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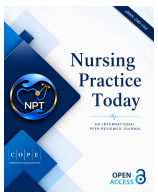

Original Article

Effectiveness of an integrated nursing program on anxiety, uncertainty in illness, and self-care ability among patients undergoing cardiac catheterization: A quasi-experimental study

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ABSTRACT

Background & Aim: Patients undergoing cardiac catheterization commonly experience elevated anxiety, illness uncertainty, and self-care challenges. This study evaluated the effectiveness of an integrated nursing program on anxiety, uncertainty in illness, and self-care ability among patients undergoing first-time cardiac catheterization.

Methods & Materials: A quasi-experimental study with repeated measures was conducted among 60 middle-aged adults (40–65 years) scheduled for first-time cardiac catheterization at a tertiary hospital in Bangkok, Thailand. Participants were consecutively enrolled and allocated using systematic alternating assignment (intervention n=30; control n=30). The intervention comprised a four-phase integrated nursing program based on Mishel's Uncertainty Theory and Orem's Self-Care Theory. Primary outcomes were measured using STAI, MUIS-A, and SCHFI at four time points.

Results: Baseline characteristics revealed no significant differences between groups ($p>0.05$). Mixed ANOVA revealed significant Group × Time interaction effects for all primary outcomes: anxiety [$F(3,174)=39.796$, $p<.001$, $\eta p^2=0.407$], uncertainty in illness [$F(3,174)=13.827$, $p<.001$, $\eta p^2=0.193$], and self-care ability [$F(3,174)=4.485$, $p=.005$, $\eta p^2=0.072$]. The intervention group demonstrated progressive reductions in anxiety and uncertainty in illness alongside sustained improvements in self-care ability. The intervention group experienced fewer complications (3.3% vs. 20.0%, $p=0.044$) and higher satisfaction scores (142.8±6.2 vs. 118.5±8.7, $p<0.001$).

Conclusion: The integrated nursing program effectively reduced anxiety and uncertainty while enhancing self-care ability among cardiac catheterization patients, demonstrating clinical utility for improving perioperative outcomes.

Trial Registration: Thai Clinical Trials Registry (Registration pending - Request No. TCTR 20260210)

Introduction

Cardiovascular disease remains the leading global cause of mortality, accounting for approximately 17.9 million deaths annually (1). Cardiac catheterization has emerged as the gold standard diagnostic and therapeutic intervention for coronary artery disease, with procedural volumes increasing substantially worldwide (2). In Thailand, the Department of Disease Control documented a continuous increase in cardiovascular mortality rates from 62.5 per 100,000 population in 2018 to 71.8 per 100,000 population in 2022 (19). Data from the Heart Association of Thailand reveals a substantial increase in cardiac catheterization procedures from 28,547 cases in 2018 to 42,163 cases in 2022, representing a 47.7% increase (20). Despite technological advances and enhanced safety profiles, patients undergoing cardiac catheterization experience significant psychological distress that can adversely impact clinical outcomes and recovery trajectories.

The psychological response to cardiac catheterization encompasses multiple dimensions, including anxiety, uncertainty about illness progression, and challenges with self-care management. Research establishes that 60-80% of patients scheduled for cardiac catheterization experience moderate to severe anxiety levels, with State-Trait Anxiety Inventory scores significantly exceeding

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general population norms (3). This heightened anxiety response stems from procedural fears, uncertainty in illness, and concerns regarding required lifestyle modifications.

Uncertainty in illness, as conceptualized by Mishel, represents a cognitive state wherein individuals cannot adequately determine the meaning of illness-related events due to insufficient interpretive cues (4). Within the cardiac catheterization context, patients frequently encounter ambiguous symptoms, complex treatment protocols, inconsistent information sources, and unpredictable outcomes. Recent studies document mean uncertainty in illness scores of 87.3±18.7 among cardiac catheterization patients, indicating substantial uncertainty in illness levels persisting throughout the perioperative period (5)

Self-care ability, fundamental to optimal recovery outcomes, encompasses patients' capacity to engage in activities maintaining life, health, and well-being (6). Research indicates that 40-50% of cardiac catheterization patients demonstrate suboptimal self-care behaviors, particularly regarding wound care management, medication adherence, and complication recognition (7). A recent Thai study revealed similar patterns, with 45% of cardiac catheterization patients exhibiting inadequate self-care behaviors, particularly in post-procedural wound management and symptom recognition (21). These self-care deficits contribute to increased readmission rates, prolonged recovery periods, and elevated healthcare utilization.

Conventional nursing interventions have predominantly addressed individual psychological responses in isolation, limiting comprehensive effectiveness. Integrated nursing care approaches, coordinating physical, psychological, and social care dimensions, offer promising solutions for addressing the multifaceted needs of cardiac catheterization patients (8). While systematic reviews demonstrate that integrated nursing interventions can effectively address individual psychological outcomes in cardiac patients (9), existing studies have important limitations. Most interventions address anxiety, uncertainty, or self-care in isolation rather than simultaneously. Furthermore, few studies have employed comprehensive theory-based frameworks integrating both psychological (Mishel's Uncertainty Theory) and behavioral (Orem's Self-Care Theory) dimensions. Additionally, limited research has been conducted in Southeast Asian contexts where cultural factors may influence psychological responses and self-care practices.

This study addresses these gaps by developing and testing a theoretically integrated nursing program that simultaneously addresses anxiety, uncertainty, and self-care ability through a culturally appropriate intervention for Thai patients undergoing cardiac catheterization.

Methods

Study design

This quasi-experimental study employed a non-randomized two-group pretest-posttest design with repeated measures, conducted at a tertiary hospital in Bangkok, Thailand. Participants were allocated to groups using systematic alternating assignment rather than randomization.

Population and sampling

The study population comprised middle-aged adults scheduled for first-time cardiac catheterization at the cardiac unit between March and May 2025. Inclusion criteria encompassed: age 40-65 years; diagnosed with ischemic heart disease; scheduled for first-time cardiac catheterization; mentally capable of providing informed consent; proficient in Thai language communication; having available caregivers for follow-up support; and willingness to participate throughout the study period. Exclusion criteria included: history of psychiatric disorders under treatment; serious post-procedural complications; cognitive or communication impairments; study withdrawal; and loss to follow-up.

Sample size calculation

Sample size calculation utilized Cohen's formula for comparing means between two independent groups, with effect size (Cohen's d) = 0.8, significance level (α)=0.05, power (1-β)= 0.80, and expected dropout rate=15% (10). This calculation yielded 30 participants per group, totaling 60 participants.

Participant allocation

This quasi-experimental study employed non-randomized group allocation. Participants meeting inclusion criteria were consecutively enrolled during the study period (March-May 2025) and allocated to groups using systematic alternating assignment. Specifically, the first eligible participant was assigned to the intervention group, the second to the control group, the third to the intervention group, the fourth to the control group, and this alternating pattern continued sequentially until 30 participants were enrolled in each group. This allocation method was selected due to practical constraints in the clinical setting, ensuring feasibility within routine clinical workflow while maintaining balanced group sizes and comparable baseline characteristics through systematic assignment.

Theoretical framework and intervention development

The integrated nursing program was developed through theoretical synthesis of Mishel's Uncertainty in Illness Theory (4) and Orem's Self-Care Theory (6). Mishel's theory provided the conceptual framework for understanding and addressing patient uncertainty through four components: ambiguity, complexity, inconsistency, and unpredictability. Orem's theory guided self-care capacity development through three key concepts: self-care requisites, self-care agency, and nursing systems.

Intervention protocol

The integrated nursing program was implemented through four distinct phases, each addressing specific patient needs throughout the perioperative continuum.

Phase 1 constituted pre-procedure preparation, conducted 2-4 hours before the scheduled procedure over 60-90 minutes. During this phase, a comprehensive baseline assessment (15 minutes) was performed utilizing standardized instruments to establish individual patient profiles. Structured information delivery (25-30 minutes) was provided through multimedia PowerPoint presentations, systematically covering: procedural steps with anatomical diagrams; insertion site access (femoral or radial approach); expected sensations (pressure, warmth from contrast dye, temporary chest discomfort); procedural duration (45-90 minutes); post-procedural restrictions (bed rest duration, limb immobilization); potential complications and their early warning signs; and recovery timeline expectations. An individualized question-and-answer session (10-15 minutes) allowed patients to express concerns and receive personalized responses addressing specific anxieties or misconceptions. Stress management technique instruction (15-20 minutes) encompassed: diaphragmatic breathing exercises (4-second inhale, 7-second hold, 8-second exhale practiced five cycles); progressive muscle relaxation protocols (systematic tension-release of major muscle groups); and guided imagery sessions utilizing audio recordings of peaceful natural environments. Therapeutic relationship establishment (5-10 minutes) occurred through empathetic communication strategies employing active listening, validation of feelings, and reassurance, fostering trust and rapport between patients and healthcare providers. All materials were provided in the Thai language at a sixth-grade reading level to ensure comprehension across educational backgrounds. Patients received a printed summary booklet containing key information for review.

Phase 2 involved intra-procedure support throughout the entire procedure duration, typically 45-90 minutes. Continuous procedural information provision was maintained, with healthcare providers

explaining each step and anticipated sensations to reduce uncertainty and maintain patient orientation. Emotional support was delivered through consistent reassurance and anxiety-reducing communication techniques, maintaining verbal contact to preserve the therapeutic connection. Relaxation techniques were applied as appropriate, reinforcing pre-procedure training and providing real-time anxiety management support.

Phase 3 encompassed post-procedure care spanning 24-72 hours following the intervention. Systematic wound assessment and care education were implemented through 4-hourly monitoring protocols, ensuring optimal healing conditions and patient education regarding wound management. Individualized self-care plan development was conducted, covering: comprehensive wound care instructions with demonstration; activity restrictions with specific timeframes; medication management protocols; and symptom recognition guidelines (bleeding, hematoma, infection signs) tailored to each patient's specific circumstances. Continuous outcome evaluation facilitated care plan modifications based on evolving patient needs and recovery progress. Discharge preparation included a comprehensive home care instruction review with printed materials, ensuring patients possessed the necessary knowledge and skills for independent post-procedural management.

Phase 4 constituted post-discharge follow-up over seven days, utilizing structured telephone consultations. Follow-up sessions occurred on day three (20-30 minutes) and day seven (15-20 minutes) post-discharge, providing systematic monitoring and support. Symptom and complication assessment was conducted through standardized protocols, enabling early identification of potential issues requiring intervention. Self-care adherence evaluation assessed patient compliance with prescribed instructions and identified areas requiring additional support or clarification. Problem-solving support and counseling were provided to address emerging challenges and maintain patient confidence in self-management capabilities. Continuous emotional support provision ensured patients felt connected to healthcare services throughout their recovery trajectory.

The control group received standard care according to established hospital protocols without these structured intervention components, enabling comparison of outcomes between enhanced and routine care approaches.

Intervention delivery and fidelity

The integrated nursing program was delivered by three registered nurses with minimum five years of cardiac care experience. Prior to study commencement, all interventionists completed a standardized 16-hour training program covering theoretical foundations (Mishel's Uncertainty Theory and Orem's Self-Care Theory), intervention protocols for each phase, communication techniques, and standardized assessment procedures. Intervention fidelity was ensured through multiple mechanisms. First, all interventionists utilized standardized intervention manuals containing detailed scripts, procedural checklists, and timing guidelines for each phase. Second, the principal investigator conducted direct observation of 20% of intervention sessions across all phases using a structured fidelity checklist assessing adherence to protocol components, intervention duration, and quality of delivery. Third, interventionists maintained detailed session logs documenting activities completed, duration, and any deviations from protocol. Monthly team meetings reviewed fidelity data and addressed implementation challenges. Fidelity assessment revealed 95.7% adherence to protocol specifications across all observed sessions, indicating high implementation consistency.

Outcome measures

Data collection utilized six validated instruments:

1. Demographic and Clinical Questionnaire: 32-item researcher-developed instrument assessing participant characteristics (Content Validity Index=1.00)

2. State-Trait Anxiety Inventory (STAI): 20-item instrument measuring state anxiety levels using a 4-point Likert scale (range: 20-80), with higher scores indicating greater anxiety (Cronbach's α= 0.94)

3. Mishel Uncertainty in Illness Scale-Adult (MUIS-A): 33-item instrument assessing illness uncertainty using a 5-point Likert scale (range: 33-165), with higher scores indicating greater uncertainty (Cronbach's α= 0.93)

4. Self-Care of Heart Failure Index (SCHFI): 22-item instrument evaluating self-care ability using a 4-point Likert scale (range: 0-100), with higher scores indicating better self-care ability (Cronbach's α=0.89)

Although the SCHFI was originally developed for heart failure populations, it was selected for this study because the self-care domains assessed self-care maintenance, self-care management, and self-care confidence are directly applicable to cardiac catheterization patients. The instrument evaluates critical post-procedural self-care behaviors including wound site monitoring, symptom recognition, activity modification, medication adherence, and decision-making regarding healthcare-seeking assistance, all of which are essential competencies for optimal recovery following cardiac catheterization. The SCHFI's focus on behavioral competencies rather than disease-specific symptoms makes it suitable for evaluating self-care ability across various cardiac interventions requiring similar post-procedural self-management strategies.

5. Complication Assessment Form: Structured checklist based on American Heart Association guidelines for documenting post-procedural complications (Inter-rater reliability ≥ 0.90)

6. Patient Satisfaction Scale: 30-item instrument adapted from the Patient Satisfaction with Nursing Care Scale, using a 5-point Likert scale (range: 30-150) (Cronbach's α=0.95)

Data collection procedure

Data collection occurred at four time points: T0 (pre-procedure baseline, 45-60 minutes); T1 (24-hour post-procedure, 30-40 minutes); T2 (pre-discharge, 35-45 minutes); and T3 (7-day post-discharge telephone follow-up, 20-30 minutes). A trained research team comprising the principal investigator, research coordinator, three data collection nurses, and two research assistants conducted all assessments following standardized protocols.

Ethical considerations

The study received ethical approval from the Human Research Ethics Committee of North Bangkok University (NS17/2568, March 25, 2025). Written informed consent was obtained from all participants prior to enrollment. Participants were assured of confidentiality, voluntary participation, and the right to withdraw at any time without consequence. Permission for data collection was obtained from the hospital administration prior to study commencement.

Statistical analysis

Data analysis was performed using SPSS version 26. Descriptive statistics included frequencies, percentages, means, and standard deviations for participant characteristics. Distribution normality was assessed using the Shapiro-Wilk test. Categorical variables were analyzed using Fisher's exact test. Primary outcomes were analyzed using Two-Way Repeated Measures ANOVA (Mixed ANOVA), with Group (intervention vs. control) as the between-subjects factor and Time (T0, T1, T2, T3) as the within-subjects factor, to evaluate the main effects of Group, Time, and the Group × Time interaction. Mauchly's Test of Sphericity was conducted prior to each analysis; where the assumption was violated, the Greenhouse-Geisser correction was applied. Effect sizes were reported as partial eta squared (ηp^2), interpreted as small (ηp^2 = 0.01), medium (ηp^2=0.06), and large

(ηp^2=0.14) (10). Statistical significance was set at p< 0.05, two-tailed.

Results

Participant characteristics

All 60 participants completed the study with no attrition. Baseline characteristics showed no significant differences between groups (p>0.05). Mean age was approximately 57 years in both groups (intervention: 56.8±7.2, control: 57.3±6.9, p=0.789), with predominantly male participants (60.0% intervention, 53.3% control, p=0.542). Educational levels and comorbidity prevalence (diabetes, hypertension, hyperlipidemia) were similarly distributed between groups (all p>0.05), confirming comparable baseline characteristics.

Primary outcomes

Two-Way Repeated Measures ANOVA (Mixed ANOVA) was conducted to examine the main effects of Group, Time, and the Group × Time interaction for each primary outcome across four time points (T0: pre-procedure, T1: 24-hour post-procedure, T2: pre-discharge, T3: 7-day post-discharge).

Anxiety levels

Table 1 illustrates significant anxiety reduction in the intervention group compared to controls across all post-intervention time points. The intervention group exhibited continuous anxiety score decreases from baseline (67.8±8.4) to 7-day follow-up (42.1±6.9), while the control group manifested minimal change (68.2±7.9 to 59.3±8.2). Mauchly's Test of Sphericity indicated that the sphericity assumption was met (W = 0.708, p=.089). Mixed ANOVA revealed a statistically significant Group×Time interaction effect [F(3, 174) = 39.796, p< .001, ηp^2 = 0.407], indicating that anxiety reduction differed significantly between groups over time. The main effects of Group [F(1, 58)=65.307, p<.001, ηp^2=0.530] and Time [F(3,174)=126.193, p<.001, ηp^2 = 0.685] were both significant with large effect sizes.

Uncertainty in illness

The intervention group demonstrated significantly greater uncertainty reduction compared to controls (Table 2). Uncertainty scores decreased substantially from baseline (102.4±15.8) to follow-up (65.2±12.1) in the intervention group, while control group reduction remained minimal (103.1±14.9 to 89.7±13.6). Between-group differences attained statistical significance at all post-intervention assessments (p < .001). Mauchly's Test of Sphericity indicated a violation of the sphericity assumption (W = 0.329, p < .001); therefore, the Greenhouse-Geisser correction was applied (ε=0.768). Mixed ANOVA revealed a statistically significant Group × Time interaction effect [F(3, 174)=13.827, p<.001, ηp^2= 0.193], indicating that patterns of uncertainty reduction differed significantly between groups over time. The main effects of Group [F(1, 58)= 58.405, p< .001, ηp^2= 0.502] and Time [F(3, 174) = 41.391, p< .001, ηp^2 = 0.416] were both significant with large effect sizes.

Table 1. Anxiety score comparisons between groups (N = 60)

Time Point	Intervention Group (n=30)	Control Group (n=30)	Mean Difference	95% CI (LB, UB)	p-value
	Mean ± SD	Mean ± SD			
T0: Pre-procedure	67.8 ± 8.4	68.2 ± 7.9	-0.40	(-3.00, 3.13)	0.852
T1: 24h post-procedure	54.3 ± 7.2	63.1 ± 8.6	-8.40	(-11.71, -5.09)	< .001***
T2: Pre-discharge	48.7 ± 6.8	61.4 ± 7.8	-15.30	(-19.13, -11.47)	< .001***
T3: 7-day follow-up	42.1 ± 6.9	59.3 ± 8.2	-19.23	(-22.80, -15.65)	< .001***

*p < .05, **p < .01, ***p < .001. Independent t-test at each time point. Mixed ANOVA: Group [F(1, 58) = 65.307, p < .001, ηp^2 = 0.530]; Time [F(3, 174) = 126.193, p < .001, ηp^2 = 0.685]; Group × Time interaction [F(3, 174) = 39.796, p < .001, ηp^2 = 0.407]. Mauchly's W = 0.708, p = .089 (sphericity assumption met). Abbreviations: CI = confidence interval; LB = lower bound; UB = upper bound.

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The intervention group demonstrated significantly greater uncertainty reduction compared to controls (Table 2). Uncertainty scores decreased substantially from baseline (102.4±15.8) to follow-up (65.2±12.1) in the intervention group, while control group reduction remained minimal (103.1±14.9 to 89.7±13.6). Between-group differences attained statistical significance at all post-intervention assessments (p< .001). Mauchly's Test of Sphericity indicated a violation of the sphericity assumption (W = 0.329, p < .001); therefore, the Greenhouse-Geisser correction was applied (ε=0.768). Mixed ANOVA revealed a statistically significant Group×Time interaction effect [F(3,174)=13.827, p<.001, ηp^2=0.193], indicating that patterns of uncertainty reduction differed significantly between groups over time. The main effects of Group [F(1, 58)=58.405, p<.001, ηp^2= 0.502] and Time [F(3,174)=41.391, p<.001, ηp^2=0.416] were both significant with large effect sizes.

Table 2. Uncertainty in illness score comparisons between groups (N = 60)

Time Point	Intervention Group (n=30)	Control Group (n=30)	Mean Difference	95% CI (LB, UB)	p-value
	Mean ± SD	Mean ± SD			
T0: Pre-procedure	102.4 ± 15.8	103.1 ± 14.9	-0.70	(-8.26, 6.86)	0.864
T1: 24h post-procedure	86.7 ± 12.3	98.2 ± 13.7	-11.50	(-17.92, -5.08)	< .001***
T2: Pre-discharge	76.5 ± 11.8	93.8 ± 12.9	-17.30	(-23.39, -11.21)	< .001***
T3: 7-day follow-up	65.2 ± 12.1	89.7 ± 13.6	-24.50	(-30.85, -18.15)	< .001***

*p < .05, **p < .01, ***p < .001. Independent t-test at each time point. Mixed ANOVA with Greenhouse-Geisser correction: Group [F(1, 58) = 58.405, p < .001, ηp^2 = 0.502]; Time [F(3, 174) = 41.391, p < .001, ηp^2 = 0.416]; Group × Time interaction [F(3, 174) = 13.827, p < .001, ηp^2 = 0.193]. Mauchly's W = 0.329, p < .001 (sphericity violated, ε = 0.768). Abbreviations: CI = confidence interval; LB = lower bound; UB = upper bound.

Self-care ability

Self-care ability exhibited marked improvement in the intervention group relative to controls (Table 3). Intervention group scores increased from baseline (54.3±10.2) to follow-up (84.7±8.9), while control group improvement remained modest (55.1±9.8 to 62.8±11.3). Between-group differences established statistical significance at all post-intervention time points (p< .001). Mauchly's Test of Sphericity indicated a violation of the sphericity assumption (W= 0.351, p< .001); therefore, the Greenhouse-Geisser correction was applied (ε= 0.857). Mixed ANOVA revealed a statistically significant Group × Time interaction effect [F(3,174)=4.485, p=.005, ηp^2 = 0.072], indicating that the rate of self-care improvement differed significantly between groups over time. The main effects of Group [F(1, 58) = 48.929, p< .001, ηp^2= 0.458] and Time [F(3, 174)= 35.343, p< .001, ηp^2 =0.379] were both significant with large effect sizes.

Table 3. Self-care ability score comparisons between groups (N = 60)

Time Point	Intervention Group (n=30)	Control Group (n=30)	Mean Difference	95% CI (LB, UB)	p-value
	Mean ± SD	Mean ± SD			
T0: Pre-procedure	54.3 ± 10.2	55.1 ± 9.8	-0.80	(-6.02, 4.42)	0.758
T1: 24h post-procedure	68.9 ± 8.7	58.4 ± 9.5	+10.50	(6.35, 14.65)	< .001***
T2: Pre-discharge	76.2 ± 9.1	60.7 ± 10.2	+15.50	(10.75, 20.25)	< .001***
T3: 7-day follow-up	84.7 ± 8.9	62.8 ± 11.3	+21.90	(16.86, 26.94)	< .001***

*p < .05, **p < .01, ***p < .001. Independent t-test at each time point. Mixed ANOVA with Greenhouse-Geisser correction: Group [F(1, 58) = 48.929, p < .001, ηp^2 = 0.458]; Time [F(3, 174) = 35.343, p < .001, ηp^2 = 0.379]; Group × Time interaction [F(3, 174) = 4.485, p = .005, ηp^2 = 0.072]. Mauchly's W = 0.351, p < .001 (sphericity violated, ε = 0.857). Abbreviations: CI = confidence interval; LB = lower bound; UB = upper bound.

Secondary outcomes

Complications and patient satisfaction

The intervention group experienced significantly fewer total complications compared to controls (3.3% vs. 20.0%, p=0.044), with specific reductions in hematoma formation and wound bleeding (Table 5). Patient satisfaction scores were significantly elevated in the intervention group (142.8±6.2 vs. 118.5±8.7, p<0.001).

Table 4. Complications and satisfaction comparisons (n=60)

Outcome	Intervention Group (n=30)	Control Group (n=30)	p-value
Complications, n (%)			
Hematoma	1 (3.3)	4 (13.3)	0.169†
Bleeding at insertion site	0 (0.0)	2 (6.7)	0.492†
Infection	0 (0.0)	1 (3.3)	1.000†
Total complications	1 (3.3)	6 (20.0)	0.044†
Satisfaction score, mean ± SD	142.8 ± 6.2	118.5 ± 8.7	<0.001*

**Independent t-test; †Fisher's exact test*

Discussion

This quasi-experimental study establishes that a theoretically-grounded integrated nursing program effectively reduces anxiety and uncertainty in illness while significantly enhancing self-care ability among patients undergoing cardiac catheterization. The intervention's multidimensional approach addresses critical gaps in perioperative cardiac care through systematic application of established nursing theories.

This study makes several important contributions to the field. First, it demonstrates the feasibility and effectiveness of integrating two complementary nursing theories (Mishel's Uncertainty in Illness Theory and Orem's Self-Care Theory) into a single intervention protocol—an approach rarely reported in previous literature. Second, it provides evidence that comprehensive perioperative support can simultaneously address multiple psychological and behavioral outcomes (anxiety, uncertainty, and self-care) rather than targeting them in isolation, as most previous interventions have done. Third, it extends the evidence base for integrated nursing interventions to a Southeast Asian context, demonstrating cultural applicability and effectiveness in Thai patients. Finally, the large effect sizes observed across all outcomes confirm the clinical significance of the intervention, with Group × Time interaction effects demonstrating that improvements were sustained and progressive across all four measurement points.

The substantial anxiety reduction observed corroborates previous research demonstrating the effectiveness of comprehensive nursing interventions (11). This reduction can be attributed to the program's systematic approach to uncertainty management through comprehensive information provision, skill development for stress management, and continuous emotional support throughout the perioperative period.

According to the Gate Control Theory, anxiety reduction occurs when cognitive and emotional interventions compete with pain and anxiety pathways, effectively diminishing the perception of distress (12). The integration of relaxation techniques, guided imagery, and therapeutic communication likely activated these competing pathways, resulting in sustained anxiety improvement.

The marked decrease in uncertainty substantiates Mishel's theoretical framework, which posits that uncertainty reduction occurs through enhancing symptom pattern clarity, providing predictable treatment information, and improving social support (4). This comprehensive approach to uncertainty management distinguishes our intervention from previous studies that typically addressed only one or two uncertainty components.

The sustained reduction through 7-day follow-up suggests that the intervention's effects extend beyond the immediate perioperative period, potentially due to patients developing cognitive frameworks for interpreting their illness experience. This finding contrasts with studies using single-session educational interventions, which typically show diminishing effects over time.

Self-care ability improvement aligns with Orem's theoretical predictions while demonstrating the synergistic benefit of combining self-care theory with uncertainty management (6). The individualized self-care planning, skill demonstration, and follow-up reinforcement likely enhanced patients' confidence and competence in managing their post-procedural care requirements. Notably, previous studies using Orem's theory alone typically report small-to-medium effect sizes for self-care outcomes; the effect sizes observed in this study may reflect the synergistic benefit of dual-theory integration, where reducing uncertainty simultaneously enhanced patients' self-care agency. This suggests that psychological readiness (low uncertainty, low anxiety) may be a prerequisite for effective self-care behavior adoption, a mechanism warranting further investigation.

The significant reduction in complications provides empirical support for the theoretical connection between psychological and physiological outcomes. This finding substantiates the relationship between psychological well-being and physiological recovery, suggesting that anxiety and uncertainty reduction may contribute to improved immune function and wound healing processes (13). More importantly, this result demonstrates that integrated psychological-behavioral interventions can produce tangible clinical benefits beyond symptom relief, potentially reducing healthcare costs through decreased complication rates. Given that post-catheterization complications extend hospital stays and increase readmission rates, the intervention's protective effect represents substantial clinical value.

Elevated patient satisfaction scores reflect the intervention's person-centered approach and comprehensive care delivery. Satisfaction enhancement occurred through multiple mechanisms, including adequate information provision, active participation in care planning, emotional support, and perceived competence in self-care management. These factors collectively contributed to positive care experiences and increased confidence in healthcare providers.

The theoretical integration of Mishel's and Orem's theories proved effective in creating a comprehensive intervention addressing multiple patients' needs simultaneously. This approach represents an advancement over single-theory interventions by providing a more holistic framework for understanding and addressing the complex psychological responses to cardiac catheterization.

These findings support implementing integrated nursing programs in cardiac catheterization units to optimize patient outcomes. The intervention's standardized protocols and theoretical grounding facilitate replication across different clinical settings. Healthcare administrators should consider resource allocation for nursing education and program implementation to achieve these beneficial outcomes. Nursing education programs should emphasize theoretical integration skills and comprehensive assessment approaches to prepare nurses for delivering complex interventions. The intervention's success demonstrates the value of theory-guided practice in achieving superior patient outcomes compared to routine care approaches. These findings align with a growing body of evidence supporting non-pharmacological nursing interventions for improving patient outcomes in cardiac care settings. For instance, a recent randomized controlled trial published in Nursing Practice Today demonstrated that environmental nursing interventions significantly improved sleep quality among cardiac intensive care unit patients, further underscoring the clinical value of nurse-initiated approaches in this population (22).

Study limitations

Several limitations warrant consideration. The single-site design may limit generalizability to other healthcare settings with different patient populations or care delivery models. The 7-day follow-up period, while appropriate for assessing immediate outcomes, may be insufficient for evaluating long-term intervention effects on self-care behavior maintenance and clinical outcomes. The quasi-experimental design, while practical for clinical settings, lacks the rigor of randomized controlled trials and may introduce selection bias. The inability to blind participants and care providers to the intervention may have influenced outcome reporting, particularly for self-report measures. Future research should employ multi-site randomized controlled trials with extended follow-up periods to strengthen evidence quality.

Conclusion

This study establishes that a theoretically integrated nursing program significantly reduces anxiety and uncertainty in illness while improving self-care ability among patients undergoing cardiac catheterization. The intervention addresses critical gaps in perioperative cardiac care through systematic application of nursing theory principles. The observed improvements in psychological outcomes, reduced complications, and enhanced patient satisfaction substantiate the intervention's clinical utility and potential for widespread implementation in cardiac care settings.

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Conflicts of interest

The authors declare no conflicts of interest regarding this study.

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