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Original Article

Effectiveness of an educational intervention on nursing students' knowledge of pressure injuries

Eficácia de uma intervenção educativa sobre lesões por pressão no conhecimento dos estudantes de enfermagem

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ABSTRACT

Objective: to analyze the effectiveness of an educational intervention on knowledge related to pressure injuries among nursing students. **Methods:** a quasi-experimental study with a before-and-after design. Participants completed the following stages: assessment of prior knowledge, educational intervention, and post-intervention reassessment. The final sample consisted of 30 students. A validated instrument was used to measure knowledge about pressure injuries. The analysis included comparisons between time points, the McNemar test for item-by-item evaluation, and calculation of effect size. **Results:** before the intervention, only 20 items presented a percentage of correct answers considered satisfactory, increasing to 38 items after the intervention. Statistically significant changes ($p<0.05$) were observed in 16 items, as well as a significant increase in the mean number of correct answers and a reduction in errors post-intervention, with a large effect size ($r = 0.874$), indicating a robust educational impact. **Conclusion:** the educational intervention was effective in increasing nursing students' knowledge. **Contributions to practice:** the findings support the adoption of well-planned and well-executed educational interventions as a strategy to improve nursing education, strengthening competencies essential to patient safety and quality of care.
Descriptors: Students, Nursing; Pressure Ulcer; Early Intervention, Educational.

RESUMO

Objetivo: analisar a eficácia de uma intervenção educativa sobre o conhecimento relacionado às lesões por pressão entre estudantes de enfermagem. **Métodos:** estudo quase experimental, do tipo antes e depois. Os participantes seguiram as respectivas etapas: avaliação do conhecimento prévio, intervenção educativa e reavaliação pós-intervenção. A amostra final foi composta por 30 estudantes. Utilizou-se instrumento validado para mensurar o conhecimento sobre lesões por pressão. A análise incluiu comparação entre os momentos, teste de McNemar para avaliação item a item e cálculo do tamanho de efeito. **Resultados:** antes da intervenção, apenas 20 itens apresentaram percentual de acerto considerado satisfatório, aumentando para 38 itens após a ação. Foram observadas mudanças estatisticamente significativas ($p<0,05$) em 16 itens, bem como um aumento significativo da média de acertos e redução de erros no pós-intervenção, com tamanho de efeito elevado ($r = 0,874$), indicando impacto educacional robusto. **Conclusão:** a intervenção educativa foi eficaz para ampliar o conhecimento dos estudantes de enfermagem. **Contribuições para a prática:** os achados sustentam a adoção de intervenções educativas bem planejadas e executadas como estratégia para qualificar a formação em enfermagem, fortalecendo competências essenciais à segurança do paciente e à qualidade do cuidado.
Descritores: Estudantes de Enfermagem; Úlcera por Pressão; Intervenção Educacional Precoce.

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Introduction

The prevention of pressure injuries is a relevant indicator of the quality of health services and the care provided, considering that a large proportion of these events is potentially preventable. Although it is not currently directly included in the International Patient Safety Goals, this practice is indirectly aligned with these guidelines and is consistent with other objectives aimed at promoting safe and high-quality care[1].

Pressure injuries are localized damage to the skin and/or underlying soft tissues, usually occurring over bony prominences or associated with the use of medical devices. Their development is related to exposure to intense and/or prolonged pressure, alone or in combination with shear. Pressure injuries are classified using an internationally standardized staging system. This classification includes stages 1 to 4, as well as the categories "unstageable" and "deep tissue pressure injury," defined according to the depth and extent of tissue damage[2-3].

Despite multicenter studies demonstrating substantial prevalence of pressure injuries, with rates ranging from 9.5% to 26.6%, a significant knowledge deficit persists among professionals responsible for their prevention and management. This educational gap is particularly concerning given the impact of this condition as a public health problem, associated with high healthcare costs and a significant increase in morbidity and mortality rates[4-6].

Evidence indicates that both nurses and nursing students present lower-than-expected levels of knowledge regarding the prevention and care of pressure injuries. Recurrent weaknesses in core domains of care highlight the need for structured educational actions, understood as planned interventions organized in stages, with defined objectives, evidence-based content, and a focus on the learning needs of the target audience[7-8].

The literature is still marked by a predominance of descriptive and analytical studies, with a scarcity of investigations aimed at intervening to change this scenario. Although such studies reinforce the relevance of knowledge in addressing this issue, the limited adoption of interventional designs highlights the need for research that advances toward the implementation and evaluation of educational strategies capable of producing concrete changes in both educational and care processes[9-11].

In this context, the importance of directing educational efforts toward nursing students stands out, particularly because they are in the final stage of their training, a critical period for consolidating knowledge essential to professional practice. Interventions aimed at this group make it possible to act preventively on educational gaps, facilitating preparation to address pressure injuries and enabling qualified entry into the healthcare setting[12-13].

Given these considerations, the present study was designed based on the following guiding question: What is the effectiveness of an educational intervention on pressure injuries in improving the knowledge of nursing students? Accordingly, the objective was to analyze the effectiveness of an educational intervention on knowledge related to pressure injuries among nursing students.

Methods

Study design

This is a quasi-experimental study with a before-and-after design, conducted in a virtual environment due to the pandemic caused by COVID-19, following the guidelines of the Standards for Quality Improvement Reporting Excellence 2.0 (SQUIRE).

Population, sample, and eligibility criteria

For sample size calculation, the recommendation of 30 participants for intervention studies was considered[14], without a control group, given the adopted design. Initially, 34 nursing students were eligible to participate in the study. However, only 30 fully

completed all three stages of the study (pre-test, educational intervention, and post-test), and therefore only these were included in the analysis. Participant selection was carried out through non-probabilistic convenience sampling[15], a strategy adopted in contexts where there is no access to the entire target population, including individuals who are available and accessible during the data collection period.

The inclusion criteria were: Brazilian nationality, age 18 years or older, and active enrollment in the final year of the nursing program during the study period. Participants who had not completed the curricular component equivalent to the course Nursing Care in the Intensive Care Unit were excluded, in order to ensure homogeneity of prior training and to minimize potential biases related to the lack of fundamental knowledge required for the proposed intervention.

Study setting

The study was disseminated through social media between August and September 2021, in accordance with the schedule previously defined by the authors. The dissemination strategy consisted of sending electronic invitations containing a link to access the research form. No restrictions were established regarding the type of educational institution (public or private) to which participants were affiliated. Upon accessing the link, volunteers were directed to sections presenting detailed information about the study, the Informed Consent Form, and the instruments used for data collection.

Measurement instrument

Two previously structured electronic questionnaires were made available through the Google Forms platform, organized into distinct sections. The first instrument was intended to characterize the participants.

To assess participants' knowledge about pressure injuries, the Pieper's Pressure Ulcer Knowledge Test (PUKT) was used, a tool previously validated and adapted to the Brazilian context. It consists of 41 statements distributed across two dimensions: knowledge of assessment and classification of pressure injuries (8 items) and knowledge of pressure injury prevention (33 items). Responses are marked according to the options "true," "false," or "I don't know." Each correct answer corresponds to one point, and the final score is obtained from the sum of correct responses, expressed as a percentage. A satisfactory performance is considered when the percentage of correct answers is equal to or greater than 90%[16].

Data collection

In the subsequent stage, participants were contacted individually by email to schedule the date and time for the educational intervention according to their availability. This strategy aimed to minimize sample loss and maximize adherence. The educational intervention was conducted in a virtual environment through the Google Meet platform, in four previously established sessions, between late 2021 and early 2022, always at 6:30 PM. It is noteworthy that all sessions strictly followed the same pedagogical script, with identical content, duration, materials, and facilitation.

The activity lasted two hours and was structured in an expository-dialogic format, covering content considered essential for safe clinical practice: skin anatomy and physiology; conceptualization and pathophysiology of pressure injuries; classification; risk factors; consequences of established injury; the role of nursing in prevention; and risk assessment scales. The intervention was planned in an objective manner and focused on critical topics frequently associated with knowledge gaps in nursing education. The dialogic nature of the activity is highlighted, as it enabled active student participation, and it was conducted in a synchronous online environment. The content was developed based on updated guidelines from the National Pressure Injury Advisory Panel (NPIAP), ensuring alignment with international recommendations

and current scientific evidence.

After each educational intervention, participants received a new link containing only the PUKT. This stage corresponded to the post-test and aimed to evaluate the impact of the educational intervention on participants' level of knowledge. Immediate application of the post-test was chosen because it allows detection of changes directly attributable to the intervention, serving as a short-term measure of effectiveness[17]. It is important to note that both the pre-test and post-test were administered by the same researcher responsible for conducting the educational intervention, ensuring standardization in the data collection procedure.

Data analysis

Data obtained during the two study time points were entered into Microsoft Excel and tabulated in SPSS, version 26.0. Descriptive statistics were performed to characterize participants (absolute and relative frequencies, measures of central tendency and dispersion), as well as inferential statistics (McNemar and Wilcoxon tests).

The McNemar test was used to compare the same variable at different measurement points, that is, to investigate discrepancies between the frequencies of correct answers of nursing students before and after the educational intervention. Since the test is indicated for dichotomous variables, responses from the Pieper test were recoded into two numerical categories, 0 and 1, where 0 corresponded to incorrect answers and "I don't know," and 1 to correct answers.

The comparison of quantitative data related to the sum of correct and incorrect answers in the pre- and post-intervention was performed using the Wilcoxon test. The non-normality of these variables was identified using the Shapiro-Wilk test, given the sample size. The confidence interval and significance level adopted for inferential analyses were 95% and 5% ($p<0.05$), respectively.

Ethical aspects

The study was conducted after receiving a favorable opinion from the Research Ethics Committee of the Centro de Ensino Superior e Desenvolvimento, under opinion no. 4,925,819/2021 and Certificate of Presentation for Ethical Consideration 49643421.2.0000.5175, in accordance with the provisions of Resolution 466/2012 of the National Health Council, as well as Circular Letter no. 2/2021 of the National Research Ethics Commission of the Executive Secretariat of the National Health Council and the Ministry of Health.

It is also noteworthy that artificial intelligence was used exclusively for grammatical and spelling review purposes, without interfering in the study design, data analysis, interpretation of results, or intellectual development of the manuscript. All scientific, argumentative, and analytical content is entirely authored by the researchers, who assume full responsibility for the information presented, in accordance with ethical guidelines for scientific publication.

Results

Of the 30 nursing students who participated in the study, 28 (96.3%) were female, 27 (90.0%) were aged between 18 and 25 years, 26 (86.7%) were single, 17 (56.7%) were in the final semester of their undergraduate program, 22 (73.3%) had a monthly income between one and two minimum wages, and 30 (100.0%) were from the Northeast region.

Regarding knowledge of pressure injuries, the mean self-reported aptitude for prevention was 7.2 (standard deviation (SD) ± 1.8); 18 (60.0%) had not received training or coursework on the topic during their undergraduate studies; 21 (70.0%) studied at a private higher education institution; 22 (73.3%) were familiar with the Braden Scale; 25 (83.3%) knew how to use pressure injury risk assessment scales; and the mean importance attributed to knowledge of prevention was 9.9 (SD ± 0.2) (Table 1).

Table 1 – Characterization of nursing students participating in the educational intervention (n=30). Campina Grande, PB, Brazil, 2022

Variables	**n (%)**
Sex	
Female	28(96.3)
Male	2 (6.7)
Age (years)	
18 to 25	27(90.0)
26 to 33	2 (6.7)
34 to 41	0 (0.0)
42 to 49	1 (3.3)
Marital status	
Single	26(86.7)
Married	3 (10.0)
Separated	1 (3.3)
Undergraduate period	
9th	13(43.3)
10th	17(56.7)
Monthly income (minimum wages)	
1 to 2	22(73.3)
3 to 4	7 (23.3)
5 to 6	1 (3.3)
Have you received any type of training/course during your undergraduate studies on pressure injury prevention?	
Yes	12(40.0)
No	18(60.0)
In which type of institution do you study?	
Private	21(70.0)
Public	9 (30.0)
Do you know any scale to assess the risk of developing pressure injuries? If yes, which one?	
No, I do not know any scale	2 (6.7)
Yes, I know the Braden Scale	22(73.3)
Yes, I know almost all or all the scales mentioned	6 (20.0)
Do you know how to use any of the scales mentioned above?	
Yes	25(83.3)
No	5 (16.7)
From 0 to 10, how important do you think it is to know how to prevent pressure injuries?	
Minimum – Maximum	9 – 10
Mean ± Standard deviation	9.9 ± 0.2
From 0 to 10, how capable do you consider yourself to act in pressure injury prevention?	
Minimum – Maximum	3 – 10
Mean ± Standard deviation	7.2 ± 1.8

Table 2 shows the percentage of incorrect and correct answers on the Pieper test and the results of the McNemar analysis. In the pre-intervention phase, 20 items achieved 90% or more correct answers, whereas in the post-intervention phase there was an increase to 38 items, demonstrating that the intervention produced satisfactory results for the participants.

Regarding the McNemar test, 16 items (1, 3, 4, 5, 6, 11, 13, 14, 15, 16, 17, 18, 31, 34, 36, and 38) showed statistical significance. This allows the inference that the educational intervention enabled refinement of nursing students' knowledge regarding pressure injuries, particularly in relation to staging definitions, risk factors and assessment, repositioning, preventive measures, early mobilization, and wound care.

Table 2 – Percentage of correct and incorrect answers on pressure injury knowledge questions before and after the educational intervention (n=30). Campina Grande, PB, Brazil, 2022

Questions	Pre-intervention		Post-intervention		p-value*
	Correct (%)	Incorrect (%)	Correct (%)	Incorrect (%)	
1. Stage 1 pressure injury is defined as intact skin with localized erythema, which does not exhibit visible blanching or whose color differs from the surrounding area.	22 (73.3)	8 (26.7)	30 (100.0)	0 (0.0)	0.008
2. Risk factors for the development of pressure injury include immobility, incontinence, inadequate nutrition, and altered level of consciousness.	26 (86.7)	4 (13.3)	30 (100.0)	0 (0.0)	0.125
3. All patients at risk for pressure injury should undergo systematic skin inspection at least once a week.	14 (46.7)	16 (53.3)	26 (86.7)	4 (13.3)	0.002
4. The use of hot water and soap may dry the skin and increase the risk of pressure injury.	23 (76.7)	7 (23.3)	30 (100.0)	0 (0.0)	0.016
5. It is important to massage areas over bony prominences if they are erythematous.	18 (60.0)	12 (40.0)	28 (93.3)	2 (6.7)	0.006
6. A Stage 3 pressure injury is a partial skin loss involving the epidermis.	17 (56.7)	13 (43.3)	28 (93.3)	2 (6.7)	0.007
7. All patients should be assessed upon hospital admission for the risk of developing pressure injury.	27 (90.0)	3 (10.0)	30 (100.0)	0 (0.0)	0.250
8. Creams, transparent dressings, and extra-thin hydrocolloid dressings help protect the skin against the effects of friction.	24 (80.0)	6 (20.0)	27 (90.0)	3 (10.0)	0.453
9. Stage 4 pressure injuries present full-thickness skin loss with extensive destruction and tissue necrosis or damage to muscles, bones, or supporting structures.	29 (96.7)	1 (3.3)	29 (96.7)	1 (3.3)	1.000
10. Adequate dietary intake of protein and calories should be maintained during illness/ hospitalization.	25 (83.3)	5 (16.7)	29 (96.7)	1 (3.3)	0.219
11. Patients who are bedridden should be repositioned every 3 hours.	12 (40.0)	18 (60.0)	26 (86.7)	4 (13.3)	0.001
12. A repositioning schedule should be used for each patient with or at risk for pressure injury.	29 (96.7)	1 (3.3)	30 (100.0)	0 (0.0)	1.000
13. Water- or air-filled gloves relieve pressure on the heels.	1 (3.3)	29 (96.7)	27 (90.0)	3 (10.0)	<0.001
14. Donut-type (water or air) cushions help prevent pressure injury.	4(13.3)	26 (86.7)	27 (90.0)	3 (10.0)	<0.001
15. In the lateral position, patients with or at risk for pressure injury should be positioned at a 30-degree angle relative to the mattress.	9 (30.0)	21 (70.0)	28 (93.3)	2 (6.7)	<0.001
16. In patients with or at risk for pressure injury, the head of the bed should not be elevated more than 30 degrees, unless contraindicated.	13 (43.3)	17 (56.7)	27 (90.0)	3 (10.0)	<0.001
17. Patients who cannot move independently should be repositioned every 2 hours when seated in a chair.	5 (16.7)	25 (83.3)	28 (93.3)	2 (6.7)	<0.001
18. Patients with limited mobility who can change body position without assistance should be instructed to relieve pressure every 15 minutes while seated in a chair.	15(50.0)	15 (50.0)	27 (90.0)	3 (10.0)	0.002
19. Patients with limited mobility who can change body position without assistance should be instructed to relieve pressure every 15 minutes while seated in a chair.	30 (100.0)	0 (0.0)	29 (96.7)	1 (3.3)	1.000
20. Stage 2 pressure injuries present full-thickness skin loss.	22 (73.3)	8 (26.7)	28 (93.3)	2 (6.7)	0.070
21. The skin of patients at risk for pressure injury should remain clean and free of moisture.	28 (93.3)	2 (6.7)	30(100.0)	0 (0.0)	0.500
22. Measures to prevent new injuries do not need to be continuously adopted when the patient already has a pressure injury.	29 (96.7)	1 (3.3)	29 (96.7)	1 (3.3)	1.000
23. Draw sheets or transfer sheets should be used to move or transfer patients who cannot move independently.	27 (90.0)	3 (10.0)	30 (100.0)	0 (0.0)	0.250
24. Mobilization and transfer of patients who cannot move independently should always be performed by two or more people.	29 (96.7)	1 (3.3)	30 (100.0)	0 (0.0)	1.000
25. In patients with chronic conditions who cannot move independently, rehabilitation should be initiated and include guidance on the prevention and treatment of pressure injury.	30(100.0)	0 (0.0)	30 (100.0)	0 (0.0)	–
26. All non-ambulatory patients should undergo risk assessment for the development of pressure injury.	29 (96.7)	1 (3.3)	30 (100.0)	0 (0.0)	1.000
27. Patients and family members should be educated about the causes and risk factors for the development of pressure injury.	29 (96.7)	1 (3.3)	30 (100.0)	0 (0.0)	1.000
28. Areas over bony prominences may come into direct contact with each other.	30(100.0)	0 (0.0)	29 (96.7)	1 (3.3)	1.000
29. All patients at risk for developing pressure injury should have a pressure-redistributing mattress.	27 (90.0)	3 (10.0)	29 (96.7)	1 (3.3)	0.500
30. Skin macerated by moisture is more easily damaged.	27 (90.0)	3 (10.0)	30(100.0)	0 (0.0)	0.250
31. Pressure injuries are sterile wounds.	20 (66.7)	10 (33.3)	27 (90.0)	3 (10.0)	0.039
32. A skin area with a pressure injury scar may be damaged more rapidly than intact skin.	28 (93.3)	2 (6.7)	29 (96.7)	1 (3.3)	1.000
33. A blister in the heel region should not be a cause for concern.	27 (90.0)	3 (10.0)	30(100.0)	0 (0.0)	0.250
34. A good way to reduce pressure on the heels is to keep them elevated off the bed.	22 (73.3)	8 (26.7)	29 (96.7)	1 (3.3)	0.039
35. All care provided to prevent or treat pressure injuries does not need to be documented.	30 (100.0)	0 (0.0)	30 (100.0)	0 (0.0)	–
36. Shear is the force that occurs when the skin adheres to a surface and the body slides.	21 (70.0)	9 (30.0)	30 (100.0)	0 (0.0)	0.004
37. Friction may occur when moving the patient on the bed.	29 (96.7)	1 (3.3)	30 (100.0)	0 (0.0)	1.000
38. Stage 2 pressure injuries may be extremely painful due to the exposure of nerve endings.	15 (50.0)	15 (50.0)	26 (86.7)	4(13.3)	0.003
39. In patients with incontinence, the skin should be cleaned at the time of elimination and at routine intervals.	25 (83.3)	5 (16.7)	30 (100.0)	0 (0.0)	0.063
40. The development of educational programs within the institution may reduce the incidence of pressure injuries.	30 (100.0)	0 (0.0)	29 (96.7)	1 (3.3)	1.000
41. Hospitalized patients need to be assessed for pressure injury risk only once during their hospitalization.	28 (93.3)	2 (6.7)	28 (93.3)	2 (6.7)	1.000

*McNemar's Chi-square test

Regarding the quantitative comparison of knowledge between the pre- and post-educational intervention, a statistically significant difference was observed, with an increase in the mean number of correct answers and a reduction in the number of errors in the post-intervention. The effect size was considered large (r = 0.874) (Table 3).

Table 3 – Descriptive measures of nursing students' performance on the pressure injury knowledge test before and after the educational intervention (n=30). Campina Grande, PB, Brazil, 2022

Performance	Statistics	Pre-intervention	Post-intervention	Z	r	p-value*
Number of correct answers	Mean (Standard deviation)	30.8 (3.6)	39.3 (2.0)	-4.789	0.87	< 0.001
	Median (IQR)	32 (6.0)	40 (3.3)			
Number of incorrect answers	Mean (Standard deviation)	10.2 (3.6)	1.7 (2.0)	-4.789	0.87	< 0.001
	Median (IQR)	9.0 (6.0)	1.0 (3.2)			

*Wilcoxon test; IQR: Interquartile range; Z: Z score; r: Effect size

Discussion

The data obtained in this study demonstrated a positive impact of the intervention on the level of knowledge of undergraduate nursing students through the correction of previously established misconceptions. Similar results have been reported in the international literature. Significant improvements in nurses' knowledge following educational interventions on pressure injuries have been identified, reinforcing the relevance of training strategies aimed at continuous updating[18]. These findings are particularly important considering that conceptual deficits in this area are directly associated with inadequate care practices and risks to patient safety[3].

Structured educational interventions play a key role in this context, with the potential to significantly contribute to the expansion of knowledge and the improvement of nursing practices in the prevention of pressure injuries, reinforcing the central role of evidence-based education in improving the quality of care[19].

In this scenario, investing in strengthening knowledge during initial training and maintaining it continuously after graduation within healthcare services is an essential strategy, with direct implications for the quality of trained professionals[7]. By developing competencies related to the prevention and management of skin injuries, it is possible to pro mote the consolidation of clinical practice aligned with professional responsibilities[20], which recognize the central role of nurses in maintaining skin integrity.

The approach to this topic during undergraduate education, when limited to traditional teaching models, tends to be insufficient to ensure the proper assimilation of complex content. In this regard, studies have recommended curricular revisions that incorporate updated guidelines and innovative pedagogical strategies capable of promoting more contextualized learning applicable to clinical practice[21-22].

Digital technologies emerge, in this context, as strategic resources to enhance the teaching-learning process by increasing temporal and spatial flexibility, facilitating access to structured content, and promoting more interactive methodologies[23-24]. Contrary to what has been highlighted in systematic reviews with meta-analysis, which point to a scarcity of educational interventions conducted during the COVID-19 pandemic, the present study contributes to filling this gap by implementing a remote educational intervention mediated by technological resources, demonstrating the feasibility and potential of virtual modalities for teaching about pressure injuries in adverse contexts[7]. It is also noteworthy that the expository-dialogic approach favored active student participation, stimulating critical reflection and promoting greater integration between theory and practice, even in a virtual environment.

Regarding item-by-item analysis, statistically significant changes were observed in 16 specific items after the intervention. These items are concentrated in fundamental domains of clinical practice, such as definition and staging of injuries, risk assessment, preventive measures, early mobilization, and nursing care—elements directly related to clinical decision-making and quality of care.

These results are consistent with evidence from other educational intervention studies, which demonstrate consistent gains in knowledge in critical areas for the prevention and management of pressure injuries, such as aspects related to etiology, classification, and preventive measures[18,25]. Beyond revealing educational gaps, these findings point to a concrete opportunity for curricular revision and improvement through the adoption of educational approaches aligned with evidence-based guidelines[24].

The fact that some domains did not show statistically significant differences between pre- and post-intervention moments may be explained by the high percentage of correct answers already observed in the pre-intervention phase, suggesting that part of the evaluated content was already consolidated among students, thereby reducing the possibility of additional measurable gains after the educational action.

The quantitative comparison between pre- and post-intervention moments revealed a statistically significant increase in the mean number of correct answers, associated with a marked reduction in the number of errors. This result becomes even more relevant when considering the observed effect size, classified as large, indicating that the intervention promoted a substantial and consistent change in the students' level of knowledge.

This finding may be explained by a set of characteristics related to the design and implementation of the proposal, which enabled the development of a well-structured intervention. Notable aspects include the use of content based on updated guidelines, systematic organization of the topics addressed, focus on critical domains of clinical practice, and pedagogical mediation in a synchronous virtual environment, which facilitated interaction and clarification of participants' doubts. These elements, combined with the profile of students in the final stage of their undergraduate program, likely enhanced learning gains[13].

The magnitude of this effect suggests that the gains achieved are not limited to isolated variations but reflect a robust educational impact, with the potential to promote meaningful learning and conceptual consolidation[26]. Although the literature recognizes positive effects of educational actions in this field, not all studies explicitly report effect size or achieve such expressive results[27].

In this sense, the findings of the present study gain greater consistency and relevance by demonstrating that educational interventions can produce measurable changes in knowledge related to pressure injuries. Comparison with other studies indicates that interventions mediated by digital technologies[28] have the potential to promote significant cognitive gains, although with variations in effect magnitude.

These data reinforce the need to move beyond the descriptive field, directing efforts toward the implementation of strategies capable of effectively intervening in the recurrent scenario of knowledge deficits. To this end, revision of undergraduate nursing curricula is suggested, aiming at a more effective approach to this topic. Furthermore, the implementation of continuous training strategies in practice settings is recommended in order to promote consolidation, updating, and critical application of knowledge, strengthening the integration between academic training and evidence-based professional practice[24].

In this regard, the present study stands out for developing and implementing an educational intervention that resulted in a measurable positive impact on the educational process of students, contributing concretely to the improvement of nursing education.

Study limitations

The study limitations include the use of conve-

nience sampling, limited to 30 participants, which may restrict representativeness and limit the generalizability of the findings, requiring caution regarding external inferences. In addition, the absence of a delayed post-test may introduce bias related to the measurement of predominantly immediate effects. Furthermore, the lack of a control group represents a methodological limitation inherent to the adopted study design. The adoption of these strategies, however, was related to the COVID-19 pandemic, which imposed significant restrictions on access to participants and in-person academic activities, constituting contextual, logistical, and operational limitations.

Regarding the immediate post-test, it should be noted that this approach is widely used in intervention studies, as it allows the assessment of the immediate impact of the pedagogical strategy before the influence of external factors or memory decay over time. Nevertheless, these limitations do not invalidate the presented results but suggest caution when extrapolating the conclusions.

Contributions to practice

The results of this study provide relevant contributions to practice and to the advancement of scientific knowledge in the fields of health and nursing, indicating that well-planned and well-executed educational interventions, including those conducted in virtual environments, can promote consistent gains in knowledge about pressure injuries. These findings reinforce the importance of incorporating evidence--based pedagogical strategies into training processes, fostering the development of competencies related to patient safety and quality of care. Furthermore, the study offers support for reflection among managers and educators regarding the importance of appropriate professional qualification, curricular improvement, strengthening of care practices aligned with current guidelines, and recognition of the nurse's role in the care of patients with pressure injuries.

Conclusion

It is concluded that the educational intervention developed was effective in increasing nursing students' knowledge about pressure injuries, as evidenced by the statistically significant increase in the number of correct answers, the marked reduction in errors, and the large effect size, indicating a consistent and meaningful change in participants' performance after the intervention. For the advancement of this field, the importance of conducting multicenter studies with longitudinal follow-up is emphasized, in order to assess the sustainability of the observed effects over time and to enhance the generalizability of the findings across different educational contexts.

Author contributions

Conception and design or analysis and interpretation of data; manuscript writing or critical review of important intellectual content; final approval of the version to be published; accountability for all aspects of the manuscript in ensuring that questions related to the accuracy or integrity of any part are appropriately investigated and resolved**: Nóbrega IS, Medeiros TPG, Sousa KA, Andrade LL, Soares MCS**.

Data availability

The authors declare that the data are fully available within the body of the article.

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