ± 3.28	0.25	0.597 (NS)
	Post-test	4.75 ± 2.33		

*p < 0.05; NS = Not significant

The experimental group's mean skills score increased dramatically from 3.20 to 20.78 (p < 0.001), while no significant change was observed in the control group. This indicates that simulation is particularly effective for developing procedural skills — a finding supported by Eman El Allah et al. (2017), who found high-fidelity simulation superior for skill acquisition in resuscitation training.

5. Effectiveness of Simulation on Skills between Groups

Table 5 compares post-test skills scores between the experimental and control groups.

Table 5
Comparison of Post-Test Skills Scores between Experimental and Control Groups (N = 80)

Group	Mean ± SD	Mean Difference	t-value (p)
Experimental	20.78 ± 3.13	16.03	25.95 (.001)*
Control	4.75 ± 2.33		

*p < 0.05

The experimental group's mean skills score was more than four times higher than the control group's after the intervention, with a highly significant difference (p < 0.001). This underscores simulation's role in building hands-on proficiency, echoing Gerard et al. (2011), who reported durable psychomotor improvements following PALS simulation.

6. Association between Knowledge Scores and Demographic Variables

Table 6 summarizes the association of pre- and post-test knowledge scores with demographic characteristics in the experimental group.

ISSN: 2961-1989
Academia Research Journal (ARJ)
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Volume: 4 Issue: 2, Year 2025

Table 6
Association between Knowledge Scores and Demographic Variables in Experimental Group (N = 40)

Demographic Variable	Significant Association (p < 0.05)
Age	No
Gender	No
Parents' Education	No
Parents' Occupation	No
Previous PALS Exposure	Not applicable (all had none)

No statistically significant association was found between knowledge scores and demographic variables, suggesting that simulation benefits learners regardless of their background. This is consistent with Ralapanawa et al. (2016), who reported knowledge improvements across diverse demographic groups after life support training.

7. Association between Skills Scores and Demographic Variables

Table 7 presents the association of skills scores with demographic characteristics in the experimental group.

Table 7
Association between Skills Scores and Demographic Variables in Experimental Group (N = 40)

Demographic Variable	Significant Association (p < 0.05)
Age	No
Gender	No
Parents' Education	Yes (p < 0.05)
Parents' Occupation	No
Previous PALS Exposure	Not applicable (all had none)

Only parents' education level showed a significant association with skills scores in the experimental group, indicating that learners whose parents had higher education may have performed better in procedural tasks. However, this finding should be interpreted cautiously, as it may reflect broader socio-educational influences rather than a direct causal link.

Findings of the Study

1. Simulation-based PALS training significantly improved both knowledge and skills among B.Sc. Nursing fourth-year students in the experimental group.
2. The control group showed no significant changes in knowledge or skills scores between pre- and post-tests.
3. Post-test comparisons revealed substantial differences in both knowledge and skills between experimental and control groups, favoring the experimental group.

4. No demographic variables were significantly associated with knowledge scores in the experimental group.
5. Parents' education level was the only demographic variable significantly associated with skills scores in the experimental group.
6. All participants lacked prior exposure to PALS, ensuring comparable baseline levels.
7. Simulation training proved particularly effective for psychomotor skill development, as shown by the large effect size in skills improvement.

Conclusion

This study evaluated the effectiveness of simulation-based Pediatric Advanced Life Support (PALS) training on the knowledge and skills of B.Sc. Nursing fourth-year students at selected nursing colleges in Moradabad, Uttar Pradesh. The findings demonstrated a significant improvement in both cognitive and psychomotor competencies among students in the experimental group compared to the control group. Simulation-based training effectively bridged the gap between theoretical learning and practical application, enabling participants to recognize pediatric emergencies, make rapid decisions, and execute life-saving interventions with greater accuracy and confidence. The intervention's impact was most pronounced in skill acquisition, with large differences observed between experimental and control groups in post-test performance. No demographic variables were significantly associated with knowledge scores, suggesting that simulation training benefits learners across diverse backgrounds. Parents' education level showed a modest association with skills performance, indicating possible indirect influences of socio-educational factors.

Overall, the study confirms that simulation-based PALS training is a valuable and effective pedagogical strategy for preparing nursing students to respond to pediatric emergencies, with the potential to improve patient outcomes and strengthen the clinical readiness of new graduates.

Recommendations

Based on the study findings, the following recommendations are proposed:

For Nursing Education

1. Integrate simulation-based PALS training into the undergraduate nursing curriculum to ensure that all nursing students acquire essential pediatric resuscitation competencies before graduation.
2. Incorporate regular refresher simulation sessions to minimize skill decay and maintain competency over time.
3. Employ high-fidelity simulation whenever feasible, as it offers realistic scenarios that enhance decision-making, teamwork, and procedural accuracy.

For Clinical Practice

4. Provide simulation-based PALS training to newly recruited nurses and other healthcare professionals to improve emergency preparedness.
5. Encourage interdisciplinary simulation exercises involving nurses, physicians, and paramedics to strengthen team coordination in real-life emergencies.

For Nursing Administration

6. Allocate resources to establish or upgrade simulation laboratories in nursing institutions.
7. Develop policies that mandate periodic simulation-based training for all staff involved in pediatric care.

For Further Research

8. Conduct longitudinal studies to assess the long-term retention of PALS knowledge and skills acquired through simulation.
9. Replicate the study with larger, more diverse samples across different geographic locations for broader generalizability.
10. Explore the cost-effectiveness of simulation-based training compared to traditional instructional methods.

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