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Psychometric Evaluation of the Thai Version of the Self-Care of Chronic Illness Inventory in Patients With Postcardiac Surgery

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Background: Self-care is vital for recovery and long-term health in postcardiac surgery patients. The Self-Care of Chronic Illness Inventory Version 4.c (SC-CII-V4c) is widely used to assess self-care, but the psychometric properties in these patients remain underexplored. **Objective:** The aim of this study was to evaluate psychometric properties of the SC-CII-V4c in Thai post cardiac surgery. **Methods:** A cross-sectional study was conducted with 200 patients who underwent cardiac surgery at a tertiary care hospital in Thailand. The Thai SC-CII-V4c, assessing self-care across 3 domains, was administered. Psychometric testing involved exploratory and confirmatory factor analysis for structural validity. Internal reliability was estimated with Cronbach α, McDonald's ω, and composite reliability. Measurement error analysis was performed to evaluate scale precision. **Results:** Exploratory factor analysis confirmed factor solutions with sufficient correlations for analysis. Confirmatory factor analysis demonstrated structural validity with good model fit for unidimensional Self-Care Maintenance, unidimensional Self-Care Monitoring, and bidimensional Self-Care Management scales. The Self-Care Maintenance structure and items allocations in the Self-Care Management dimensions differed from the previous US and Thai models. A simultaneous model combining all items supported the first-order structure, whereas the second-order model had partial support. Internal reliability was adequate across all scales (α = .86–.90, ω = 0.86–0.90; composite reliability, 0.85–0.90). Measurement error analysis demonstrated thresholds for meaningful score change. **Conclusions:** The SC-CII-V4c is valid, reliable, and suitable for clinical practice and research to address self-care maintenance, monitoring, and management in Thai postcardiac surgery.

KEY WORDS: cardiac surgery, heart disease, self-care

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The data sets used and analyzed during the current study are available from the corresponding author upon reasonable request.

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Cardiovascular disease remains a leading cause of death and disability globally. In Thailand, both acquired (eg, coronary artery disease, valvular heart disease) and congenital (eg, atrial septal defect) heart disease are increasing.[1,2] Effective management includes medication, surgery, and continuum care. Cardiac surgeries, such as coronary artery bypass grafting and valve repairs, have been successfully performed in Thai university hospitals since 1953, expanding access to specialized care over the decades.[3] The first national statistics reported within the last decade show most surgeries are 43% coronary artery bypass grafting and 38% valve surgery.[4] Despite limited recent data, expert consensus suggests continued growth in cardiac surgeries, particularly in adult cardiac, congenital, and aortic procedures.[5]

Patients postcardiac surgery face challenges in adopting lifestyle modifications, adhering to medical regimens, and managing symptoms.[6] Managing complications such as renal failure, dysrhythmia, bleeding, chronic pain, anxiety, and depression is critical for recovery.[7–10] Self-care plays a vital role in cardiac rehabilitation, requiring patients to develop strategies suited to their new circumstances postoperative.[11] Defined as a naturalistic decision-making process for optimizing health and well-being, self-care consists of 3 key elements: self-care maintenance, monitoring, and management.[12–14] Self-care maintenance contains health-promoting behaviors (eg, avoiding sickness, maintaining a healthy diet) to preserve overall health and illness-related behaviors (eg, taking medications, attending routine clinical visits) to manage specific chronic conditions. Self-care monitoring focuses on recognizing changes in conditions, such as the onset of symptoms, signs of worsening illness, medication adverse effects, or treatment complications. Addressing these changes is the core of self-care management, which encompasses taking actions to handle symptoms. Together, these elements are essential for long-term recovery after cardiac surgery.

To track self-care postcardiac surgery, a valid instrument is essential for clinicians to support rehabilitation and long-term care. Such instruments can enhance outcomes by ensuring appropriate support for recovery and lifetime management of cardiac conditions. Recently, 2 forms of theory-based self-care instruments have become available for patients with cardiovascular diseases. The first and most recognized disease-specific instrument is the Self-Care of Heart Failure Index.[15–19] Later, the Self-Care of Hypertension Inventory[20,21] and the Self-Care of Coronary Heart Disease Inventory[22,23] were developed, all derived from the parent theories of chronic illness self-care.[12,24] On the other hand, the Self-Care of Chronic Illness Inventory and its updated version (SC-CII-V4c) serve as a non–disease-specific measure.[25] The developers designed them for patients with any chronic condition, particularly those with multiple chronic conditions. These instruments have been translated into various languages and undergone psychometric testing in both non–disease specific[26,27] and disease specific.[28] However, there is no evidence yet applying them to postcardiac surgery patients. This gap underscores the need for further research to evaluate their effectiveness in this population.

Promoting self-care through behavior change and education is central to cardiovascular disease prevention and rehabilitation.[29,30] Cardiac rehabilitation addresses the underlying causes of cardiovascular disease while optimizing physical, mental, and social well-being. Encouraging self-responsibility can slow or reverse disease progression through improved health behaviors.[30] Long-term rehabilitation and secondary prevention require adopting healthy behaviors and self-care skills.[31] Both cardiac rehabilitation and self-care emphasize the importance of individuals' actions in achieving health goals. Key health behaviors, including healthy eating, physical activity, stress management, medication adherence, and smoking cessation, are linked to better health outcomes.[6,29] Aerobic or physical exercise programs can improve cardiopulmonary function, such as increased peak oxygen consumption, greater 6-minute walk distance, and lower resting heart rate.[32] Comprehensive cardiac rehabilitation combining behavior change and educational support accelerates recovery in the first weeks post coronary artery bypass grafting or plus valve procedures and reduces all-cause mortality by 20% to 86% over 2 to 9 years of follow-up.[33] Various cardiac rehabilitation approaches, including exercise training, home-based programs, and telemonitored interventions, consistently improve health-related quality of life and physiological outcomes.[34] Effective stress management techniques, such as relaxation, mindfulness, and counseling, reduce anxiety and emotional distress while enhancing coping. Integrating these psychosocial supports into cardiac rehabilitation and self-care programs fosters physical and mental recovery, promoting holistic patient care after cardiac surgery.[31]

Given that comprehensive cardiac rehabilitation should prioritize self-care to maximize long-term outcomes, a credible instrument to tailor self-care interventions and monitor progress is essential. Adult patients undergoing cardiac surgery typically present with comorbidities, adding complexity to their care. Among existing instruments, the SC-CII-V4c seems particularly suitable for this population.[25] Previous research has validated its applicability in Thai patients with specific conditions, such as stroke.[28] Its structural validity aligns with theoretical foundations, effectively measuring self-care maintenance, monitoring, and management. The SC-CII-V4c also demonstrates adequate internal consistency and test-retest reliability across its 3 scales, reinforcing its relevance for diverse populations overall. Hence, in this study, we expand knowledge

on the applicability of this generic self-care instrument in postcardiac surgery patients.

Aim

Our aim was to evaluate the psychometric properties of the SC-CII-V4c in Thai postcardiac surgery. Specifically, we assessed its structural validity, internal consistency reliability, and measurement error.

Methods

Study Design

This methodological research used a cross-sectional, single-center study in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology guidelines.[35] We collected data between April and August 2024.

Study Settings and Participants

Participants were enrolled using convenience sampling. Inclusion criteria were as follows: (*a*) adults 18 years or older, (*b*) postcardiac surgery for at least 3 months, and (*c*) nonhospitalized patients attending follow-up at a cardiac care clinic. Eligible participants included those who underwent open or closed heart surgeries, such as coronary artery bypass grafting, valve repair or replacement, ventricular septal defect closure, and thoracic aneurysm repair. All patients scheduled for follow-up in the cardiac care clinic who met the inclusion criteria were considered eligible. No additional exclusions were made based on clinical or demographic characteristics, ensuring a representative sample.

To meet factor analysis requirements, a targeted sample size of 200 participants was chosen. Although no universal standard exists, recommendations suggest a range of 150 to 1000 participants.[36] Our sample size met the recommended maximum item-to-sample ratio of 1 per 20, ensuring robust psychometric evaluation.

The study was conducted at a tertiary referral and teaching hospital in Surat Thani Province, Thailand, one of the first public health sector facilities to provide advanced cardiac care and surgery. Since 2005, approximately 2740 cardiac surgeries have been performed, serving patients across the southern region. According to the hospital statistics report (unpublished, 2024), 1099 cardiac surgeries were completed between 2019 and 2024, with annual cases ranging from 138 to 285.

Measurements

Self-Care of Chronic Illness Inventory Version 4.c

The 19-item SC-CII-V4c[25] was translated and cross-culturally adapted into Thai and successfully applied to populations with general chronic conditions[26] and stroke.[28] It is widely recognized as a generic self-care measure for patients with multiple chronic conditions.[37–40] The 7-item Self-Care Maintenance scale assesses behaviors related to health promotion and illness management. The 5-item Self-Care Monitoring scale assesses recognition of worsened conditions and signs and symptoms. The 7-item Self-Care Management scale assesses symptoms management behaviors. Items are rated on a 5-point ordinal scale. The Self-Care Maintenance and Self-Care Monitoring scales ask, "How often or routinely do you do the following?" with responses ranging from never to always. The Self-Care Management scale asks, "How likely are you to use one of these?" with responses ranging from not likely to very likely. The Self-Care Management scale includes 2 items with a score of 0 option: item 13 ("I did not recognize the symptom") and item 19 ("I did not do anything to manage symptoms"). Higher scores indicate better self-care, with theoretical scores of 4 and 5 representing adequate self-care.[25]

The Thai SC-CII-V4c's validity and reliability have been established in patients with generic chronic conditions[26] and stroke.[28] Structural validity is supported by multifaced fit indices, although item allocation differs from the original US model. Particularly, in the Self-Care Maintenance scale, health promotion behaviors (items 1–4 and 7) and illness-related behaviors (items 5 and 6) varied. The Self-Care Management scale showed differences in autonomous behaviors (items 13–15 and 19) and consulting behaviors (items 16–18) compared with the US model. Internal consistency reliability was established with McDonald ω (Self-Care Maintenance, 0.65–0.67; Self-Care Management, 0.75–0.78) and composite reliability (Self-Care Maintenance, 0.79–0.80; Self-Care Management, 0.82–0.83). Cronbach α for the Self-Care Monitoring scale (0.83–0.86) indicated good internal reliability. Test-retest reliability was adequate for each scale, with intraclass correlation coefficients from 0.76 to 0.90.

Participants Characteristics Form

Participants were asked to complete a sociodemographic and clinical data form. Sociodemographic variables included age, gender, education, marital status, employment, and household income. Clinical data included details on cardiac conditions, cardiac surgery procedures, time since surgery, and comorbidities. An investigator verified clinical data through electronic medical records.

Data Collection

Data collection occurred during routine clinical visits using a paper-and-pencil survey package. A research coordinator, a nurse from the cardiac outpatient clinic, identified eligible participants and asked about their interest in the study. The principal investigator and the first author (N.K.) provided informed consent and research details. Survey completion was overseen by the

principal investigator and 3 nurse research assistants, all thoroughly briefed on the study protocol and fieldwork procedures for data collection.

Ethical Considerations

Before data collection, approval was obtained from both the institutional review board of Boromarajonani College of Nursing Nakhonsithammarat (approval no. E-03/2567) and Suratthani Hospital, Thailand (approval no. REC 67-0030). The study adhered to the Declaration of Helsinki. Participants gave written consent before completing the survey. Ethical safeguards included secure data handling, voluntary participation, the right to withdraw, access to routine care, discussions of risk and benefits, and confidentiality.

Data Analysis

Data analysis proceeded in 4 steps. First, descriptive statistics were generated for patient characteristics and item scale descriptions, including frequencies (%), means, and standard deviations (SDs). All items were normally distributed with skewness and kurtosis $\leq |1.00|$.[41] Although 15 outliers were identified using Mahalanobis distance, all were retained to maintain a minimal sample size and avoid unstable estimates and reduced statistical power. Raw scores for the 3 scales and overall SC-CII-V4c were standardized to a 0-to-100 scale for comparability.[25]

Second, we assessed the structural validity. Exploratory factor analysis was performed on the first split-half subsample (n = 98) to identify factorial structure, followed by confirmatory factor analysis on the full sample (n = 200). This cross-validation procedure has been applied in previous self-care measure studies.[25,42] However, confirmatory factor analysis was not conducted with the second split-half subsample (n = 102) because of its small sample size. Given the normal distribution of items, we used the maximum likelihood estimator for both exploratory and confirmatory factor analyses.[43] We finalized the factorial structure through exploratory factor analysis with varimax rotation, retaining factors with an eigenvalues $\geq$ 1.00. The Kaiser-Meyer-Olkin of 0.60 and a significant Bartlett test ($P < .001$) supported the suitability of the correlation matrix for factor analysis.[44] The model fit for confirmatory factor analysis was assessed using multifaceted goodness-of-fit indices with the following minimal threshold values.[45–47] Comparative fit index (CFI) and Tucker-Lewis index (TLI) $\geq$ 0.90 indicate acceptable fit, with $\geq$0.95 considered excellent.[48,49] Root-mean-square error of approximation (RMSEA) $\leq$ 0.80 reflects adequate fit, whereas $\leq$0.05 indicates excellent fit, emphasizing the model's alignment with the population covariance structure.[50] In addition, the values along with a nonrejection of the null hypothesis in its 90% confidence interval (CI) and $P > .05$ further support model appropriateness. Similarly, standardized root-mean-square residual (SRMR) $\leq$ 0.80 is acceptable, and $\leq$0.05 indicates a superior fit.[47] We reported the χ^2 test for completeness but did not use it for interpretation because of its sensitivity to a large sample size.[25]

Third, internal consistency reliability was assessed using the full sample (n = 200), applying methods appropriate to the scale's dimensional structure[51] as determined by the final first- or second-order factor model. We used the global reliability index,[52] including McDonald ω[53] and composite reliability.[54] These coefficients estimate the proportion of variance in observed scores attributable to the underlying latent construct, providing a more accurate reliability measure than Cronbach α, particularly for multidimensional scales. In addition, these methods account for model structures that include residual covariance adjustment. Cronbach α coefficient, although traditionally used for the unidimensional scales,[51] was also reported for completeness and ease of comparison with previous studies. Thus, we present Cronbach α for each scale and overall instrument. All reliabilities were expected to exceed 0.70, indicating acceptable reliability.[55]

Finally, measurement error was assessed using the full sample (n = 200) through the standard error of measurement and the smallest detectable change.[56] These approaches have been successfully applied by investigators evaluating relevant self-care measures.[42] The standard error of measurement was calculated using SD $\times \sqrt{(1 - \text{reliability coefficient})}$, where SD represents the reliability corresponding to Cronbach α.[56] A standard error of measurement value lower than SD/2 suggests that the instrument is precise.[57] The smallest detectable change was determined by $1.96 \times \sqrt{2} \times \text{SEM}$, where the smallest detectable change represents the minimum number of points on the SC-CII-V4.c, which are considered clinically meaningful.[57]

In addition, to evaluate the robustness of the psychometric findings, a sensitive analysis was performed using a reduced sample that excluded identified outlier cases (n = 185). Exploratory factor analysis was conducted on the first split-half subsample (n = 94), whereas confirmatory factor analysis and internal reliability were evaluated using the full sample (n = 185).

SPSS Statistics version 28.0 was used for the descriptive statistics and exploratory factor analysis, and AMOS version 24.0 was used for the confirmatory factor analysis.

Results

Participants Characteristics

The participants (n = 200) were predominantly adults younger than 65 years, with 52.5% men and 47.5% women (Table 1). About one-third completed secondary school or

TABLE 1 Sociodemographic and Clinical Characteristics of the Participants (N = 200)

Characteristic	M ± SD or Md (IQR)	Frequency	%
Age, y	56.09 ± 11.66		
Adults < 65 y		149	74.5
Gender, men		105	52.5
Education			
Primary school or lower		125	62.5
Secondary or high school		62	31.0
College or higher		13	6.5
Marital status			
No spousal or never married		80	40.0
Spousal		120	60.0
Living arrangement			
Alone		27	13.5
With a small family		60	30.0
With a large family		113	56.5
Work status			
Homemaker or unemployed		60	30.0
Working with irregular income		91	45.5
Working with regular income		49	24.5
Household income			
Insufficient to meet end needs		83	41.5
Sufficient to meet end needs		54	27.0
Comfortable to meet end needs		63	31.5
Chronic diseases			
Heart disease		200	100
Hypertension		99	49.5
Diabetes		57	28.5
Stroke		15	7.5
Chronic kidney disease		11	5.5
Chronic respiratory disease		24	12.0
Chronic joint pain		12	6.0
Chronic liver disease		3	1.5
Cancer		7	3.5
No. chronic diseases, total	2 (1, 3)		
No. chronic diseases ≥ 2		111	55.5
Duration since cardiac surgery, mo	18 (12, 27)		

Participants could select multiple categories of chronic diseases. Chronic respiratory diseases include chronic obstructive pulmonary disease and asthma.
Abbreviations: IQR, interquartile range; M, mean; Md, median.

higher, and worked with regular income. Two-thirds had a spouse, lived with family, and had sufficient income. Most had 2 chronic diseases, commonly hypertension and diabetes. The average duration since cardiac surgery was 18 months.

Items Descriptive

Table 2 presents item descriptives with all items normally distributed (skewness and kurtosis < |1|).[41] Items 6 (Take prescribed medicines) and 12 (Monitor for symptoms) met the expected score of 4.00 for adequate self-care, whereas other items were near the theoretical score. Items 4 (Eat healthy foods) and 13 (How quickly did you recognize it as a symptom) had the lowest scores. Mean raw and standardized scores indicated adequate self-care across domains: Self-Care Maintenance (26.31 ± 5.35/35; 75.18 ± 15.29/100), Self-Care Monitoring (19.26 ± 3.74/25; 77.04 ± 14.98/100), Self-Care Management (25.73 ± 5.12/35; 73.36 ± 14.45/100), and overall SC-CII-V4.c (71.30 ± 12.39/95; 75.19 ± 12.96/100).

Structural Validity

Factor loadings from exploratory and confirmatory factor analyses are shown in Table 2, with fit indices for structural testing of each scale in Table 3. Simultaneous model testing results are illustrated in the Figure, with further details in Appendixes A to D (http://links.lww.com/JCN/A356).

Self-Care Maintenance Scale

Exploratory factor analysis on the split-half subsample (n = 98) revealed a 1-factor structure, with satisfactory model adequacy (Kaiser-Meyer-Olkin, 0.83; Bartlett $P < .001$), explaining 48.51% of the variance. Items had moderate to high factor loadings (0.62–0.78) and significant correlations ($n^2 = 0.39–0.61$) (Table 2). Confirmatory factor analysis on the full sample (n = 200) initially showed inadequate fit (Table 3, Model A1), requiring residual covariances adjustment (items 1 and 2, 3 and 5, and 5 and 6). The modification model showed good fit: $\chi^2(11, n = 200) = 20.29$, $P < .041$, CFI = 0.98, TLI = 0.97, RMSEA = 0.06 (90% CI, 0.01–0.10), $P = .254$, and SRMR = 0.03. Factors loadings ranged from 0.56 to 0.77 (Appendix A, http://links.lww.com/JCN/A356).

Self-Care Monitoring Scale

Exploratory factor analysis on the split-half subsample (n = 98) identified a 1-factor structure, with satisfactory model adequacy (Kaiser-Meyer-Olkin, 0.81; Bartlett $P < .001$), explaining 62.31% of the variance. Items demonstrated moderate to high factor loadings (0.69–0.87) and significant correlations ($n^2 = 0.48–0.77$) (Table 2). Confirmatory factor analysis on the full sample (n = 200) initially showed good fit, except for RMSEA (Table 3, Model B1). Adjusting residual covariances (items 8 and 9) improve the model to a perfect fit: $\chi^2(4, n = 200) = 5.56$, $P < .234$, CFI = 0.99, TLI = 0.99, RMSEA = 0.04 (90% CI, 0.00–0.12), $P = .458$, and SRMR = 0.02. Factor loadings ranged from 0.68 to 0.92 (Appendix B, http://links.lww.com/JCN/A356).

Self-Care Management Scale

Exploratory factor analysis on the split-half subsample (n = 98) identified a 2-factor structure with adequacy data (Kaiser-Meyer-Olkin, 0.78; Bartlett $P < .001$), explaining 67.2% of the variance—36.3% from the Autonomous dimension (items 14–17) and 30.7%

TABLE 2 Factor Loadings From Exploratory Factor Analysis and Confirmatory Factor Analysis, Item-Total Corrected Correlation, and Means and Standard Deviations of Individual Items in the Self-Care of Chronic Illness Inventory Version 4.c in Thai PostCardiac Surgery

Self-Care of Chronic Illness Inventory Version 4.c	Exploratory Factor Analysis (n = 98)		Confirmatory Factor Analysis (n = 200)	Item-Total Corrected Correlation	M ± SD	Skewness	Kurtosis
	Loadings	h^2	Loadings				
Self-Care Maintenance scale							
1. Make sure to get enough sleep.	0.67	0.45	0.70	0.64	3.56 ± 1.10	−0.33	−0.77
2. Try to avoid getting sick (eg, get vaccinated, wash your hands, wear a mask, maintain distance from sick people, practice social distancing).	0.71	0.50	0.77	0.70	3.87 ± 0.97	−0.87	0.67
3. Exert energy on daily activities or exercise (eg, take a brisk walk, use the stairs, do housework, work, gardening, sport, physical rehabilitation).	0.62	0.39	0.64	0.60	3.75 ± 1.06	−0.52	−0.44
4. Eat healthy foods, a disease-specific diet, or avoid certain foods (eg, eating vegetables, fruits, sugar, and low-salt and low-fat food).	0.75	0.56	0.73	0.65	3.46 ± 1.04	−0.28	−0.47
5. Make appointments for routine or regular healthcare.	0.78	0.61	0.61	0.66	3.88 ± 0.99	−0.69	−0.03
6. Take prescribed medicines without missing a dose and follow time schedules (for oral, injection, inhaler, or external usage).	0.67	0.45	0.56	0.56	4.01 ± 0.94	−0.81	0.31
7. Mindful relaxation, being aware of stress or overthinking (eg, meditation, yoga, music, recreational activities, doing good things, praying, religious ceremony, consulting others, accepting things as they are)	0.64	0.41	0.72	0.63	3.80 ± 1.08	−0.75	−0.08
Self-Care Monitoring scale							
8. Monitor whether your physical, emotional, or cognitive conditions are out of the ordinary.	0.69	0.48	0.73	0.74	3.70 ± 0.87	−0.65	0.42
9. Monitor for medication side effects (oral, injection, or inhaler usage).	0.82	0.67	0.77	0.77	3.85 ± 0.90	−0.68	0.58
10. Pay attention to changes in how you feel your symptoms occurred as well as the worsening of physical, emotional, or cognitive conditions.	0.87	0.77	0.92	0.82	3.83 ± 0.83	−0.44	0.23
11. Monitor whether you tire more than usual doing normal activities.	0.83	0.70	0.86	0.77	3.88 ± 0.87	−0.75	0.75
12. Monitor for symptoms.	0.69	0.48	0.68	0.65	4.01 ± 0.94	−0.89	0.54
Self-Care Management scale							
Autonomous behavior dimension							
14. Change what you eat or drink to make the symptoms decrease or go away (eg, reduce salt, restrict water and drinks, change food, restrict sugar).	0.54	0.41	0.76	0.69	3.59 ± 0.96	−0.31	−0.57
15. Change your activity level (eg, slow down, rest).	0.65	0.48	0.76	0.69	3.49 ± 1.07	−0.44	−0.41
16. Take medicine to make the symptoms decrease or go away.	0.92	0.91	0.71	0.69	3.80 ± 0.86	−0.34	−0.49
17. Talk to your healthcare provider (doctor/nurse) about your symptoms at the next follow-up.	0.85	0.79	0.78	0.70	3.77 ± 0.92	−0.40	−0.45
Consultation behavior dimension							
13. The last time you had a symptom, how quickly did you recognize it as a symptom of your health condition?	0.59	0.46	0.66	0.55	3.46 ± 1.04	−0.16	−0.56
18. Contact your healthcare provider (doctor/nurse) for guidance or go to your hospital or clinic.	0.73	0.62	0.78	0.65	3.84 ± 0.96	−0.66	0.14
19. Think of a treatment you used the last time you had symptoms. Did the treatment you used to make your symptoms better?	0.97	0.98	0.84	0.62	3.81 ± 0.93	−0.41	−0.36

Exploratory factor analysis was performed using the first split-half subsample (n = 98), whereas confirmatory factor analysis and item analysis were conducted on the full sample (N = 200). Factor loadings for confirmatory factor analysis of each scale were obtained from their respective final specified models.
Abbreviations: M, mean; h^2, communalities.

TABLE 3 Fit Index Values for the Self-Care of Chronic Illness Inventory Version 4.c in Thai Post Cardiac Surgery

Model	χ^2 Test Goodness of Fit									
	χ^2	*df*	*P*	CMIN/*df*	CFI	TLI	RMSEA	90% CI	*P*	SRMR
Self-Care Maintenance scale (N = 200)										
Model A1: unspecified	84.59	14	<.001	6.04	0.87	0.81	0.15	0.12–0.19	<.001	0.06
Model A2: specified	20.29	11	.041	1.84	0.98	0.97	0.06	0.01–0.10	.254	0.03
Self-Care Monitoring scale (N = 200)										
Model B1: unspecified	29.75	5	<.001	5.95	0.96	0.92	0.15	0.10–0.21	.001	0.03
Model B2: specified	5.56	4	.234	1.39	0.99	0.99	0.04	0.00–0.12	.458	0.02
Self-Care Management scale (N = 200)										
Model C1: unspecified, first-order	85.04	13	<.001	6.54	0.90	0.84	0.16	0.13–0.20	<.001	0.05
Model C2: specified, first-order	19.82	9	.019	2.20	0.98	0.96	0.07	0.03–0.12	.143	0.03
Model C3: specified, second-order	19.82	9	.019	2.20	0.98	0.96	0.07	0.03–0.12	.143	0.03
SC-CII-V4c (N = 200)										
Model D1: unspecified, first order	468.09	146	<.001	3.20	0.86	0.83	0.10	0.09–0.11	<.001	0.06
Model D2: Specified, first-order	333.25	141	<.001	2.36	0.91	0.90	0.08	0.07–0.09	<.001	0.05
Model D3: Specified, second-order	338.21	145	<.001	2.33	0.91	0.90	0.08	0.07–0.09	<.001	0.06

Models C3 and D3 are second-order hierarchical factor analyses. Despite providing χ^2 statistics and *P* values, they were not used for model interpretation, considering their appropriateness for large sample sizes.

Abbreviations: CFI, comparative fit index; CI, confidence interval; CMIN/*df*, minimum discrepancy per degree of freedom; RMSEA, root-mean-square error of approximation; SC-CII-V4.c, Self-Care of Chronic Illness Inventory Version 4.c; SRMR, standardized root-mean-square residual; TLI, Tucker-Lewis index.

from the Consultation dimension (items 13, 18, and 19). This allocation differed from previous US and Thai models.[25,26] Item loadings were moderate to high (0.54–0.97) and significant correlations (n^2 = 0.41–0.98) (Table 2). Confirmatory factor analysis on the full sample (n = 200) initially produced a poor model fit (Table 3, Model C1), requiring residual covariance adjustments between items 14 and 15, items 15 and 16, items 16 and 17, and items 16 and 13. After these modifications, the model demonstrated good fit (Table 3, Model C2). The 2 dimensions were positively correlated at 0.71, and a second-order factor analysis also demonstrated a good fit with stable loadings (0.66–0.84) (Table 3, Model C3; Appendix C, http://links.lww.com/JCN/A356).

Simultaneous Model of Chronic Illness Self-Care

A simultaneous model tested all 19-item SC-CII-V4c across Self-Care Maintenance (1-factor), Self-Care Monitoring (1-factor), and Self-Care Management (2-factor) scales. The initial model showed poor fit (Table 3, Model D1), which improved after adjusting 5 residual covariances (items 4 and 14, 5 and 6, 12 and 18, 14 and 15, and 15 and 17): $\chi^2(141, n = 200) = 333.25$, $P < .001$, CFI = 0.91, TLI = 0.90, RMSEA = 0.08 (90% CI, 0.07–0.09), $P < .001$, and SRMR = 0.05. All items showed moderate to high factor loadings (0.57–0.88), and the 4 constructs were positively correlated (0.59–0.62). The second-order factor model produced adequate fit (Table 3, Model D3), comparable with the first-order factor model. However, the standardized estimate and residual variances of the Self-Care Management scale slightly exceeded 1.00, indicating possible overfitting. Therefore, the second-order model was partially supported (Figure). Detailed models are presented in Appendix D (http://links.lww.com/JCN/A356).

Scale Internal Consistency Reliability and Item Analysis

Internal reliability and item analysis were performed on the full sample (n = 200). The Self-Care Maintenance scale demonstrated adequate reliability (α = 0.86). Given the covariances between 3 pairs of residuals, global reliability index estimates were also satisfactory (ω = 0.86; composite reliability, 0.85). All items had adequate discrimination, with an item-to-total corrected correlation ranging from 0.56 to 0.70. Deleting any item did not significantly affect the α coefficients, which ranged from .83 to .85.

The Self-Care Monitoring scale demonstrated adequate reliability (α = .90). Given the covariances between 1 pair of residuals, global reliability index estimates were also satisfactory (ω = 0.90; composite reliability, 0.89). All items had adequate discrimination, with item-total corrected correlations ranging from 0.65 to 0.82. Deleting any item did not significantly affect the α coefficients, which ranged from .86 to .90.

The Self-Care Management scale, being multidimensional, had adequate reliability (ω = 0.87; composite reliability, 0.90). For completeness and comparison, the α coefficients were estimated, resulting in adequate reliability across the Self-Care Maintenance scale (α = .87), Autonomous behavior (α = .87), and Consultation behavior (α = .79). All items had adequate discrimination, with item-total corrected correlations ranging from 0.55 to 0.70. Deleting any item did not significantly affect the α coefficients, which ranged from .85 to .87.

The overall SC-CII-V4c demonstrated excellent reliability across all indices (α = .93, ω = 0.93; composite reliability, 0.92).

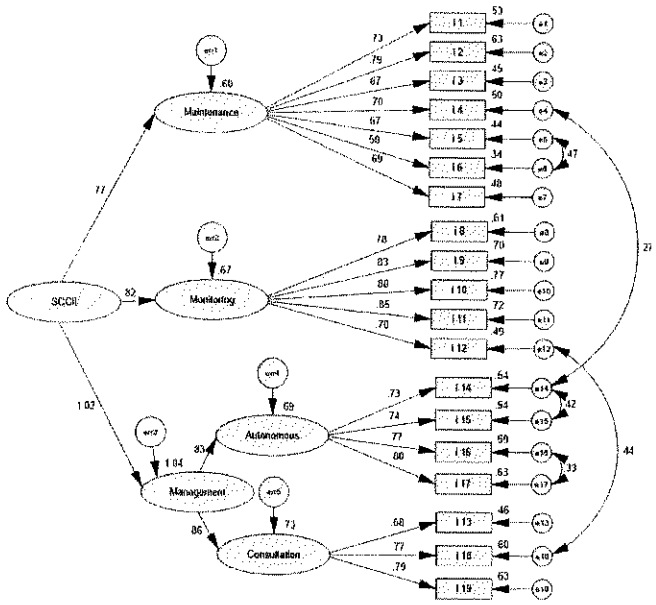

FIGURE. *Final specified second-order factor structural model of the simultaneous Self-Care of Chronic Illness Inventory Version 4.c (SC-CII-V4c) for Thai postcardiac surgery. Model fit: $\chi^2(145, n = 200) = 338.21$, $P < .001$, comparative fit index (CFI) = 0.91, Tucker-Lewis index(TLI) = 0.90, root-mean-square error of approximation = 0.08 (90% confidence interval, 0.07–0.09), (RMSEA) $P < .001$, and standardized root-mean-square residual (SRMR) = 0.06.*

Measurement Error

For the full sample (n = 200), the smallest detectable change and SD/2 were 1.96 and 2.67 for the Self-Care Maintenance scale, 1.18 and 1.87 for the Self-Care Monitoring scale, 1.81 and 2.56 for the Self-Care Management scale, and 3.20 and 6.19 for the overall SC-CII-V4c, respectively. These measures were considered adequate. The smallest detectable change scores were 3.88 for the Self-Care Maintenance scale, 3.01 for the Self-Care Monitoring scale, 3.73 for the Self-Care Management scale, and 4.96 for the overall SC-CII-V4c. These coefficients highlight the thresholds for meaningful change at scale and overall instrument levels.

Sensitivity Analysis

Data analysis excluding outlier cases (n = 185) demonstrated structural validity and internal reliability comparable with results obtained from the original sample (n = 200) that included outliers (see Appendixes E–I, http://links.lww.com/JCN/A356).

The Self-Care Maintenance scale demonstrated a 1-factor structure in the exploratory factor analysis (n = 94), with satisfactory model adequacy (Kaiser-Meyer-Olkin, 0.83; Bartlett $P < .001$), explaining 47.02% of the variance. The final specified confirmatory model demonstrated excellent fit and moderate to high factor loadings (Appendix F, http://links.lww.com/JCN/A356). Internal consistency reliability was adequate ($\alpha = .86$, $\omega = 0.86$; composite reliability, 0.85). All items demonstrated adequate discrimination (item-total correlations = 0.55–0.69), and item deletion had minimal impact on Cronbach α (0.83–0.85).

The Self-Care Monitoring scale demonstrated a 1-factor structure in the exploratory factor analysis (n = 94), with good data adequacy (Kaiser-Meyer-Olkin, 0.81; Bartlett $P < .001$), explaining 61.94% of the variance. The final confirmatory model showed excellent fit with moderate to high factor loadings (Appendix G, http://links.lww.com/JCN/A356). Internal consistency reliability was adequate ($\alpha = .89$, $\omega = 0.89$; composite reliability, 0.88). All items showed adequate discrimination (item-total correlations = 0.64–0.81), and item deletion had minimal effect on Cronbach α (0.85–0.89).

The Self-Care Management scale demonstrated a 2-factor structure in the exploratory factor analysis (n = 94), with good data adequacy data (Kaiser-Meyer-Olkin, 0.81; Bartlett $P < .001$), explaining 66.70% of the variance—36.48% from the Autonomous dimension and 30.22% from the Consultation dimension. The final confirmatory model showed excellent fit with moderate to high factor loadings (Appendix H, http://links.lww.com/JCN/A356). Internal consistency was adequate for the overall scale ($\alpha = .87$, $\omega = 0.86$; composite reliability, 0.90), the Autonomous dimension ($\alpha = .87$, $\omega = 0.87$; composite reliability, 0.83), and the Consultation dimension ($\alpha = .79$, $\omega = 0.78$; composite reliability, 0.80). All items showed adequate discrimination (item-total correlations, 0.64–0.81), and item deletion had minimal effect on Cronbach α (0.84–0.86).

The structural validity of the final simultaneous self-care model (n = 185) was supported by adequate fit indices in the first-order factor analysis. However, in the second-order model, the standardized estimate and residual variances for the Self-Care Management scale slightly exceeded 1.00, suggesting potential overfitting. Thus, the second-order model was only partially supported, consistent with findings from the original sample of 200 (Appendix I, http://links.lww.com/JCN/A356). The overall internal consistency reliability of the SC-CII-V4.c was excellent ($\alpha = .93$, $\omega = 0.93$; composite reliability, 0.92).

Overall, the structural validity and internal reliability of the full SC-CII-V4c and its scales were robust in this population, with consistent results regardless of whether outliers were included or excluded from the analysis.

Discussion

In this methodological, cross-sectional study, we evaluated the psychometric properties of the SC-CII-V4c in Thai postcardiac surgery. Findings support its structural validity, internal consistency, and precision. To our knowledge, this is the first study to explore its applicability in this population, offering new insights.

Our results highlight the instrument could be broadly useful for assessing self-care in post–cardiac surgery patients.

The structural testing of the SC-CII-V4c provided new insights into its theoretical construct and item structure across scales, enhancing understanding of its dimensionality and application in diverse patient populations. Although the Self-Care Maintenance scale has shown multidimensionality in previous models for patients with nonspecific conditions[25–27,38,39,58] and stroke,[28] it demonstrated unidimensionality in patients post cardiac surgery, similar to findings in Albanian older adults with multiple chronic conditions.[59] This unidimensional structure was also noted in the Self-Care of Heart Failure Index among Nepali.[60] These patterns suggest that, in certain populations, self-care maintenance may align more cohesively. This contrasts with the multidimensional structures observed in heart disease–specific self-care measures such as the Self-Care of Coronary Heart Disease Inventory[22,61,62] and the Self-Care of Heart Failure Index.[15,16] This suggests that Thai postcardiac surgery integrates both health-promoting and illness-related behaviors as a unique form of health maintenance. Furthermore, structural modeling revealed that patients often simultaneously engage in multiple self-care behaviors. For example, adherence to routine healthcare appointments correlated strongly with taking prescribed medications, both reflecting illness-related behavior, whereas getting enough sleep and avoiding illness reflected health-promotion behaviors. Physical activity was also linked to attending routine appointments, emphasizing the overlap between health promotion and illness management domains. These findings support the theoretical model that effective chronic illness self-care behaviors are performed cohesively to maintain health status and manage illness, aligning with previous psychometric evaluation of this instrument,[25–28,38,58] and other heart disease self-care measures.[15,16,22,62]

The Self-Care Monitoring scale demonstrated a good fit within a unidimensional construct, suggesting streamlined and cohesive monitoring behaviors. This may reflect the focused self-care required during post-surgical recovery, where patients prioritize monitoring early symptoms of complications and health changes specific to heart diseases.[13] Similar to self-care maintenance, patients often perform multiple monitoring behaviors simultaneously, such as monitoring health conditions and medication adverse effects. This interconnectedness reinforces effective self-care by enabling early detection of illness changes and potential complications.[12,63] The unidimensional self-care monitoring model in this population aligns with previous testing of this instrument[25–28,38,58] and heart disease self-care measures.[15,16,22,62] The simplicity of this scale may enhance patient engagement and the implementation of self-care monitoring strategies for effective illness management.

Structural testing of the Self-Care Management scale supported a bidimensional model,[25–28,38,58] indicating that self-care management can be categorized into 2 related dimensions. However, the items for Autonomous and Consultation behaviors in this population differed from previous US[25] and Thai[26,28] models. Autonomous behavior reflected independent symptom management, such as adjusting diet, activity levels, medications, and communicating symptoms to healthcare providers. Consultation behavior involved seeking professional advice, including recognizing symptoms, contacting healthcare providers, and evaluating symptom remedies. Surprisingly, symptom recognition (item 13) and remedies (item 19) were part of the Consultation dimension, reflecting cultural diversity and variations in disease-specific self-care practices.[25,26,28,58] Patients with generic chronic conditions in Thailand[26] and elsewhere,[25,58] as well as Thai with stroke,[27] often manage symptoms autonomously. However, Thai postcardiac surgery may have more frequent concerns about complications and medication adverse effects, prompting them to seek professional guidance. These consultation behaviors could develop pre and post surgery as part of long-term heart disease management, emphasizing the need for accessible clinicians. Similar to self-care maintenance and monitoring, Thai postcardiac surgery often perform management behaviors simultaneously, as seen in correlations within and between the Autonomous and Consultation dimensions. For example, those adjusting dietary and fluid intake often modified physical activity, suggesting an integrated approach to symptom management in daily routines.[25–28,38,58]

Structural testing of the simultaneous model supports the generalizability of the SC-CII-V4c in Thai postcardiac surgery. The 3 scales showed a good fit with the first-order factor model, whereas the second-order model showed borderline overfit, remaining within acceptable limits. Both models align with the theoretical foundation[14] and evidence.[25,26,28] Comprehensive self-care was effectively explained by these 3 core constructs, emphasizing the multidimensional nature of self-care behaviors in maintaining health, monitoring conditions, and managing symptoms. These findings also expand the understanding of the application of the SC-CII-V4c, particularly regarding the Self-Care Maintenance and Self-Care Management scales, highlighting the need for further refinement to ensure the constructs accurately reflect self-care behaviors in specific conditions, such as postcardiac surgery.

Each scale and the overall SC-CII-V4c demonstrated strong internal consistency across multiple reliability metrics.[51–54] All items showed satisfactory discrimination and positive interitem correlations, indicating cohesive item performance. This supports the reliability of the SC-CII-V4c in capturing self-care behaviors among Thai post cardiac surgery. The robust reliability

What's New and Important

- The structural validity, internal consistency, and precision of the Self-Care of Chronic Illness Version 4c are robust in postcardiac surgery patients, confirming its reliability as a tool for assessing self-care in this population.
- Cross-cultural differences were highlighted, as the Self-Care Maintenance scale is perceived as a unidimensional construct in this Thai population.
- Items from the Self-Care Management scale's Autonomous and Consultation dimensions show variations from the original US and previous Thai models.

aligns with previous testing of this instrument among patients with generic chronic conditions.[27,38,58] Interestingly, although the Self-Care Maintenance scale had only borderline acceptable reliability in previous US[25] and Thai[26] contexts, it demonstrated stronger reliability in this population, also surpassing previous findings in Thai stroke studies.[28] This suggests a more consistent measurement of self-care maintenance in this specific condition. Overall, the SC-CII-V4c is a reliable instrument with internal consistency comparable with existing heart disease self-care measures.[15,16,22,60–62]

Furthermore, the instrument demonstrated strong precision across all 3 scales, 2 dimensions of Self-Care Management, and the full SC-CII-V4c, as indicated by standard error of measurement values below SD/2. This finding provided novel insights into the instrument's measurement accuracy. The small detectable change of 4.96 for the overall instrument reflects the minimum change required to represent a clinically meaningful difference, highlighting the scale's sensitivity in detecting real improvements or declines in self-care.[42] The capacity to identify subtle yet significant changes is essential for evaluating interventions and guiding patients in improving their self-care.

Practice Implications

Clinicians can use the SC-CII-V4c to assess self-care in postcardiac surgery patients, identifying areas for improvement. Particularly, patients in this study demonstrated lower scores in behaviors such as sleep, diet, physical activity, and symptom recognition. This helps develop tailored interventions to promote health-promoting behaviors, improve symptom monitoring, and enhance symptom management.[64] The Consultation dimension of the Self-Care Management domain reflects cultural and illness-related influences,[40] offering insights for culturally sensitive support. Incorporating mobile and digital health technologies into cardiovascular care can further support self-care by enhancing patient-clinician communication.[65,66] Health applications can offer real-time feedback, reminders, and educational resources, empowering patients to take a more active role in symptom management and improving health outcomes.[64–66]

Research Implications

Investigators can confidently use this reliable and valid instrument in future studies to assess comprehensive self-care domains, identify areas needing intervention, and track change over time. Furthermore, the psychometric properties of the SC-CII-V4c support its potential use in clinical trials to guide tailored self-care interventions for patients recovering from cardiac surgery and health outcomes. However, further research is needed to validate its validity and reliability through pilot testing, test-retest reliability, and application across multiple settings.

Limitations

The lack of a pilot study limits the validation of context-specific adaptations. In addition, test-retest reliability could not be provided because of follow-up challenges, with only 10 of 60 targeted participants completing the second survey. Without this evaluation, the stability of the measure cannot be confirmed. Using a convenience sample from a single setting limits the generalizability to broader healthcare environments.

Conclusions

The SC-CII-V4c demonstrated robust structural validity, internal consistency, and precision in postcardiac surgery patients, making it valuable for research and practice. The study revealed cross-cultural nuance, with differences in the Self-Care Maintenance and Self-Care Management models compared with previous US and Thai models. Further research is needed for enhanced validation, including pilot testing, test-retest reliability, and cross-setting application.

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