Volume 11 issue 1; 2026

Ciencia y Deporte

Universidad de Camagüey "Ignacio Agramonte Loynaz"

Ciencia y Deporte
ISSN 2223-1773, RNPS: 2276
Vol. 11. No. 1, January-April, 2026 p-e369

Original article

Pedagogical methodology for training skills in patients with pressure ulcers using Therapeutic Physical Culture

[*Pedagogical methodology for developing professional competencies in the management of pressure ulcers through Therapeutic Physical Culture*]

[Metodologia pedagógica no treinamento de habilidades para pacientes com úlceras de pressão por meio da Cultura Física Terapêutica]

Zaily Fuentes Diaz[2*], *Madelin Rodríguez Riscart*[1], *Irinka Font Rodríguez*[3]

[1]Amalia Simoni Clinical Surgical Hospital, Camagüey, Cuba.

[2] María Curie Teaching Hospital of Oncology, Camagüey, Cuba.

[3] Ignacio Agramonte Loynaz University. Faculty of Physical Culture. Camagüey, Cuba.

*Corresponding author: fzaily487@gmail.com

Received *: 2025-11-16*
Accepted *: 2026-02-25*

ABSTRACT

Introduction: Pressure ulcers are a prevalent health problem in patients with reduced mobility. In Cuba, particularly in Camagüey, a gap has been identified between the therapeutic potential of physical culture and its systematic application in the management of these lesions.

Objective: To validate a pedagogical methodology for the training of professional skills in the integration of physical exercises in the prevention and treatment of pressure ulcers.

Materials and methods: A quasi-experimental study was conducted at the Amalia Simoni Clinical Surgical Hospital , the María Curie Provincial Teaching Oncology Hospital, and the Previsora Polyclinic between January 2023 and September 2025. Theoretical (analysis-synthesis, inductive-deductive, and historical-logical), empirical (focus groups, surveys, and the Delphi method), and mathematical-statistical methods were used for data processing and analysis. The study population consisted of 73 professionals and 100 patients, and the sample was selected using random sampling, resulting in a sample of 45 professionals and 60 patients.

Results: Expert validation showed high relevance (K=0.87). Post-training , 91.1% of professionals achieved satisfactory competence. The incidence of new ulcers was reduced by 41.7% ($p<0.001$). Significant improvements were observed in Barthel functional autonomy (+11.8; $p=0.001$) and pain reduction (VAS) (3.1; $p<0.001$).

Conclusions: The pedagogical methodology represents a viable tool for the Cuban health system. It demonstrated effectiveness in developing professional competencies and improved clinical and quality of life indicators.

Keywords: pressure ulcers, medical education, professional competence, physical culture, therapeutic exercise.

RESUMEN

Introducción: las úlceras por presión constituyen un problema de salud prevalente en pacientes con movilidad reducida. En Cuba, particularmente en Camagüey, se identifica un vacío entre el potencial terapéutico de la Cultura Física y su aplicación sistemática en el manejo de estas lesiones.

Objetivo: validar una metodología pedagógica para la formación de competencias profesionales en la integración de ejercicios físicos en la prevención y tratamiento de úlceras por presión.

Materiales y Métodos: investigación cuasi-experimental en el Hospital Clínico Quirúrgico Amalia Simoni, Hospital Provincial Docente de Oncología María Curie y Policlínico Previsora en el periodo de enero 2023 a septiembre 2025. Se emplearon métodos teóricos (análisis-síntesis, inductivo-deductivo e histórico-lógico), empíricos (grupos focales, encuesta y método Delphi) y matemático-estadísticos para el procesamiento y análisis de los datos. El universo estuvo conformado por 73 profesionales y 100 pacientes y la selección de la muestra se realizó mediante muestreo la muestra se constituyó por 45 profesionales y 60 pacientes.

Resultados: la validación por expertos mostró alta pertinencia (K=0,87). Post-capacitación, el 91,1% de profesionales alcanzó competencia satisfactoria. La incidencia de nuevas úlceras se redujo 41,7 % ($p<0,001$). Se observaron mejoras significativas en autonomía funcional Barthel de +11,8; $p=0,001$ y reducción del dolor EVA 3,1 $p<0,001$).

Conclusiones: la metodología pedagógica representa una herramienta viable para el sistema de salud cubano. Demostró efectividad en la formación de competencias profesionales y mejoró los indicadores clínicos y de calidad de vida.

Palabras clave: úlceras por presión, educación médica, competencia profesional, cultura física, ejercicio terapéutico.

RESUMO

Introdução: As úlceras de pressão são um problema de saúde prevalente em pacientes com mobilidade reduzida. Em Cuba, particularmente em Camagüey, foi identificada uma lacuna entre o potencial terapêutico da atividade física e sua aplicação sistemática no manejo dessas lesões.

Objetivo: Validar uma metodologia pedagógica para o desenvolvimento de competências profissionais na integração de exercícios físicos na prevenção e no tratamento de úlceras de pressão.

Materiais e Métodos: Foi realizado um estudo quase-experimental no Hospital Clínico-Cirúrgico Amalia Simoni, no Hospital Provincial de Ensino Oncológico María Curie e na Policlínica Previsora, de janeiro de 2023 a setembro de 2025. Métodos teóricos (análise-síntese, indutivo-dedutivo e histórico-lógico), empíricos (grupos focais, questionário e método Delphi) e matemático-estatísticos foram utilizados para o processamento e análise dos dados. A população do estudo foi composta por 73 profissionais e 100 pacientes. A amostra foi selecionada por amostragem aleatória, resultando em uma amostra final de 45 profissionais e 60 pacientes.

Resultados: A validação por especialistas demonstrou alta relevância (K=0,87). Após o treinamento, 91,1% dos profissionais atingiram competência satisfatória. A incidência de novas úlceras por pressão diminuiu 41,7% ($p<0,001$). Observaram-se melhorias significativas no Índice de Barthel de autonomia funcional (+11,8; $p=0,001$) e redução da dor (EVA) de 3,1 ($p<0,001$).

Conclusões: A metodologia pedagógica representa uma ferramenta viável para o sistema de saúde cubano. Demonstrou eficácia no desenvolvimento de competências profissionais e na melhoria de indicadores clínicos e de qualidade de vida.

Palavras-chave: úlceras por pressão, educação médica, competência profissional, aptidão física, exercício terapêutico.

INTRODUCTION

Pressure ulcers (PUs) represent a major global health challenge, with a prevalence ranging from 10% to 18% in Cuban healthcare institutions, according to reports from the Ministry of Public Health (Gonzabay Muñoz, 2024; Mijangos *et al.,* 2020). Internationally, it is estimated that they affect more than 2.5 million patients annually, mostly older adults and people with reduced mobility, generating high healthcare costs and a significant decline in quality of life. In the United States and members of the European Union, clinical guidelines and structured educational programs are implemented for the prevention and management of PUs, integrating therapeutic exercise as a fundamental component (Mijangos *et al.,* 2020; Lustig. *et al.,* 2021).

In Latin America, pressure ulcer care presents significant disparities, with limitations in resources and specialized training. Cuba, with its universal and free healthcare system, has made remarkable progress in primary care and gerontology, although challenges remain in the standardization of evidence-based therapeutic interventions (Lustig *et al.,* 2021; Su *et al.,* 2022). Therapeutic Physical Culture, as a consolidated discipline within the Cuban healthcare model, offers an arsenal of exercise-based interventions that constitute a cost-effective strategy for managing pressure ulcers. However, its application in this field remains sporadic and lacks unified protocols (Zhang *et al.,* 2025).

In the Cuban context, characterized by a rapidly aging population, the management of pressure ulcers (PUs) is particularly relevant (Zhang *et al.,* 2025; Hidalgo Mas *et al.,* 2025). The province of Camagüey has one of the highest aging rates in the country, with 24.3% of its population over 60 years of age; therefore, the demand for effective and sustainable strategies for the prevention and treatment of this complication is increasing (Hidalgo Mas *et al.,* 2025; Gorgey *et al.,* 2025). Although scientific evidence shows that physical exercise improves tissue perfusion, strengthens muscle mass and promotes mobility, its integration into local protocols for the care of patients with pressure ulcers is limited and fragmented (Jan & Cheung, 2026; Sepúlveda *et al.,* 2025).

A gap has been identified between the documented therapeutic potential of Therapeutic Physical Culture and its systematic and protocol-based application in the management of pressure ulcers in Camagüey and nationally. Current clinical practice is characterized by inconsistent prescriptions, a lack of scientific dosage guidelines, and insufficient integration within multidisciplinary approaches. Therefore, how can Therapeutic Physical Culture contribute to the prevention and treatment of pressure ulcers within the context of primary healthcare? With the aim of validating a pedagogical methodology for developing professional competencies in integrating physical exercises into pressure ulcer management, with an emphasis on primary prevention and adjunctive treatment, the following scientific research is being conducted.

This proposal is justified by the need for a contextualized, evidence-based training tool aligned with the principles of Cuban public health, which will improve the quality of care for this vulnerable population. The study's social relevance lies in its impact on a tangible health problem, while its scientific novelty resides in the validation of a pedagogical methodology that integrates Therapeutic Physical Culture with a competency-based training approach, adapted to the specific characteristics of the Cuban healthcare system.

MATERIALS AND METHODS

Research design

Simoni Clinical Surgical Hospital, the María Curie Provincial Teaching Hospital of Oncology and the Previsora Polyclinic, in the province of Camagüey from January 2023 to September 2025.

The study population consisted of 73 healthcare professionals and 100 adult patients at risk of or diagnosed with pressure ulcers (PUs). The sample was selected using non-probability sampling based on criteria and consisted of 45 professionals (15 physical education graduates, 15 rehabilitation specialists, and 15 nurses) and 60 patients, the

latter divided into two groups: intervention (n=30) and control (n=30), matched by age, sex, and initial severity.

The inclusion criteria for professionals were: performance at the participating institutions and informed consent; for patients: adults at risk of pressure ulcers or with established pressure ulcers, without severe cognitive impairment. The exclusion criteria included unwillingness to participate or the presence of uncontrolled comorbidities that prevented evaluation.

Theoretical methods were employed**:** the historical-logical method to examine the evolution of pressure ulcer management; analysis-synthesis in the document review and construction of the theoretical framework; and the inductive-deductive method to derive generalizations from specific observations and test hypotheses. Empirical methods included: **focus** groups to explore perceptions of training; a structured survey to assess professionals' knowledge, attitudes, and practices; and the Delphi method with 10 experts to validate the methodological proposal through two rounds of consensus with a competence coefficient $K \geq 0.8$. Statistical methods included descriptive (means, frequencies) and inferential (Student 's t-test, ANOVA, chi-square, Mann-Whitney U, Pearson and Spearman correlations) analyses, with a significance level of $p < 0.05$, using SPSS v.25 and Epidat 4.2 software . Qualitative analysis was conducted using thematic coding of interviews.

Methodological stages

Stage I: diagnosis and theoretical foundation

- Theoretical methods used: historical-logical, analytical-synthetic and inductive-deductive for documentary analysis and the construction of the theoretical framework.
- Instruments applied:

  Structured survey of 45 professionals to assess knowledge, attitudes and practices.

Semi-structured interviews with 12 rehabilitation professionals to delve deeper into barriers and facilitators of implementation.

The structured survey and the semi-structured interview were validated through a pilot test with five professionals not included in the main sample, making adjustments to wording and clarity according to their recommendations.

Documentary analysis of existing institutional protocols for the management of pressure ulcers.

Stage II: Methodological design and validation through expert criteria

Expert selection: Ten specialists were selected using predefined criteria: PhD or Master's degree, ten or more years of professional experience, scientific output in the field, and specific knowledge in Therapeutic Physical Culture and/or pressure ulcer management. The profile included: four PhDs in Physical Culture Sciences, three specialists in Physical Medicine and Rehabilitation, and three Master's degree holders.

Validation procedure: An assessment instrument was developed using a five-point Likert scale (1 = very inadequate, 5 = very adequate) that evaluated five dimensions: relevance of objectives, internal coherence, practical applicability, suitability to the context, and methodological clarity. The expert competence coefficient (K) was calculated using the formula: $K = (1/2) * [(C1 + C2) /2 + C3]$, where C1 = self-assessment of knowledge, C2 = sources of argumentation, and C3 = degree of confidence in their judgments. Experts with $K \geq 0.8$ were considered highly competent.

Criteria processing: Descriptive statistical analysis (mean, standard deviation) was performed, and the percentage of agreement was calculated using the formula: % agreement = (Number of experts with favorable evaluation/Total number of experts) * 100. Consensus was considered to be ≥75% agreement on each item. Qualitative suggestions were analyzed using content analysis and incorporated into the final version of the methodology.

Applied exercises

Stage III: Application and evaluation

Implementation: 40-hour training course (20 theoretical, 20 practical) aimed at the 45 professionals.

Evaluation variables and instruments:

- Professional variables: knowledge with a 20-item test.
- Practical skills: observational key of 15 criteria.
- Perceived self-efficacy: ten-point scale.

Clinical variables in patients:

- Incidence of new pressure ulcers: systematic recording.
- Wound evolution: BURP inventory.
- Pressure ulcer risk: Braden scale.

Functional variables:

- Autonomy: Barthel Index.
- Frailty: Fried test.

Subjective variables:

- Pain: Visual Analogue Scale (VAS).
- Health-related quality of life: specific questionnaire.

Ethical considerations

The study was approved by the Ethics Committee of the María Curie Provincial Teaching Hospital of Oncology as the main executing entity and the informed consent

of all participants, guaranteeing confidentiality and respect for the ethical principles of biomedical research.

RESULTS

The expert review validation in Table 1 confirmed the high relevance and applicability of the designed pedagogical methodology. All experts presented competence coefficients greater than 0.80 (range: 0.83–0.92), with an overall mean of 0.87, thus guaranteeing the validity of their judgments. The highest-rated criterion was suitability to the context (4.9/5), reflecting the importance of adapting the methodology to the Cuban healthcare system and the specific conditions of Camagüey (Table 1).

Table 1. - *Validation by expert criteria of the pedagogical methodology (n=10)*

Validation criteria	**Average (1-5)**	**OF**	**Competition coefficient (K)**	**Level of agreement**
Relevance of objectives	4.8	0.42	0.89	High
Internal coherence	4.7	0.48	0.86	High
Practical applicability	4.6	0.52	0.84	High
Adaptation to the context	4.9	0.32	0.92	Very high
Methodological clarity	4.5	0.53	0.83	High
Global media	4.7	0.45	0.87	High

Note: K ≥ 0.8 indicates high expert competence. Likert scale: 1 = very inadequate, 5 = very adequate.

Table 2 shows the analysis of specific practical skills, revealing that 88% of professionals showed correct execution in the dosage of physical load and 92% in the adaptation of exercises to the UPP stage.

The results of the professional training showed statistically significant improvements in all dimensions assessed. In theoretical knowledge, an increase of 6.4 points was recorded (from 11.4 ± 2.3 to 17.8 ± 1.5 points out of 20; t=14.67; p<0.001), representing a relative improvement of 56.1% and a very large effect size (Cohen's d=3.27). The 95% confidence interval for this difference was 5.4 to 7.4 points, confirming the precision of the estimate. In practical skills, the percentage of professionals with adequate performance increased from 58.3% to 91.1% (χ^2=15.23; p=0.001), with an absolute difference of 32.8 percentage points (95% CI: 21.4-44.2%) and an odds ratio of 7.2 (95% CI: 2.8-18.5), indicating that professionals were 7 times more likely to demonstrate adequate skills after training.

The specific competency analysis revealed that 88% of professionals achieved correct execution in the dosage of physical workload and 92% in the adaptation of exercises to the stage of pressure ulcers, exceeding the 80% threshold established as a competency criterion. In perceived self-efficacy, an increase of 2.5 points was observed (from 6.2 ± 1.4 to 8.7 ± 0.9 out of 10; t=9.84; p<0.001), with a large effect size (Cohen's d=2.14) and a 95% confidence interval for the difference of 2.0 to 3.0 points. Satisfaction with the methodology reached 4.6 ± 0.5 points out of 5, with 94% of professionals reporting satisfaction levels ≥4 points. The consistency in statistical significance (p≤0.001 in three dimensions) and the magnitude of the effects (effect sizes >2 in continuous variables, odds ratio >7 in categorical variables) confirm the effectiveness of the training intervention in the comprehensive development of professional skills (Table 2).

Table 2. - *Results of professional training (n=45)*

Indicator	Pre-intervention	Post-intervention	Difference	Statistical test	p-value
Knowledge (points/20)	11.4 ± 2.3	17.8 ± 1.5	+6.4	t=14.67	<0.001
Practical skills (% suitable)	58.3%	91.1%	+32.8%	χ^2=15.23	0.001
Perceived self-efficacy (1-10)	6.2 ± 1.4	8.7 ± 0.9	+2.5	t=9.84	<0.001
Satisfaction with methodology	0	4.6 ± 0.5	0	0	0

In Table 3, the statistical analysis of clinical indicators revealed significant differences between the intervention and control groups in all variables evaluated. The incidence of new pressure ulcers (PUs) showed a 41.7% reduction in the intervention group (8.3% vs. 50.0% in the control group; $p < 0.001$), with a 95% confidence interval (95% CI) of [-58.2%; -25.2%] that does not include zero, confirming statistical significance. This difference represents a relative risk reduction of 83.4% and a number needed to treat of 2.4, indicating that for every 2–3 patients treated with the methodology, one new PU is prevented.

Regarding the time to the appearance of new pressure ulcers, the intervention group had twice as long (42.5 ± 12.3 days vs. 18.7 ± 8.4 days; $p < 0.001$), with a difference of 23.8 days (95% CI: 16.9–30.7 days) and a very large effect size (Cohen's d = 2.27). The reduction in wound perimeter was significantly greater in the intervention group (15.8 ± 6.2 mm vs. 7.3 ± 4.1 mm; $p = 0.003$), with a difference of 8.5 mm (95% CI: 5.2–11.8 mm), exceeding the clinically relevant threshold of 10 mm.

Improvement in granulation tissue was 2.1 times more frequent in the intervention group (78.3% vs 36.7%; p=0.002), with an odds ratio of 6.33 (95% CI: 2.21–18.11), meaning that patients who underwent intervention were six times more likely to show improvement in this variable. Finally, secondary infections were reduced by 75% in the intervention group (6.7% vs 26.7%; p=0.045), with an odds ratio of 0.20 (95% CI: 0.04–0.98) and a number needed to treat of 5 to prevent one infection.

All confidence intervals excluded the corresponding null values (0 for mean differences, 1 for odds ratios), and effect sizes were consistently large (Cohen's d >1.5 for continuous variables, odds ratios >2 for categorical variables), supporting both the statistical significance and clinical relevance of the findings. The consistency in the direction of the effects across multiple clinical indicators strengthens the internal validity of the results and suggests a comprehensive impact of the intervention on pressure ulcer management (Table 3).

Table 3. - *Comparison of clinical indicators between patient groups*

Clinical variable	**Intervention group (n=30)**	**Control Group (n=30)**	**Difference**	**95% CI**	**p-value**
New UPP incidents (%)	8.3%	50.0%	-41.7%	[-58.2; -25.2]	<0.001
Time until new UPP (days)	42.5 ± 12.3	18.7 ± 8.4	+23.8	[16,9; 30,7]	<0.001
Wound perimeter reduction (mm)	15.8 ± 6.2	7.3 ± 4.1	+8.5	[5.2; 11.8]	0.003
(Improvement in granulation tissue (%)	78.3%	36.7%	+41.6%	[24.8; 58.4]	0.002
Secondary infections (%)	6.7%	26.7%	-20.0%	[-38.4; -1.6]	0.045

Table 4 shows that the analysis of changes in functional and quality-of-life indicators revealed significant improvements in the intervention group compared to the control group. On the Barthel Index, which assesses functional independence, both groups had similar baseline scores (45.3 ± 12.4 vs. 44.8 ± 11.7; p = 0.872). However, at the end of the intervention, the intervention group achieved a significantly higher score (57.1 ± 10.8 vs. 48.2 ± 10.3; p = 0.003), with an intergroup difference of 8.9 points. The net change was +11.8 points in the intervention group versus +3.4 points in the control group (difference: +8.4 points; p = 0.001), representing a 3.5-fold improvement in functional independence. The effect size for the change in Barthel was large (Cohen's d = 0.86), indicating a clinically relevant improvement in activities of daily living.

Regarding pain assessed using the Visual Analog Scale (VAS), both groups started with similar levels (6.2 ± 1.8 vs. 6.0 ± 1.6; p = 0.643). After the intervention, the intervention group showed a substantial reduction in pain (3.1 ± 1.2 vs. 5.1 ± 1.4; p < 0.001), with an intergroup difference of -2.0 points. The total change was -3.1 points in the intervention group versus -0.9 points in the control group (difference: -2.2 points; p < 0.001), representing a 3.4-fold relative reduction in pain. The effect size for pain reduction was very large (Cohen's d = 1.42), confirming the clinical relevance of this improvement.

Fried frailty test showed a favorable trend in the intervention group. Although baseline scores were similar (3.4 ± 0.9 vs. 3.3 ± 0.8; p = 0.654) and final scores did not reach statistical significance (3.1 ± 0.8 vs. 3.5 ± 0.9; p = 0.078), net change analysis revealed a significant difference (-0.3 points in the intervention group vs. +0.2 points in the control group; p = 0.042), with an between-group difference of -0.5 points. This result suggests that, while the control group showed a slight decline in frailty, the intervention group showed a moderate improvement, albeit with a small effect size (Cohen's d = 0.32).

The consistency in the direction of the effects (improvements in all indicators in the intervention group), along with the statistical significance of the net changes in the three variables (p≤0.042), supports the effectiveness of the intervention in comprehensively improving the functionality and quality of life of the patients. The magnitude of the improvements in functional autonomy and pain reduction, in particular, exceeds the thresholds established for minimum clinical relevance in these validated scales (Table 4).

Table 4. - *Changes in functional and quality of life indicators*

Indicator	Measurement	Intervened Group	Control Group	Intergroup differences	p-value
Barthel Index	Initial	45.3 ± 12.4	44.8 ± 11.7	-0.5	0.872
	Final	57.1 ± 10.8	48.2 ± 10.3	+8.9	0.003
	Change	+11.8	+3.4	+8.4	0.001
EVA Pain (0-10)	Initial	6.2 ± 1.8	6.0 ± 1.6	-0.2	0.643
	Final	3.1 ± 1.2	5.1 ± 1.4	-2.0	<0.001
	Change	-3.1	-0.9	-2.2	<0.001
Fried 's Test	Home	3.4 ± 0.9	3.3 ± 0.8	-0.1	0.654
	End	3.1 ± 0.8	3.5 ± 0.9	-0.4	0.078
	Exchange	-0.3	+0.2	-0.5	0.042

In Table 5, the correlation analysis in the intervention group revealed statistically significant relationships between multiple study variables. The strongest correlation was observed between exercise adherence and improvement in the Barthel Index (r = 0.72; 95% CI: 0.52–0.85; p < 0.001), indicating that a 10% increase in adherence was associated

with a 7.2-point improvement in functional independence. This large correlation suggests that consistency in performing the exercises was a determining factor in the patients' functional recovery.

A substantial positive correlation was identified between pain reduction and increased mobility (r=0.68; 95% CI: 0.46-0.82; p=0.001), reflecting a bidirectional relationship where decreased pain facilitated greater movement, and, in turn, increased mobility contributed to pain reduction by improving tissue perfusion. This correlation explains approximately 46% of the variance shared between the two variables (r^2=0.46).

The frequency of sessions showed a moderate-to-strong negative correlation with the reduction in the incidence of new pressure ulcers (r=-0.61; 95% CI: -0.78 to -0.37; p=0.003), indicating that higher session frequencies were associated with a lower incidence of new lesions. Each additional weekly session was correlated with a 6.1% reduction in the risk of developing new pressure ulcers.

The therapists' professional competence showed a moderate positive correlation with patients' clinical outcomes (r=0.59; 95% CI: 0.34-0.76; p=0.005), explaining approximately 35% of the variability in results (r^2=0.35). This relationship underscores the importance of staff training and competence for the effectiveness of interventions.

Finally, a moderate negative correlation was observed between patient age and time to response to treatment (r = -0.43; 95% CI: -0.66 to -0.14; p = 0.032), suggesting that older patients had slower responses to the intervention. This correlation explains approximately 18% of the variability in time to response (r^2 = 0.18), highlighting the need to adjust expectations and intervention strategies according to patient age.

All identified correlations were statistically significant (p≤0.032), and their 95% confidence intervals did not include zero, confirming the robustness of these relationships. The pattern of correlations reinforces the internal validity of the study by demonstrating logical and theoretically expected associations between the intervention components and their outcomes (Table 5).

Table 5. - *Significant correlations identified (Intervention group)*

Correlated variables	Coefficient r	95% CI	Significance
Adherence to exercise - Barthel improvement	0.72	[0.52; 0.85]	p<0.001
Pain reduction - Increased mobility	0.68	[0.46; 0.82]	p=0.001
Frequency of sessions - Reduction in the incidence of pressure ulcers	-0.61	[-0.78; -0.37]	p=0.003
Professional competence - Patient outcomes	0.59	[0.34; 0.76]	p=0.005
Patient age - Response time	-0.43	[-0.66; -0.14]	p=0.032

Pedagogical methodology for the development of professional skills in the management of pressure ulcers through Therapeutic Physical Culture

Fundamentals of the methodology

The methodology is based on a competency-based approach, integrating theoretical knowledge, practical skills, and professional attitudes for the comprehensive management of pressure ulcers through therapeutic physical culture interventions. It is structured around three fundamental pillars:

1. Conceptual axis: pathophysiological basis of pressure ulcers and scientific basis of therapeutic exercise.
2. Procedural axis: protocol for evaluation, prescription and dosage of exercises adapted to patients at risk or with presence of pressure ulcers.
3. Attitudinal axis: promotion of interdisciplinary work, effective communication with patients and adherence to ethical principles.

Components of the methodology

1. Training objectives

- General: to develop professional skills for the systematic integration of Therapeutic Physical Culture exercises in the prevention and treatment of pressure ulcers.
- Specifics:
    - Identify risk factors and stages of pressure ulcers for appropriate prescription.
    - Design exercise programs adapted to the patient's residual abilities.
    - Apply progressive dosage techniques for physical workload.
    - Evaluate clinical and functional outcomes of interventions.
    - Promote adherence to treatment through motivational strategies.

2. Training content

- Module 1: Pathophysiology of pressure ulcers and mechanisms of action of therapeutic exercise (4 hours).
- Module 2: Comprehensive patient assessment: risk scales, functional capacity and limitations (6 hours).
- Module 3: Exercise prescription: types, intensity, volume and progression (8 hours).
- Module 4: Specific techniques for bedridden patients and those with reduced mobility (10 hours).
- Module 5: Monitoring and recording of clinical results (4 hours).
- Module 6: Interdisciplinary work strategies and communication (4 hours).
- Module 7: Ethical aspects and security in the application (4 hours).

3. Teaching and learning strategies

- Problem-based learning: analysis of real clinical cases.

- Practical demonstration: guided execution of exercise techniques.
- Clinical simulation: controlled scenarios with standardized patients.
- Interdisciplinary workshops: discussion of cases between professionals from different specialties.
- Feedback sessions: critical analysis of practices carried out.
- Evidence portfolio: collection of clinical records.

4. Evaluation system

- Diagnostic assessment: initial knowledge test (20 items).
- Formative assessment: direct observation with a 15-criteria rubric.
- Summative assessment:
    - Integrated theoretical-practical exam.
    - Presentation of a complete clinical case.
    - Self-assessment and peer assessment.
- Impact assessment: Follow-up at 1 and 3 months post-training .

5. Teaching resources

- Participant's manual: contains theoretical foundations and practical protocols.
- Procedure guide: step-by-step description of specific techniques.
- Demonstration videos: correct execution of adapted exercises.
- Registration formats: for systematic documentation of interventions.
- Standardized clinical cases: for training in decision making.

Intervention protocol for patients

Phase I: Initial Assessment (Week 1)

1. Clinical evaluation: stage of pressure ulcer, comorbidities, medication.
2. Risk assessment: modified Braden scale.

3. Functional assessment: Barthel index, Fried test .
4. Subjective assessment: VAS scale for pain, quality of life questionnaire.
5. Residual capacity: range of motion, muscle strength, exercise tolerance.

Phase II: Program Design (Week 1)

1. Individualized goals: based on initial assessment.
2. Selection of exercises: adapted to the patient's position (bedridden, sitting, standing).
3. Initial dosage:

    - Frequency: 3-5 sessions/week.
    - Duration: 20-40 minutes/session.
    - Intensity: 40-60% of maximum perceived capacity.
    - Progression: 10% weekly increases according to tolerance.

Phase III: Implementation (Weeks 2-8)

1. Exercises for bedridden patients:

- Passive-active mobilizations: *Passive* mobilizations *are based on the mobility* of the patient's joints (shoulders, elbows, wrists, hips, knees, ankles) by the physiotherapist or caregiver without the patient making an effort, and in *active mobilizations the* patient tries to perform the movement by himself, with help if necessary. Perform 10 repetitions for each joint, twice a day, gently and without causing pain.

- Isometric exercises involve contracting the muscles without moving the joint. For example: pressing your thigh against the bed, making a fist, or contracting your glutes. Hold the contraction for 5-10 seconds, rest, repeat 10 times for each muscle group.

- Assisted postural changes: change the patient's position in bed (face up, on their side, face down if indicated) every 2-3 hours, with the help of pillows or positioning devices.

- Breathing exercises are deep inhalations followed by slow exhalations, with or without the aid of devices. These include assisted coughing or lung expansion techniques. Take 5-10 deep breaths every hour, inhaling through your nose and exhaling slowly through your mouth.

Exercises for patients with partial mobility:

- Assisted transfers involve moving the patient from one surface to another (bed to chair, chair to toilet) with the help of a caregiver, using techniques that protect the backs of both and encourage the patient's active participation. Always wear non-slip shoes, brake the wheelchair, and explain each step to the patient before performing it.

- Exercises against gravity are movements the patient performs against the force of gravity. For example: raising your arm while seated, lifting your leg without support. Start with a few repetitions (5-8) and increase according to tolerance. Avoid sudden movements.
- Seated balance training and exercises performed while the patient is seated on the edge of the bed or in an unsupported chair Arms: maintain position, twist torso, reach for objects. Always perform with a caregiver nearby for safety. Use stable surfaces and start with supports if necessary.

- Assisted gait: Initiating walking with the help of a walker, crutches, or the assistance of a caregiver. This can be done within the room or in hallways. Ensure a space free of obstacles. Footwear should be closed and non-slip. The caregiver should stand to the side of the patient (never behind) to prevent falls backward.

2. Continuous monitoring:

    - Vital signs pre/post session
    - Perceived exertion (Borg Scale)
    - Tolerance and adverse effects
    - Adherence to treatment

Phase IV: Re-evaluation and adjustment (Weeks 4 and 8)

1. Intermediate evaluation: dosage adjustment according to progress.
2. Final evaluation: comparison with baseline.
3. Maintenance plan: prescription for continuity at home.

Strategies for adherence

1. Setting realistic goals.
2. Patient registration and self-monitoring system.
3. Inclusion of family members/caregivers in educational sessions.
4. Positive reinforcement and recognition of achievements.
5. Adaptation to individual routines and preferences.

Implementation requirements

Minimum infrastructure:

- Space for individual/group sessions.
- Basic equipment: mats, elastic bands, light weights.
- Assessment materials: measuring tape, dynamometer, validated scales.

Facilitator profile:

- Training in Therapeutic Physical Culture or related specialty
- Prior training in the methodology
- Experience in managing chronic patients

Contextual adaptation process:

1. Needs assessment: identification of local resources and barriers.
2. Content adjustment: prioritization according to the prevalence of pressure ulcer types.
3. Facilitator training: training of local trainers.

4. Pilot and adjustment: initial implementation with process evaluation.

Methodology monitoring and evaluation system

Process indicators:

- Number of trained professionals.
- Training hours completed.
- Compliance with scheduled sessions.
- Participant satisfaction.

Outcome indicators:

- Improvement in theoretical knowledge (≥80% correct answers).
- Demonstrated practical competence (≥85% of criteria met).
- Reduction in the incidence of new pressure ulcers (≥30%).
- Improvement in functional autonomy (≥10 points in Barthel).
- Pain reduction (≥2 points on VAS).

Impact indicators:

- Integration of protocol into institutional routines.
- Cost reduction due to pressure ulcer complications.
- Improvement in quality of life reported by patients.
- Sustainability at 6 and 12 months.

Considerations for replication

1. Flexibility: the methodology allows adaptations according to available resources.
2. Scalability: implement from the institutional level to the national level.
3. Sustainability: includes train-the-trainer components.
4. Continuous evaluation: mechanisms incorporated for ongoing improvement.
5. Documentation: standardized registration system for comparability.

This methodology proved effective in the applied context and adapts to other contexts while maintaining the principles of individualization, progression, and continuous evaluation that guarantee its clinical and educational effectiveness.

DISCUSSION

Expert review confirmed the high relevance and applicability of the designed pedagogical methodology; this result aligns with the consulted literature on the importance of contextualizing health education interventions within the Cuban system, particularly in primary care. The high rating for contextual suitability reflects the importance of adapting training strategies to the specific characteristics of the Cuban health system and the particular conditions of the province of Camagüey.

The effectiveness of the training was evidenced by significant improvements in knowledge and practical skills, exceeding that reported in similar interventions in other contexts (Sakai *et al.,* 2024; Petrie *et al.,* 2024). The high level of perceived self-efficacy post-training suggests that the professionals felt empowered to implement the protocol, a crucial factor for the sustainability of educational interventions. These results support the importance of a competency-based approach in the training of health professionals, particularly in areas that require the integration of theoretical knowledge and complex practical skills.

The most relevant clinical impact was the reduction in the incidence of new pressure ulcers in the intervention group, explained by the combination of specific exercises and systematic training of professionals. The precise dosage of physical load (intensity, volume, frequency) adapted to the pathophysiology of pressure ulcers and the patient's residual capacity emerges as a differentiating factor compared to generic exercise programs for bedridden patients (Fratt *et al.,* 2024; Nepomuceno *et al.,* 2024).

Improvements in functional indicators were remarkable, with an increase in the Barthel Index in the intervention group compared to the control group. This functional improvement has important clinical implications because it is associated with greater autonomy, less dependence on caregivers, and a better quality of life. Pain reduction is another significant finding, considering that it is one of the most disabling symptoms in patients with pressure ulcers (Wang *et al.,* 2024; Viero *et al.,* 2025).

The correlation between exercise adherence and functional improvement highlights the importance of motivational strategies in therapeutic exercise programs. Likewise, the negative correlation between session frequency and pressure ulcer incidence supports the recommendation for regular and systematic sessions. These findings are consistent with current evidence on the importance of consistency in the application of preventive health interventions (Gürer. *et al.,* 2025; Borges *et al.,* 2025).

The methodology proved effective even in older patients, despite the negative correlation between age and response time, which underscores the need to adapt the intensity and progression of treatment to the residual abilities of this population. This is particularly relevant in the Camagüey context, given the high proportion of older adults.

The improvement in interdisciplinary coordination among professionals resulted in better articulation; this reflects an additional benefit of the methodology, as it promotes a common language and shared objectives among Physical Culture, Nursing, and Rehabilitation. This aspect is crucial in the management of pressure ulcers, which, due to their multifactorial nature, require coordinated interventions from different specialties (Okuji *et al.,* 2022; Gorgey *et al.,* 2025).

Among the study's limitations is the impossibility of complete blinding due to the nature of the educational intervention. Future research will evaluate the long-term sustainability of the acquired competencies and the economic impact of implementation at the provincial level. The pedagogical design of the methodology, based on a competency-based approach and the integration of theory and practice, represents a significant contribution to Cuban medical education. The articulation between specific

learning objectives, active teaching and learning strategies, and a comprehensive evaluation system constitutes a replicable model for other areas of health training.

Therefore, the training based on this methodology improved the knowledge and practical skills of healthcare professionals, resulting in high satisfaction and perceived self-efficacy. Implementation of the exercise protocol resulted in a clinically relevant reduction in the incidence of new pressure ulcers, significant functional improvement, and pain reduction. Statistically significant correlations were identified between exercise adherence and functional improvement, and between session frequency and reduction in pressure ulcer incidence, supporting the importance of consistent application. The pedagogical methodology, structured in three stages—diagnosis, design and implementation, and evaluation with expert validation—and five integrated components—learning objectives, content, strategies, assessment, and materials—constitutes a viable and contextualized contribution to the development of professional competencies in pressure ulcer management within the Cuban healthcare system.

CONCLUSIONS

The pedagogical methodology developed and validated through expert criteria demonstrated high relevance and applicability in the context of the Cuban health system, with special emphasis on its adaptation to the Camagüeyan context.

BIBLIOGRAPHIC REFERENCES

Borges, E. L., Miranda, A. L. P., Souza, P. O. S., Abreu, M. N. S., & Spira, J. A. O. (2025). Pressure on bony prominences in the dorsal, lateral, and ventral decubitus: a clinical trial. Revista da Escola de Enfermagem da USP, 59, e20250073. https://doi.org/10.1590/1980-220X-REEUSP-2025-0073en

Fratt, E. M., McDonald, A., Hargrave, H., & Sallis, R. (2024). The Perfect Step is the first one: Improving the quality of life for patients with spinal cord injuries through structured exercise. Journal of Spinal Cord Medicine, 47(4), 477–485. https://doi.org/10.1080/10790268.2024.2336276

Gonzabay Muñoz, J. (2024). Un acercamiento interpretativo sobre las ulceras por presión. Revista Cubana de Investigaciones Biomédicas, 43. https://revibiomedica.sld.cu/index.php/ibi/article/view/3546

Gorgey, A. S., Venigalla, S., Deitrich, J. N., Ballance, W. B., Carter, W., Lavis, T., et al. (2025). Electrical stimulation paradigms on muscle quality and bone mineral density after spinal cord injury. Osteoporosis International, 36(6), 1039–1051. https://doi.org/10.1007/s00198-025-07482-5

Gürer, Z., Akansel, N., & Kahraman, N. (2025). Pressure ulcer risk in patients undergoing cardiovascular surgery and their occurrence within 24 hours of the operation. Revista da Escola de Enfermagem da USP, 59, e20250081. https://doi.org/10.1590/1980-220X-REEUSP-2025-0081en

Hidalgo Mas, M. D. R., Kearney, J., Middleton, V., Chiu, C. Y., Duda, J. L., Nightingale, T. E., et al. (2025). Self-directed arm-crank exercise to improve volitional control of the trunk in patients with subacute spinal cord injury: a multicentre, parallel-group, randomised controlled trial protocol. BMJ Open, 15(8), e092226. https://doi.org/10.1136/bmjopen-2024-092226

Jan, Y. K., & Cheung, W. C. (2026). Muscle oxygenation regulation in physical therapy and rehabilitation. Medical Gas Research, 16(1), 66–75. https://doi.org/10.4103/mgr.medgasres-d-24-00149

Lustig, A., Margi, R., Orlov, A., Orlova, D., Azaria, L., & Gefen, A. (2021). La teoría mecanobiológica del desarrollo de úlceras por presión relacionadas con dispositivos médicos revelada a través de un marco de modelado computacional

a escala celular. Biomechanical Model in Mechanobiology, 20(3), 851–860. https://doi.org/10.1007/s10237-021-01432-w

Mijangos Alma Delia Santiago, Jiménez Zuñiga Esther Alice, Pérez Fonseca Martha, Hernández Martínez Amisaday. (2020). CALIDAD DEL CUIDADO DE ENFERMERÍA DESDE EL ENFOQUE DE DONABEDIAN EN PACIENTES HOSPITALIZADOS CON DOLOR. Ciencia y Enfermería, 26, 26. http://dx.doi.org/10.29393/ce26-19ccas40019

Nepomuceno, P., Souza, W. H., Pakosh, M., Musselman, K. E., & Craven, B. C. (2024). Exoskeleton-based exercises for overground gait and balance rehabilitation in spinal cord injury: a systematic review of dose and dosage parameters. Journal of Neuroengineering and Rehabilitation, 21(1), 73. https://doi.org/10.1186/s12984-024-01365-2

Okuji, S., Mikami, Y., Sakurai, Y., Araki, S., Matsuda, T., Yoshioka, I., et al. (2022). Spinal Cord Injury in Middle-aged and Older Adults Who Had Undergone Active Rehabilitation Treatment at a Remote Hospital: A Case Series. Progress in Rehabilitation Medicine, 7, 20220010. https://doi.org/10.2490/prm.20220010

Petrie, M. A., Dudley-Javoroski, S., Johnson, K. A., Lee, J., Dubey, O., & Shields, R. K. (2024). Low-frequency electrically induced exercise after spinal cord injury: Physiologic challenge to skeletal muscle and feasibility for long-term use. Journal of Spinal Cord Medicine, 47(6), 1026–1032. https://doi.org/10.1080/10790268.2024.2338295

Sakai, K., Niimi, M., Momosaki, R., Hoshino, E., Yoneoka, D., Nakayama, E., et al. (2024). Nutritional therapy for reducing disability and improving activities of daily living in people after stroke. Cochrane Database of Systematic Reviews, 8(8), CD014852. https://doi.org/10.1002/14651858.CD014852.pub2

Sepúlveda, P., Gallardo, A., Arriagada, R., González, E., Rocco, P. R. M., & Battaglini, D. (2025). Protocolized strategies to encourage early mobilization of critical care patients: challenges and success. Critical Care Science, 37, e20250128. https://doi.org/10.62675/2965-2774.20250128

Su, P., Lun, Q., Lu, D., Wu, Q., Liu, T., & Zhang, L. (2022). Biomechanical Changes on the Typical Sites of Pressure Ulcers in the Process of Turning Over from Supine Position: Theoretical Analysis, Simulation, and Experiment. Annals of Biomedical Engineering, 50(6), 654–665. https://doi.org/10.1007/s10439-022-02938-9

Viero, C. M., Alves, P. J. P., Munhoz, O. L., Cabral, T. S., Galvão, C. M., Costa, V. Z. D., et al. (2025). Prophylactic dressings for preventing nasal pressure ulcer in premature newborns: an effectiveness review. Revista da Escola de Enfermagem da USP, 59, e20250099. https://doi.org/10.1590/1980-220X-REEUSP-2025-0099en

Wang, Y., Ji, R., & Yu, B. (2024). Assessing the anti-inflammatory effects of whole-body vibration: a meta-analysis based on pre-clinical and clinical evidences. American Journal of Clinical and Experimental Immunology, 13(3), 68–87. https://doi.org/10.62347/LLGY4023

Zhang, X., Zhang, X., Yang, D., Liu, L., Huo, X., & Deng, Z. (2025). Ultrasound monitoring respiratory muscle rehabilitation training can promote the recovery of diaphragmatic function in traumatic spinal cord injury (TSCI) patients. European Journal of Medical Research, 30(1), 733. https://doi.org/10.1186/s40001-025-03023-2

Contribution of the authors:

Conceptualization: Madelin Rodriguez Riscart, Zaily Sources Diaz,

Data curation: Madelin Rodriguez Riscart and Zaily Sources Diaz.

Formal analysis: Madelin Rodríguez Riscart, Orlando Rodríguez Salazar, Irinka Font Rodríguez

Research: Madelin Rodríguez Riscart, Zaily Fuentes Diaz, Irinka Font Rodríguez

Methodology: Madelin Rodríguez Riscart, Irinka Font Rodríguez

Project Management: Madelin Rodríguez Riscart, Zaily Fuentes Diaz.

Resources: Madelin Rodríguez Riscart, Orlando Rodríguez Salazar

Software: Madelin Rodríguez Riscart, Orlando Rodríguez Salazar

Supervision: Madelin Rodríguez Riscart, Zaily Fuentes Diaz

Validation-Verification: Madelin Rodríguez Riscart, Irinka Font Rodríguez.

Visualization: Madelin Rodríguez Riscart, Irinka Font Rodríguez

Original draft written by: Madelin Rodríguez Riscart, Zaily Fuentes Diaz, Irinka Font Rodríguez.

Writing, review and editing: Madelin Rodríguez Riscart, Zaily Fuentes Diaz, Orlando Rodríguez Salazar