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Research Paper

Cross-cultural adaptation and psychometric evaluation of the Thai version of Self-Care of Chronic Illness Inventory Version 4.c

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ABSTRACT

Objectives: To translate and validate the Thai Self-Care of Chronic Illness Inventory version 4.c (Thai SC-CII v4.c) in individuals with chronic illnesses.
Methods: A scale translation and cross-sectional validation study was conducted. The English version was translated for Thai involved nine steps: preparation, forward translation, reconciliation, back-translation, back-translation review, harmonization, cognitive debriefing, review of cognitive debriefing and finalization, and proofreading. A cross-sectional study was conducted from July to November 2022 at 16 primary care centers in southern Thailand, involving 410 participants with at least one chronic condition. Validity assessments included structural, convergent, and discriminant validity. Concurrent validity examined correlations between SC-CII v4.c with the Self-Care Self-Efficacy Scale (SCSES) and self-perceived health. Internal coherence reliability was calculated using Cronbach's α coefficient, item-total correlation coefficients, and the composite reliability (CR) index.
Results: Thai SC-CII v4.c demonstrated excellent translational validity ($\kappa = 0.99$). The specified Self-Care Maintenance model fit well, with minor differences in health promoting behavior and illness-related behavior items compared to the original model. The original Self-Care Monitoring, and Self-Care Management models fit well with Thai data. Simultaneous confirmatory factor analysis confirmed a satisfactory fit of the full SC-CII v4.c. Convergent validity had partial support (average variance extracted = 0.23–0.51), and discriminant validity was established (heterotrait-monotrait ratios = 0.37–0.88). Concurrent validity was supported by positive correlations between each scale and overall SC-CII v.4c with SCSES ($r = 0.25$–0.65) and self-perceived health ($r = 0.09$–0.35). The Cronbach's α coefficient were adequate for all scales except the Self-Care Maintenance scale (Cronbach's $\alpha = 0.68$), but the CR estimate improved the reliability of all three scales (ranging 0.80–0.82). All items had satisfactory item-total correlation coefficients (ranging 0.34–0.71), except the one pertaining to sleep.

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Conclusions: The Thai SC-CII v4.c is valid and reliable for assessing self-care in various chronic illnesses. Further testing is recommended for patients with specific diseases.

What is known?

- Self-care is essential for patients with all chronic illnesses to maintain overall health and manage specific diseases.
- Many chronic illnesses have similar self-care requirements, and individuals with multiple chronic conditions often need to engage in complex self-care.
- The Self-Care of Chronic Illness Inventory version 4. c (SC-CIIv4.c) is a well-established, theory-based instrument that comprehensively measures self-care in individuals with chronic conditions.

What is new?

- The cross-culturally adapted Thai version of SC-CII version 4. c (Thai SC-CII v4.c) had excellent translational validity.
- Psychometric evaluations of the three scales (Self-Care Maintenance, Self-Care Monitoring, and Self-Care Management) and Thai SC-CII v4.c indicated their validity and reliability.
- Clinicians and investigators can use the instrument to assess self-care behaviors in individuals with one or multiple chronic conditions.

1. Introduction

Non-communicable chronic diseases—specifically hypertension, diabetes, heart disease, stroke, chronic respiratory disease, chronic kidney disease, and cancer—are the leading causes of death and disability globally [1,2] and in Thailand [3]. Most adults with chronic diseases have multiple chronic conditions or multimorbidity [4]. Chronically ill individuals with coexisting chronic conditions have an increased risk of several adverse health outcomes regarding overall health status [5,6], physical functioning [6], health-related quality of life [5–7], disease recurrence or exacerbation [8,9], hospitalization [10], healthcare costs [5], and mortality [11].

Living with any chronic condition requires specific medical treatment from healthcare providers and individuals caring for themselves. These two essential elements have led to a common term and theory, self-care for chronic illnesses [12]. Each chronic disease shares common self-care requirements [13–17]. Individuals with chronic conditions are typically advised to adhere to long-term self-care regimens to maintain their health status and stability [12]. These self-care actions include adequate sleep, avoiding sickness, eating a healthy or disease-specific diet, performing regular exercise and rehabilitation, reducing stress, adhering to medication and treatment procedures, and following up on appointments [18]. Changes in health status, disease severity, progressive illness, and complications over time mark the chronic illness trajectory.

Consequently, symptoms are a clinical marker of a worsened illness. Therefore, monitoring symptoms to determine relevant changes in health and disease is essential for daily self-care. A rapid response to the symptom is expected once individuals recognize changes in their physical, psychological, emotional, or cognitive status. Symptom management is another crucial self-care element for people with chronic illnesses [19]. Several symptom management strategies have been used to relieve unpleasant symptoms. This includes changing, adjusting, or restricting routine self-care—including physical activities, food consumption, drink intake, and medication use—and consultations or sharing symptoms with healthcare providers for appropriate management [18].

In nursing, self-care has long been widely recognized as a process of nurse-patient interaction and a significant clinical outcome. Nurses have a vital role, responsibility, and active involvement in facilitating the development of patients' self-care competence [20]. Self-care can be viewed as an integrative health outcome for chronic illnesses, reflecting both patient- and clinical-focused measures [12]. In Thailand, nursing [21–23] and national health policy [3,24] have long considered self-care one of the most important ways to maintain good health, prevent ill health, and manage diseases. However, self-care in chronic illness management must be improved since only one-third of people with chronic illnesses perform adequate self-care [22,25]. Better self-care—either comprehensive self-care (e.g., overall self-care regimen, the combination of self-care actions) or specific self-care action (e.g., physical activity, diet, medication use)—is associated with positive health outcomes, including overall health status [26–28].

Therefore, a well-developed self-care instrument with robust validity and reliability is required to determine routine practice and research outcomes. Several useful disease-specific self-care instruments for hypertension [13], chronic obstructive pulmonary disease [14], heart failure [15], diabetes [16], and coronary heart disease [17] have been developed in the United States and Europe. These have been widely adapted across diverse cultures, languages, and countries [25,29–37]. Among various self-care instruments available, the Self-Care of Chronic Illness Inventory (SC–CII) stands out as it specifically focuses on individuals with multiple chronic diseases [18]. Developed within the United States context, the SC-CII is a theory-based instrument that assesses self-care in individuals with any diagnosis, irrespective of specific conditions or the number of diseases [18]. According to the parent framework [12], self-care is a natural cognitive decision-making process in which individuals daily maintain routine health promotion and manage chronic illness conditions, including medication and treatment regimens. The SC-CII consists of three fundamental constructs assessing self-care components: Self-Care Maintenance, Self-Care Monitoring, and Self-Care Management. The psychometric testing of the previous version of SC-CII has demonstrated credible, reliable, and generalizable results in the Western context [18,38]. The instrument has recently updated to version 4.c, known as SC-CII v4.c. This version has been translated into several languages and are available online (https://self-care-measures.com). Our research team specifically translated the Thai version and conducted psychometric testing in this study. The instrument developer deserves recognition for their comprehensive approach to designing the self-care assessment tool. Notably, they incorporated three basic self-care behaviors (Sections: A, Self-Care Maintenance; B, Self-Care Monitoring; and C, Self-Care Management), along with the motivation aspect of self-care (Section D: Self-Care Self-Efficacy Scale [SCSES]), into the instrument provided on their website. Based on recommendations from previous studies [18,38], the SCSES was not considered a direct measure of self-care

behavior itself. Instead, it was proposed as a motivational factor influencing of self-care. Therefore, the SCSES was not included as a component of SC-CII v4.c in this study but was treated as a determinant of self-care, consistent with the approach taken in previous studies [18,38].

Only a few recent studies have provided evidence of whether the SC-CII is suitable for use in Asia, specifically in the Thai context. However, the cross-cultural adaptation of the relevant disease-specific self-care measures that underpin a similar theory as that of the SC-CII shows a cultural fit with Thailand [25,29] and other Asian countries [32,34,35,39]. Further, only some studies have conducted a psychometric evaluation of the SC-CII outside the United States, finding supportive structural validity, internal coherence reliability, and cross-cultural comparability [38], whereas no evidence has been provided in other contexts—additionally, no psychometric testing of the SC-CII v4.c in the Asian context, including Thailand.

In this study, we conducted a psychometric study of the Thai SC-CII v4.c in line with methodological recommendations [18,38]. The instrument was developed in accordance with international guidelines for translation and cross-cultural adaptation processes for patient-reported outcome measures [40,41]. Specifically, we assessed structural validity based on dimensionality or the factorial structure using factor analysis. This study evaluated criterion-related construct validity, internal coherence, and test-retest reliability. We hypothesized that the three separate scales and the simultaneous Thai SC-CII v4.c would demonstrate adequate validity and reliability.

2. Methods

2.1. Study design

This was a methodological and cross-sectional study. The translation and cross-cultural adaptation processes adhered to ISPOR international guidelines for patient-reported outcomes' translation and cultural adaptation [41]. The psychometric test was conducted from July to November 2022. The study is reported following the COSMIN (Consensus-based Standards for the Selection of Health Measurement Instruments) Reporting Guideline for studies of measurement properties [40].

2.2. Ethical considerations

Approval was obtained from the Ethics Board Committee of Walailak University (Approval no. WUEC-22-168-01) before data collection. This study adhered to the standards outlined in the Declaration of Helsinki. All the participants provided oral and written informed consent and were aware of their rights and responsibilities. Their right to withdraw and the confidentiality of their data was also ensured. The analyzed data were anonymized and treated as strictly confidential.

2.3. Instrument translation and translational validity

2.3.1. Translation and cross-cultural adaptation processes

We translated and cross-culturally adapted Thai SC-CII v4.c using multiple steps for translation and a cross-cultural adaptation framework for patient-reported outcomes [41]. The panel of seven expert committees follows the nine subsequent steps, which are as follows: preparation, forward translation, reconciliation, back-translation, back-translation review, harmonization, cognitive debriefing, review of the cognitive debriefing results and finalization, and proofreading [41]. Each step ensures linguistic accuracy, cultural appropriateness, and consistency in conveying the intended meaning across multiple languages.

Appendices A1-A4 provide comprehensive details regarding the translation and cross-cultural adaptation of the Thai SC-CII v4.c, including rationales for the changes made to each scale's instruction parts and items. We used common and specific words and sentences for the instructions to conform to the patient's culture. For example, in Instructions Part 1, "self-help behaviors" was replaced with "self-care actions" because the word "actions" is commonly used in Thailand instead of "behaviors." The sentence "Think about how you have been feeling" was altered to "Think about the things you have been doing to manage your health and illness" to focus on health conditions, as "feeling" usually refers to emotional components in Thai. Similarly, informal and particular words and sentences with semantic meanings were used. For instance, item 3 ("Do physical activity") was replaced by the common term "Exert energy on daily activities or exercise" to capture any bodily movement produced by skeletal muscles that requires energy expenditure. Both promote health as well as prevent chronic illnesses [42]. Hence, the modes (i.e., household activity, occupational activity, transportation, and leisure time activity) and intensity of physical activities (i.e., light, moderate, and vigorous) were added as examples of being physically active [25]. In addition, item 4 ("Eat special food or avoid certain foods") was adapted to "Eat healthy foods and a disease-specific diet" because healthy foods are a requisite for health promotion. By contrast, special foods in the Thai context refer to foods for special occasions.

Moreover, we added various self-care methods as examples of each item to improve the participants' understanding. We also added "including symptom or illness as well as changed in physical, emotional, and cognition conditions" into Instructions Part 2, Monitoring. The examples of self-care actions in several items, such as 6 and 14, were expanded.

2.3.2. Translational validity

Before conducting psychometric testing, content validity was evaluated to ensure translational validity [43]. This evaluation involved nine expert committees who were requested to rate on a 4-point ordinal scale considered four basic criteria [44]. Rating scores of 3 or 4 on the items were expected to be relevant (1, not relevant; 4, very relevant), clear (1, not clear; 4, very clear), simple (1, not simple; 4, very simple), and ambiguous (1, doubtful; 4, meaning is clear) [44]. Based on the kappa coefficients table [45,46], the average scale-level content validity index (S-CVI) of each scale as well as the full Thai SC-CII V4.c, was 0.99, indicating excellent translational validity [46]. Additional details are presented in Appendix B.

2.4. Psychometric testing

2.4.1. Study settings and participants

Patients with at least one chronic disease aged 18 or older were eligible to participate in the study. Hypertension, diabetes, heart disease (heart failure, myocardial infarction, valvular heart disease, cardiac arrhythmia), stroke (ischemic stroke, hemorrhagic stroke, transient ischemic attack), chronic respiratory disease (asthma, chronic obstructive pulmonary disease), chronic kidney disease (stage 3–5, dialysis), and cancer were the chronic diseases of interest, as well as common rare conditions (e.g., chronic liver disease, chronic hematologic disease, autoimmune disease). Patients who registered and were treated at the health-promoting hospital in Southern Thailand were eligible for the study. Health-promoting hospitals or primary healthcare centers are first-level healthcare facilities that provide comprehensive services in rural areas, including patients referred to higher levels of care. Health-promoting hospitals provide ongoing care and follow-ups to

patients without admission care services. We included participants who were not hospitalized and living at home without obvious dementia. There were no specific exclusion criteria except for patients who were unable to communicate, unable to complete the instruments, pregnant, or hospitalized. We kept in mind that engaging in self-care requires time, that ongoing self-care is carried out at home, and that self-care shortly after hospital discharge is often uncertain [19,47]. Hence, patients with experience of chronic illnesses of less than three months, those currently hospitalized, and those within three months of their hospital discharge were not included in this study.

To allow cross-validation [18], we enrolled 430 participants, although a sample size of 200 participants would have been sufficient for the confirmatory factor analysis (CFA) [48]. We recruited patients from 16 health-promoting hospitals in six provinces. Patients with any of the targeted chronic diseases were listed; 5 to 10 individuals were invited to participate in the research using convenience sampling. Approximately 20–30 participants were recruited from each health-promoting hospital. Eight patients refused to participate because of a lack of time. Among these, 60 participants from four health-promoting hospitals were used to assess test-retest reliability. They were asked to complete the Thai SC-CII v4.c twice 10–14 days apart. All the participants were included in the final psychometric analysis.

2.4.2. Measurements

2.4.2.1. Thai version of the self-care of Chronic Illness Inventory. The Thai SC-CII v4.c has 19 items similar to the original version. Each item of the instrument evaluates essential self-care behaviors allocated with the three distinct but interconnected scales: Self-Care Maintenance (7-item), Self-Care Monitoring (5-item), and Self-Care Management (7-item). This self-report questionnaire had a rating of 0 or 1 to 5 on an ordinal response scale [18]. The Self-Care Maintenance and Self-Care Monitoring scales asked, "How often or routinely do you do the following?" Responses ranged from 1 = never to 5 = always. One item on the Self-Care Management scale assessed whether the patient had recognized a symptom; the three response options were "never had a symptom," "had a symptom but did not recognize it," or "had a symptom and recognized it." Those who had recognized a symptom were asked to rate how quickly they realized it was a symptom of a health condition. Responses ranged from 1 = not quickly to 5 = very quickly. The other Self-Care Management items assessed how likely the patient is to use any self-care actions to manage symptoms when they occur by asking, "When you have symptoms, how likely are you to use one of these?" The responses ranged from 1 = not likely to 5 = very likely. Notably, two items in the Self-Care Management scale included a 0 option (item 13: "I had a symptom but did not recognize it as a symptom of my health condition"; item 19: "I did not do anything") [18]. Higher scores on each scale as well as overall self-care, are indicative of better self-care [18].

2.4.2.2. Self-Care Self-Efficacy Scale. The Self-Care Self-Efficacy Scale (SCSES) [49] was used to test the concurrent validity of the Thai SC-CII v4.c. Self-efficacy is important to self-care maintenance, monitoring, and management [12,19]. We hypothesized that self-efficacy correlates significantly and positively with self-care [12]. This self-reported measure was developed as part of the SC-CII v.4c. The updated SCSES was proposed as a separate domain scale to measure self-care confidence in self-care maintenance, monitoring, and management [49]. The SCSES asks, "How confident are you that you can?" All ten items were rated on a 5-point ordinal response scale (not confident, somewhat confident, moderately confident, very confident, extremely confident). A higher score indicates higher self-efficacy [49].

We translated the Thai SC-CII V4.c and SCSES simultaneously. In addition, the final Thai SCSES and back-translated versions were approved by the developer (Barbara Riegel) and are available online (https://self-care-measures.com). The translational validity of the Thai SCSES was excellent, with kappa coefficients [46] of 1.00 for the item-level content validity index and averaged scale-level content validity indices. We performed test-retest reliability using the same sample as the SC-CII, which revealed excellent reliability. The intraclass correlation coefficient (ICC) [45] of each item ranged between 0.94 and 0.98, while the ICC of the full SCSES was 0.96 (95% CI = 0.95–0.97).

2.4.2.3. Self-perceived health questionnaire. A self-rated, self-perceived health questionnaire was used to test the concurrent validity of the Thai SC-CII v4.c. Self-care's specific goal is to maintain health status and control illness. Therefore, optimal health status can result in better self-care [47]. We hypothesized that self-care would be positively and significantly associated with health status. We determined the overall health status based on a valid and reliable global rating of self-perceived health status, the European Quality of Life-Visual Analog Scale [50]. Permission was given to the primary investigator by the EuroQol Group (https://euroqol.org; tracking number: 48440). The Thai version [51] was used to test concurrent criterion-related validity. The participants were asked to rate their best and worst imaginable health statuses on a 0–100 mm vertical line, where the lowest point was labeled the worst imaginable health status, and the highest point was labeled the best imaginable health status. The higher the score, the better the overall health status.

2.4.2.4. Sociodemographic and illness characteristics. We used a structured questionnaire to collect sociodemographic data (e.g., age, sex, education, literacy, marital status, living arrangement, work status, household income) and clinical characteristics (e.g., types of chronic diseases, other chronic conditions, medications, and treatments received, duration of illness) of the participants. The variety and number of other chronic conditions (dyslipidemia, visual problems, hearing problems, walking difficulty, wheelchair use) were also assessed. All the chronic diseases and other chronic conditions were counted and classified as the total number of comorbidities. All the medications and treatment modalities (i.e., oral pill, injection, inhalation or external medication, rehabilitation, cardiac procedure, dialysis, chemotherapy, radiotherapy) received by type, form, or route were also counted.

2.5. Data collection

We prepared a pencil-and-paper data collection package. Data were collected by nurses in each study setting. All 16 nurses were trained as research assistants by the principal investigator following the research protocols. They obtained data from the participants during face-to-face interviews. The location and time of data collection were not specified, but the interviews were either at a health-promoting hospital or at the patient's home. In most cases, the participants completed the data collection forms within 30 min, although very old and illiterate participants took up to 50 min to complete the task. Furthermore, the participants' electronic health records were collected to determine their illness characteristics.

2.6. Data analysis

Data were analyzed using IBM SPSS Statistic version 28.0 and AMOS version 24.0. Statistically significant was set at $P < 0.05$. Descriptive analysis provided an overview of participants'

characteristics and item descriptives. Continuous variables that followed a normal distribution were summarized using means and standard deviations (*Mean* ± *SD*), while median and interquartile range (*IQR*) represented nonnormality variables. To enhance the interpretability, comparability and facilitate statistical analysis, the raw scores of each scale and those of the full SC-CII v4.c and SCSES were recommended to transform into standardized scores [18] on a scale between 0 and 100. This standardization process allows for more comprehensive and meaningful understanding of the results.

The Mahalanobis distance test [52] was performed initial structural validity test. The results of this test identified 12 cases as multivariate outliers, which were subsequently excluded from the confirmatory factor analysis (CFA). The results of skewness and kurtosis tests showed that several items on each of the three scales had non-normal distributions. We also performed a Kolmogorov-Siminov test ($P < 0.05$), which showed that the distributions of all items departed significantly from normality [53]. Out of the remaining 410 samples included in CFA, 396 individuals reported experiencing symptoms. The next step involved conducting CFA to examine the fit between the Thai data and the originally proposed models [18]. The CFA was performed separately for the three scales and simultaneous model [18]. Exploratory factor analysis (EFA) was not initially employed as the primary method in this analysis. However, if the results of the CFA indicate a misfit model, we plan to conduct EFA. In such a case arises, EFA would be used to explore and determine the factor structure of the respective scale. This approach is in accordance with recommendations from a relevant study [36]. We selected the robust maximum likelihood method for the parameter estimation because of several non-normally distributed items [18,36]. Factor loadings of ≥0.30 were regarded as adequate [52]. We considered several goodness-of-fit indices to evaluate the model fit: the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) [54]. The required thresholds for each [18,36,52] were CFI ≥0.90, TLI ≥0.90, RMSEA ≤0.08, and SRMR ≤0.08. Specifically, CFI and TLI values of 0.90–0.95 indicate an acceptable fit, while values > 0.95 indicate a good fit [55]. RMSEA values of ≤0.05 indicate a well-fitting model, values between 0.05 and 0.08 indicate a moderate fit, and values ≥ 0.10 indicate a poor fit [56]. In addition, RMSEA values with 90% confidence intervals (CIs; lower bound ≤0.05 and upper bound ≤0.08) suggest a good fit [57]. To determine whether the model was a good fit, we conducted tests to examine the probability of a low approximation error, with insignificant $P > 0.05$, indicating a good fit. SRMR values of ≤0.08 indicate a good fit. Owing to the sensitivity of the chi-square likelihood ratio test to sample size, we report the chi-square statistics even though they were not used to interpret the model fit [18,36].

Three basic criterion-related measures were evaluated to assess the scale's construct validity: convergent, discriminant, and concurrent validity [58]. Convergent and discriminant validity are related concepts. Convergent validity is the correspondence between theoretically similar constructs [58]. The average variance extracted (AVE) [59] was used to determine convergent validity. An AVE value of ≥0.50 is adequate for establishing convergent validity [59]. Discriminant validity, the opposite of convergent validity, is the extent to which the scale can differentiate between theoretically different constructs [58]. We used the heterotrait-monotrait (HTMT) method to estimate the multidimensional scales, where a threshold of 0.85 indicates adequate discriminant validity [60]. However, another proposed HTMT ratio with a threshold of 0.90 is acceptable [61,62]. Concurrent validity is the extent to which the scale correlates with any related criterion at the same time [58]. Better self-care is expected to be correlated with higher self-efficacy in self-care, the antecedent variable, and better health status, a consequence of self-care. We estimated the Pearson's correlation coefficients [63] between self-care scales, dimensions, and total SC-CII scores with the SCSES scores and self-perceived health status scores, with positively correlated values indicating concurrent validity. Pearson's correlation coefficients of 0.10–0.29 were considered weak, 0.30–0.49 as moderate, and ≥0.50 as strong [64].

Cronbach's α coefficients were utilized to estimate the internal coherence reliability for each scale and overall SC-CII. In addition, composite reliability [59] was estimated based on a final first- or second-order CFA model, and the global reliability index [65] was estimated for the multidimensional scales. To establish acceptable internal coherence reliability [66], a value ≥ 0.70 was considered. Item discrimination was estimated using item-to-total corrected correlation coefficients, with ≥0.30 considered acceptable [67]. In the test of the internal construction of the scale, a higher corrected item-to-total correlation reflects the total score of all the other items and the item-score reliability [68]. The corrected item-to-total correlation was used to determine the item's association with the total score on the other scale items and full SC-CII [18]. In the test, item discrimination was estimated using item-to-total corrected correlation coefficients, with values of 0.30 considered a realistic lower bound for item-score reliability [18].

Test-retest reliability was examined using ICCs [69]. The two-way random-effect, consistency agreement, and multiple rater or measurement models were used [45]. We estimated the Pearson's correlation coefficients and 95% CIs between Rounds 1 and 2 scores for each item. Coefficients of 1.00 indicated perfect reliability, 0.90–0.99 excellent reliability, 0.80–0.89 good reliability, 0.70–0.79 acceptable reliability, and <0.50 poor reliability [69].

3. Results

3.1. Characteristics of the participants

Most of the final 410 participants were older (*Mean* = 67.30, *SD* = 13.16), women, primary school graduates, living with a large family, earning an income, and having sufficient household income to make ends meet. The average reported the number of chronic diseases was 2 (ranged 1–6), with 3 (ranged 1–9) treatment modalities. The duration of chronic disease treatment was 8 years (ranged 0.3–40). The most common chronic diseases were hypertension, diabetes, stroke, chronic kidney disease, chronic joint problems, and heart disease (Table 1).

3.2. Item descriptive analysis

Table 2 shows the descriptive items, with mean scores of eight items (items 1, 8, 9, 10, 11, 14, 16, and 18) close to the theoretical score [18] of 4; five items (items 2, 5, 6, 12, and 17) had scores above the theoretical score, and the rest of the items had moderate scores. Items 6 and 13 had the highest and lowest scores, respectively. Several items were not normally distributed (items 5, 6, 9, 10, 17, and 19), as they had skewness or kurtosis indices [70] above 1.00.

3.3. Validity

3.3.1. Dimensionality (structural validity)

3.3.1.1. Self-care maintenance scale. First, we performed the CFA for the two-factor Self-Care Maintenance scale, as originally proposed [18] the theoretical structure was composed of three Health Promoting Behavior items (items 1, 3, and 7) and five Illness-Related Behavior items (items 2, 4, 5, and 6). When the original model was tested, the model fit was inadequate (Appendix C: Figure C1): χ^2 [13, n = 410] = 111.51, $P < 0.001$, CFI = 0.84, TLI = 0.74,

Table 1
Sociodemographic and clinical characteristics of the participants ($n = 410$).

Characteristics	*n* (%)	Characteristics	*n* (%)
Sex		Type of chronic diseases[a]	
Male	171 (41.7)	Hypertension	327 (79.8)
Female	239 (58.3)	Diabetes	223 (45.6)
Education		Heart diseases (i.e., heart failure, coronary heart disease, valvular heart disease)	58 (24.9)
Less than primary school graduate	44 (10.7)	Strokes	102 (24.9)
Primary school graduate	249 (60.8)	Chronic kidney diseases (CKD Stage 3–5, dialysis)	63 (15.4)
Secondary, or high school graduate	69 (16.8)	Chronic lung diseases (asthma, chronic obstructive pulmonary disease)	42 (10.3)
Some college, or higher educated	48 (11.7)	Chronic joint problems (gout, osteoarthritis)	63 (15.4)
Literacy		Cancer	17 (4.1)
Unable to read	34 (8.3)	Other (i.e., cirrhosis, hepatitis, thalassemia, hemophilia)	8 (2.5)
Able to read	376 (91.7)	Type of other chronic conditions[a]	
Marital status		Dyslipidemia	223 (54.4)
Single, never married	17 (4.1)	Visual problem	141 (34.4)
Married or partnered	295 (72.0)	Hearing problem	83 (20.2)
Divorced, separated, or widowed	98 (23.9)	Walk difficulty	158 (38.5)
Living arrangement		Type of treatment modality[a]	
Alone	20 (4.9)	Blood pressure lowering pill	335 (81.7)
With a couple	80 (19.5)	Blood glucose lowering pill	224 (45.4)
With large family	310 (75.6)	Blood glucose lowering injection	39 (9.5)
Work status		Lipid - lowering pill	282 (68.8)
Not working, or unemployed (no income)	99 (24.1)	Antiplatelet, or anticoagulation pill	140 (34.1)
Retired (had pension income)	35 (8.5)	Bronchodilator pill	33 (8.0)
Working (with irregular income)	93 (22.8)	Bronchodilator inhaler	39 (9.5)
Working, or employed (regular income)	183 (44.6)	External medicine (pain relief balm, eyes drop)	110 (26.8)
Household income		Hematologic - related injection (erythropoietin, anti - bleeding)	10 (2.5)
Comfortable (have more than enough to make ends meet)	110 (26.8)	Renal replacement therapy (CAPD, hemodialysis)	27 (6.6)
		Chemotherapy, or radiotherapy	26 (6.3)
Sufficient (have enough to make end meet)	199 (48.5)	Physical rehabilitation program	53 (12.9)
Insufficient (do not have enough to make ends meet)	101 (24.6)	Cardiac procedure (PCI, CABG, valvular replacement, pacemaker)	14 (3.4)

[a] *Note*: Participants were allowed to select multiple categories. CABG = coronary artery bypass graft. CAPD = continuous ambulatory peritoneal dialysis. CKD = chronic kidney disease. IQR = interquartile range. PCI = percutaneous coronary intervention.

RMSEA = 0.13 (90% CI = 0.11–0.16), $P < 0.001$, SRMR = 0.08. As planned, we then performed an EFA to verify the factorial structure (KMO = 0.78, Bartlett's test of sphericity χ^2 [21, $n = 410$] = 637.21, $P < 0.001$, total cumulative explained = 40.73%, revealing two factorial structures. The Health-Promoting Behavior items (items 1, 2, 3, 4, and 7) and Illness-Related Behavior items (items 5 and 6) were different from those in the original version [18]. The CFA testing of the Self-Care Maintenance model yielded a good fit (Appendix C: Figure C2): χ^2 [13, $n = 410$] = 28.28, $P = 0.008$, CFI = 0.97, TLI = 0.96, RMSEA = 0.05 (90% CI = 0.02–0.08), $P = 0.375$, SRMR = 0.03. All the factor loadings (Table 2) were significant and above 0.30 except for one item (item 1 "Be sure to get enough sleep"), which had a low but significant loading of 0.28.

These two factors were significantly correlated ($r = 0.52$). Therefore, we specified a second-order hierarchical model [70] that produced a good fit (Appendix C: Figure C3): χ^2 [12, $n = 410$] = 28.28, $P = 0.008$, CFI = 0.97, TLI = 0.96, RMSEA = 0.05 (90% CI = 0.02–0.08), $P = 0.375$, SRMR = 0.03.

3.3.1.2. Self-care monitoring scale. We performed the CFA for the single-factor Self-Care Monitoring scale, as originally proposed [18], which revealed a good fit to the data (Appendix D): χ^2 [5, $n = 410$] = 15.57, $P = 0.008$, CFI = 0.98, TLI = 0.97, RMSEA = 0.07 (90% CI = 0.03–0.11), $P = 0.155$, SRMR = 0.019. All the factor loadings (Table 2) were significant and above 0.30 (ranged 0.67–0.80).

3.3.1.3. Self-Care Management scale. We performed the CFA for the two-factor Self-Care Maintenance scale, as proposed in the original model [18], resulting in a good fit (Appendix E: Figure E1): χ^2 [13, $n = 396$] = 39.35, $P < 0.001$, CFI = 0.95, TLI = 0.93, RMSEA = 0.07 (90% CI = 0.04–0.09), $P = 0.082$, SRMR = 0.03. All the factor loadings (Table 2) were significant and above 0.30 (ranged 0.58–0.73). Since the two factors were significantly positively correlated at 0.73, we specified a second-order hierarchical model [70] that also produced a good fit (Appendix E: Figure E2): χ^2 [13, $n = 396$] = 39.35, $P < 0.001$, CFI = 0.95, TLI = 0.93, RMSEA = 0.07 (90% CI = 0.04–0.09), $P = 0.082$, SRMR = 0.03.

3.3.1.4. Simultaneous confirmatory factor analysis. Finally, we evaluated a simultaneous CFA of a combined set of 19 items [18]. The first-order CFA model was tested with five structures: the health-promoting behavior and illness-related behavior dimensions of the Self-Care Maintenance scale, the Self-Care Monitoring scale, and autonomous behavior and consulting behavior dimensions of the Self-Care Management scale. Most of the fit indices provided substantial support for this general model, except for the TLI (Appendix F: Figure F1): χ^2 [142, $n = 396$] = 406.02, $P < 0.001$, CFI = 0.90, TLI = 0.88, RMSEA = 0.06 (90% CI = 0.06–0.07), $P < 0.001$, SRMR = 0.04. The model fit would have improved if two pairs of covariance residuals had been specified: between items 3 ("Do physical activity") and 15 ("Change your activity level") as well as between items 4 ("Eat special foods or avoid certain foods") and 14 ("Change what you eat or drink to make the symptom decrease or go away"). The model fit was improved and adequate when the final Thai model was verified with these error covariances (Appendix F: Figure F2): χ^2 [140, $n = 396$] = 321.44, $P < 0.001$, CFI = 0.93, TLI = 0.91, RMSEA = 0.05 (90% CI = 0.04–0.06), $P = 0.098$, SRMR = 0.03. All the factor loadings were positive and above 0.30 except for item 1, which had a low but significant loading of 0.25. The correlations among the five dimensions of the model estimates ranged from 0.45 to 0.84.

The second-order CFA model was tested by allowing the residuals of the two pairs of covariances, resulting in an adequate fit model (Fig. 1): χ^2 [144, $n = 396$] = 328.25, $P < 0.001$, CFI = 0.93, TLI = 0.91, RMSEA = 0.05 (90% CI = 0.04–0.06), $P = 0.108$,

Table 2
Factor loadings, item-total corrected correlation, and descriptive statistics of each scale in Thai Self-Care of Chronic illness Inventory version 4. c.

Items	Loading	ITC	*Mean* ± *SD*	Skewness	Kurtosis
Self-Care Maintenance scale (How often or routinely do you do the following?)					
Health-promoting behavior					
1. Make sure to get enough sleep.	0.28	0.19	3.98 ± 0.94	−0.69	−0.06
2. Try to avoid getting sick (e.g., get vaccinated, wash your hands, wear a mask, maintain distance from sick people, practice social distancing).	0.53	0.41	4.28 ± 0.75	−0.87	0.60
3. Exert energy on daily activities or exercise (e.g., take a brisk walk, use the stairs, do housework, work, gardening, sport, physical rehabilitation).	0.45	0.34	3.72 ± 1.19	−0.70	−0.34
4. Eat healthy foods, a disease - specific diet or avoid certain foods (e.g., eating vegetables, fruits, sugar, and low salt and low - fat food).	0.66	0.51	3.87 ± 0.92	−0.65	0.23
7. Mindful relaxation, being aware of stress or overthinking (e.g., meditation, yoga, music, recreational activities, doing good things, praying, religious ceremony, consulting others, accepting things as they are).	0.56	0.45	3.79 ± 0.98	−0.52	−0.25
Illness-related behavior					
5. Make appointments for routine or regular healthcare.	0.85	0.46	4.60 ± 0.73	−1.95	3.55
6. Take prescribed medicines without missing a dose and follow time schedules (for oral, injection, inhaler, or external usage).	0.88	0.47	4.63 ± 0.70	−2.22	5.75
Self-Care Monitoring scale (How often or routinely do you do the following?)					
8. Monitor whether your physical, emotional, or cognitive conditions are out of the ordinary.	0.67	0.60	3.90 ± 0.91	−0.80	0.69
9. Monitor for medication side effects (for oral, injection, or inhaler usage).	0.73	0.65	4.13 ± 0.91	−1.14	1.42
10. Pay attention to changes in how you feel your symptom occurred as well as the worsening of physical, emotional, or cognitive conditions.	0.71	0.64	4.07 ± 0.96	−1.11	1.11
11. Monitor whether you tire more than usual doing normal activities.	0.67	0.59	4.18 ± 0.82	−0.85	0.50
12. Monitor for symptoms.	0.80	0.71	4.25 ± 0.80	−0.97	0.73
Self-Care Management scale (When you have symptoms, how likely are you to use one of these?)					
Autonomous behavior					
13. The last time you had a symptom, how quickly did you recognize it as a symptom of your health condition?	0.58	0.46	3.10 ± 0.94	−0.10	0.69
14. Change what you eat or drink to make the symptom decrease or go away (e.g., reduce salt, restrict water and drinks, change food, restrict sugar).	0.62	0.49	3.93 ± 0.90	−0.77	0.52
15. Change your activity level (e.g., slow down, rest).	0.61	0.47	3.81 ± 1.00	−0.56	−0.29
19. Think of a treatment you used the last time you had symptoms. Did the treatment you used make your symptom better?	0.58	0.47	3.57 ± 0.77	−0.74	2.64
Consulting behavior					
16. Take medicine to make the symptom decrease or go away.	0.63	0.48	3.93 ± 1.04	−0.89	0.35
17. Talk to your healthcare provider (doctor/nurse) about your symptoms at the next follow - up.	0.73	0.54	4.31 ± 0.87	−1.35	1.64
18. Contact your healthcare provider (doctor/nurse) for guidance or go to your hospital or clinic.	0.69	0.52	4.01 ± 1.12	−1.12	0.51

Note: In the analysis, data from all the items within each scale were utilized, and factor loadings were obtained through confirmatory factor analysis for each of the three separate scales. ITC = corrected item-to-total correlation.

SRMR = 0.03. All the factor loadings of the simultaneous model were positive and above 0.30 except for one item (item 1), which had a low but significant loading of 0.25. The correlations among the three scales ranged between 0.84 and 0.89 (Fig. 1).

3.3.2. Convergent validity

The AVE values [59] ranged between 0.23 and 0.52 for the three scales and four dimensions (Appendix G). Specifically, the AVEs of the illness-related behavior dimension and Self-Care Monitoring scale were over the threshold value [59] of 0.50; consulting behavior had an AVE close to the acceptable threshold (AVE = 0.47); and four other scales and dimensions had AVEs below from the minimum threshold. Hence, the AVE criterion partially established the convergent validity of the Thai SC-CII V4.c [59].

3.3.3. Discriminant validity

The HTMT ratios (Appendix G) were calculated for each of the ten factorial scales and dimensions in the general Thai SC-CII v4.c (e.g., between the health-promoting behavior and illness-related behavior dimensions as well as between the health-promoting behavior dimension and Self-Care Monitoring scale). Nine of the ten pairs of factors had HTMT ratios below the threshold value of 0.85 (ranged 0.37–0.83), indicating adequate discriminant validity [60], and the HTMT ratio between the health-promoting behavior and autonomous behavior dimensions was 0.88, below the threshold of 0.90, which was acceptable [61,62]. Therefore, the discriminant validity of the Thai SC-CII v4.c was established using the HTMT criterion [60–62].

3.3.4. Concurrent validity

The Pearson's correlation coefficients [63] were estimated between each dimension (Health-Promoting Behavior, Illness-Related Behavior, Autonomous Behavior, Consulting Behavior), each scale (Self-Care Maintenance, Self-Care Monitoring, Self-Care

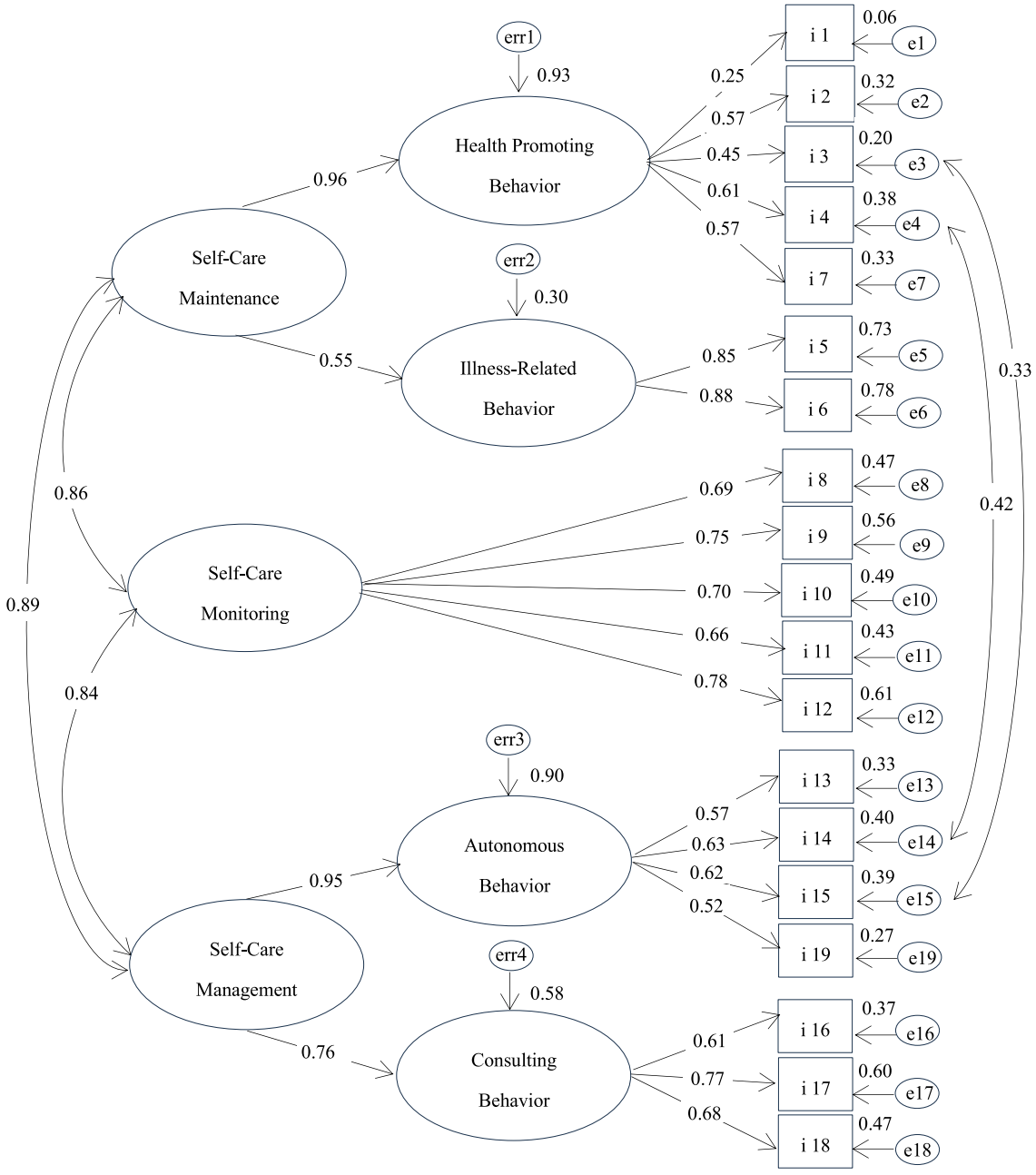

Fig. 1. Second-order factor analysis of the final general Thai model of Self-Care of Chronic Illness Inventory version 4.c. All coefficients are statistically significant ($P < 0.05$). The numbers near the one-headed arrows are factor loading coefficients; the numbers near the two-headed arrows are correlation coefficients. i = item number 1-19.

Management), and the full SC-CII and the SCSES score, and self-perceived health status. All the self-care dimensions ($r = 0.24–0.65$; all $P < 0.001$), scales ($r = 0.49–0.65$; all $P < 0.001$), and full SC-CII ($r = 0.66$, $P < 0.001$) were positively correlated with the SCSES. All the self-care dimensions ($r = 0.12–0.34$; $P < 0.05$, <0.01, or < 0.001), scales ($r = 0.28–0.32$; all $P < 0.001$), and full SC-CII ($r = 0.34$, $P < 0.001$) were positively correlated with self-perceived health status. Overall, the concurrent validity of the scales was thus established (Appendix G).

3.4. Reliability

3.4.1. Internal coherence reliability and item analysis

3.4.1.1. Self-Care Maintenance scale. Cronbach's α coefficients of 0.68 and 0.70 standardized ($n = 410$) were obtained, indicating inadequate internal coherence reliability. The Cronbach's α coefficients ranged between 0.61 and 0.70 if items were deleted, and no item was expected to significantly increase the coefficient if deleted. All the items presented adequate item discrimination, with an item-to-total corrected correlation (Table 2) above 0.30, except for one item with a low but significant corrected correlation (item 1 = 0.19). The composite reliability coefficient [59] was 0.80, while the global reliability index for the multidimensionality scales [65] was 0.67.

3.4.1.2. Self-care monitoring scale. Cronbach's α coefficients of 0.83 and 0.83 standardized were obtained ($n = 410$), indicating good internal coherence reliability. The Cronbach's α coefficients ranged

between 0.78 and 0.81 if items were deleted, and no item was expected to significantly increase the coefficient if deleted. All the items presented adequate item discrimination, with an item-to-total corrected correlation (Table 2) above 0.30 (ranged 0.59–0.71). composite reliability coefficient [59] was 0.85

3.4.1.3. Self-Care Management scale. Cronbach's α coefficients of 0.78 and 0.78 standardized ($n = 396$) were obtained, indicating adequate internal coherence reliability. The Cronbach's α coefficients ranged between 0.74 and 0.76 if items were deleted, and no item was expected to significantly increase the coefficient if deleted. All the items presented adequate item discrimination, with an item-to-total corrected correlation (Table 2) above 0.30 (ranged 0.47–0.55). The composite reliability [59] was 0.82, and the global reliability index [65] for the multidimensionality scales was 0.78.

3.4.1.4. Simultaneous Thai Self-Care of Chronic Illness Inventory. The internal coherence reliability of the full Thai SC-CII v4.c was estimated, yielding Cronbach's α coefficients of 0.88 and 0.89 standardized ($n = 396$). These coefficients indicate good internal coherence reliability. The Cronbach's α coefficients ranged between 0.87 and 0.89 if the items were deleted, and no item was expected to significantly increase the coefficient if deleted. All items had adequate discrimination, with an item-to-total corrected correlation above 0.30, except item 1, which had a lower at 0.19 but was significant. The composite reliability [59] for the Self-Care Maintenance scale, Self-Care Monitoring scale, Self-Care Management scale, and overall Thai SC-CII v4.c, estimated using respecified second-order CFA model, were 0.81, 0.82, 0.84, and 0.93, respectively. The global reliability index [65] for the overall Thai SC-CII v4.c was 0.88.

3.4.2. Test-retest reliability

The ICCs of the Self-Care Maintenance items were between 0.89 and 0.98, indicating good-to-excellent test-retest reliability (Appendix B). The ICCs of the Self-Care Monitoring items were between 0.77 and 0.97, suggesting fair to excellent test-retest reliability. The items on the Self-Care Management scale had ICCs between 0.83 and 0.94, indicating good-to-excellent test-retest reliability [69]. The average ICCs for three scales ranged between 0.84 and 0.88, with the full Thai SC-CII v4.c demonstrated an ICC of 0.92. These values indicate good-to-excellent test-retest reliability [69].

4. Discussion

We evaluated the psychometric properties of Thai SC-CII v4.c in diverse culture outside the United States and Western contexts [18,38]. No prior studies have examined the measurement equivalence of this scale in Asian countries, especially Thailand and Southeast Asia. Our study demonstrated the validity and reliability of the Thai SC-CII v4.c, which is already being used in clinical and further research endeavors.

The Thai SC-CII v4.c captured translational, theoretical, and internal constructs, as explained by good-to-excellent content validity, structural validity, internal coherent reliability, test-retest reliability, and criterion-related construct validity. These findings are consistent with those of the original study and other studies in Europe [18,38]. The generalizability of the scale is also reflected by the universal concept of self-care, where patients from different countries share the same fundamental view of self-care actions [38]. Our findings provide support for the theoretical framework for self-care of chronic illnesses. Self-care involves maintaining health; monitoring for changes in signs and symptoms; and managing changes in physical, emotional, and cognitive processes when they occur [12,19]. However, there was both cultural diversity and commonality in the self-care constructs among Thai people with chronic illnesses, as noted below.

Regarding the Self-Care Maintenance scale, the initial CFA model supported the two-dimensionality structure; however, it required specification to fit with Thai context. Thai patients did not support the structural validity of this scale, mainly differences in item allocation to each dimension. Notably, the items allocated to the health-promoting behavior and illness-related behavior dimensions differed somewhat from the original model [18]. In this study, Thai patients viewed daily lifestyle behaviors as self-care for health promotion, while medication use and treatment-related self-care were seen as illness management. These variation in factorial structures reflected cross-cultural differences in embedded norms, settings, meanings, attitudes, and values [71]. Similar differences in the psychometric characteristics of this self-care measures have been observed in disease-specific self-care scales tested in Asian countries [34,39]. Among the self-care behavior items, only sleep behavior (item 1) had exhibited inadequate loading. However, the mean score of this item was close to the theoretical score and other self-care items in the same dimension. Participants considered sleep a health-promoting behavior and recognized it importance in preventing illness, along with diet, physical activity, and stress management. The poor correlation of this item with others may attribute to the fact that sleep is the only form of self-care typically performed at night, whereas other self-care activities predominantly occur during the day. Consequently, sleep and other health-promoting behaviors may not be directly related in this context, requiring further investigation and understanding.

The Self-Care Monitoring scale was proposed as a single-factor model [18]. The original model fit well with the Thai data and supported structural validity. We examined which among the monitoring changes (illness exacerbation, medication side effects, and treatment complications) are commonly considered self-care across cultures. We verified that patients with different chronic diseases and those from different countries share similar responses to these illness-related changes [18,38]. Monitoring symptoms necessitates daily routine behaviors such as self-care maintenance to prevent and detect early symptoms. A symptom may or may not result from inappropriate self-care maintenance, although symptoms interact most directly with self-care monitoring and management [19]. Patients who gain awareness and interpretation of changes as symptoms may be able to manage their symptoms rapidly and appropriately [19].

When patients experience worsening symptoms and deteriorating health conditions, they make decisions to address their symptoms. Most patients reported experiencing symptoms and considered symptom management as an important effort. We confirmed that the original two-dimensional Self-Care Management scale, comprising autonomous and consulting behaviors [18], was perfect fit with Thai context. This indicated that patients' responses to specific illness conditions, such as symptom management, are similar across cultures [38]. A previous study on a disease-specific self-care measure, the SC-HI [36], demonstrated both commonalities and differences in the theoretical construct of the Self-Care Management. The items describing autonomous behavior and consulting behavior [36] differed from the original model [64]. However, it is remarkable that the Self-Care Management model of the generic SC-CII exhibited a perfect fit with Thai context. These findings highlight the unified nature of this scale and the cognitive-driven decision-making involved in symptom management.

As expected, the simultaneous Thai SC-CII v4.c was supported by three basic scales [18]. However, the structural validity of the more general Thai model was confirmed through improved fit indices

considered items correlations residual. Positive correlations existed among the scales and substantial components. Our findings highlight the simultaneous nature of self-care behaviors and the domains and components of self-care. Patients engage in multiple self-care activities, as proposed in the Middle-Range Theory of the Self-Care of Chronic Illness [12] and the Theory of Integrating Symptoms into the Self-Care of Chronic Illness [19], which are captured by the SC-CII [18]. To ensure theoretical and cultural alignment, we recommend that investigators verify the construct validity of the full SC-CII in their specific culture, country, or language and modify the model accordingly [18].

Additionally, we evaluated the construct validity of the instrument through various criteria, including convergent, discriminant, and concurrent validity. Regardless of the method used, the overall construct validity of the instrument was established. Discriminant validity was supported by HTMT estimates [60–62], while convergent validity required further validation for certain scales or dimensions based on AVE estimates [59]. Specifically, the Self-Care Maintenance, Self-Care Management, health-promoting behavior, and autonomous behavior components demonstrated insufficient convergent validity [72] due to several factor loading below 0.70. Concurrent validity was well-established, indicating the importance of self-care self-efficacy in influencing all self-care domains [12]. Moreover, it is important to note that each individual scale as well as overall self-care have the potential to be significant predictors of health outcomes [50,51].

For the reliability assessment, we employed the classical Cronbach's α coefficient, as well as composite reliability [59] and global reliability index [65] to evaluate the internal coherence reliability of each scale and overall instrument. Regardless of the method, the overall Thai SC-CII v4.c exhibited moderate-to-good internal consistency reliability, similar to previous studies [18,38]. However, the Cronbach's α coefficient was inadequate for the multidimensional Self-Care Maintenance scale, while it was adequate for the Self-Care Management scale. As the Cronbach's α coefficient captures the internal construct of the scale, it also involves the way patients respond to the items measuring health-promoting and illness-related behaviors, as discussed earlier. Furthermore, we extended the knowledge that each scale and overall instrument had good-to-excellent test-retest reliability, indicating stability over time.

Overall, we demonstrated that our cross-culturally adapted Thai SC-CII v4.c was valid and reliable and can be used in alternative contexts, including Thailand.

4.1. Practical implications

The SC-CII is available online (https://self-care-measures.com). The developers recommended a precise step-by-step approach for translating and back-translating the instrument into the target language. We also suggest that investigators and clinicians interested in adapting the instrument follow the international guidelines, such as ISPOR Task Force for Translation and Cultural Adaptation [41] and COSMIN [40]. By adhering to these recommendations, a culturally valid and conceptually sound instrument can be developed, enabling comparisons of self-care outcomes across different countries.

The instrument is suitable for assessing self-care in patients with chronic conditions involving multiple diseases. Furthermore, it allows for comparing self-care between different chronic diseases and episodes of illness using a reliable instrument. As patients may require different levels of self-care support depending on their diseases stage, clinicians are encouraged to assess patients' self-care needs item by item, scale by scale, or holistically. Consequently, interventions should be tailored to address health-promoting behaviors, illness management regimens, symptom monitoring, symptom management strategies, and modes of self-care enhancement [18]. For instance, patients newly diagnosed with a chronic illness are considered novices in self-care and may benefit from comprehensive self-care support as an initial step. Patients initiating self-care may require advanced approaches, such as deeper understanding of the disease, disease management regimens, and the incorporation of digital technologies to reinforce long-term self-care and adherence.

Also, self-efficacy is a crucial factor for self-care practices. We recommend that clinicians assess self-efficacy and self-care behaviors concurrently. The SCSES is available online from the same source as the SC-CII. Enhancing self-efficacy can positively influence self-care actions by motivating behavioral changes [12]. Patients with high self-efficacy are more likely to be motivated to modify their self-care behaviors, while low self-efficacy can impede self-care engagement and adherence [73].

4.2. Research implications

The first theoretically derived self-care instrument was developed to measure heart failure self-care and later expanded to various disease-specific measures. The generic SC-CII v4.c currently emphasizes self-care in people with one or multiple chronic conditions. Future research should verify its suitability for specific diseases like stroke, chronic kidney disease, cancer, and chronic joint problems. By using this unique measure, we can compare self-care among chronic diseases in terms of antecedents, processes, statuses, and outcomes. One psychometric study used multi-group CFA among patients from the United States, Italy, and Sweden to assess cross-cultural equivalence [38]. We propose extending this to Asian countries, which share sociocultural relevance in self-care behavior despite their language differences. Cross-cultural and cross-border studies have improved our knowledge of the self-care framework, individuals' responses to self-care, and the usefulness of this instrument.

4.3. Strengths and limitations

This study has strengths. Firstly, we followed international guidelines for cross-cultural adaptation of self-reported instrument [41]. We considered both language (i.e., translation, back-translation) and cultural aspects (i.e., culturally relevant, self-care practice, healthcare providers' view) during cross-cultural adaptation to assess Thai individuals with chronic illnesses. The translational validity was robust and applicable beyond its original context [58,74]. These recognized methods can yield valis and reliable instruments [58,74]. Moreover, cultural adaptation offers advantages over developing new instruments, including cost and time savings, requiring fewer steps to create the instrument [75].

Secondly, participants reflected typical characteristics of Thai individuals with chronic conditions [3] and resembled the original study's sample (i.e., spanning from young to very old adults, middle socioeconomic status, and multiple chronic conditions). Our study had a higher representation of females, enhancing the description of self-care across genders. Finally, the Thai SC-CII v4.c exhibited strong psychometric properties, ensuring cultural equivalence with translational validity, structural validity, construct reliability, internal coherence reliability, and stability over time. The robustness of the structural model and overall SC-CII v.4c supported the suitability of a medium sample size. Our findings establish a positive correlation between better self-care and general health, demonstrating the predictive potential of the instrument in assessing self-care outcomes.

However, limitation exist as we unable recruit an equal number of participants for each chronic disease type, introducing bias.

Convenience sampling was used, further contributing to selection bias, but involving participants from multicenter could alleviate this. Although nurse research assistants were trained, agreement between observers remains unknown. Notably, participants with primary education could independently complete the instrument, suggesting favorable inter-observer reliability. Future psychometric testing should include larger samples of patients with various conditions to comprehensively assess the instrument's validity and reliability. Furthermore, assessing agreement between different nurse observers is necessary to verify inter-observer reliability.

5. Conclusions

We demonstrated excellent model fit for the SC-CII v4.c in Thai patients with chronic conditions. However, respecified models are required, such as reallocating items in Self-Care Maintenance scale and adding several covariance residuals for the Self-Care Maintenance scale, Self-Care Management scale, and simultaneous model. The Thai SC-CII v4.c exhibits good psychometric properties and reflects the theoretical structure of the original scale. To enhance generalizability, future studies should sample patients with equal chronic conditions across regions within a country and throughout Asia.

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CRediT authorship contribution statement

Chonchanok Bunsuk: Conceptualization, Methodology, Validation, Investigation, Data curation, Writing - original draft, Writing - review & editing, Funding acquisition. **Jom Suwanno:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Funding acquisition, Supervision, Project administration. **Nuntaporn Klinjun:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Wanna Kumanchan:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Kannika Srisomthrong:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Chennet Phonphet:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Chidchanog Mayurapak:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Chutiporn Dansuwan:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Juk Suwanno:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Punnaphat Chramnanpho:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Umaporn Kamlungdee:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Wichai Arab:** Conceptualization, Methodology, Validation, Investigation, Writing - review & editing. **Putrada Ninla-aesong:** Conceptualization, Methodology, Validation, Writing - review & editing. **Sadee Saithong Hamilton:** Conceptualization, Methodology, Validation, Writing - review & editing. **Ladda Thiamwong:** Conceptualization, Methodology, Validation, Formal analysis, Funding acquisition, Writing - review & editing, Supervision.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declaration of competing interest

The author (s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendices A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2023.06.019.

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