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Psychometric Properties of the Turkish CardioToxicity Management Self-Efficacy Scale for Nurses

Aslı Akdeniz Kudubes[a,*], Remziye Semerci[b]

[a] Associate Professor, Department of Pediatric Nursing, Bilecik Şeyh Edebali University Faculty of Health Sciences, Bilecik, Turkey
[b] Assistant Professor, Department of Pediatric Nursing, Koç University Faculty of Nursing, İstanbul, Turkey

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ABSTRACT

Objectives: This study was conducted to evaluate the validity and reliability of the CardioToxicity Management Self-Efficacy Scale (NSS-CTC) in Turkey.
Method: This methodological and descriptive study was undertaken with 204 oncology nurses. Information was gathered using a descriptive questionnaire and the NSS-CTC instrument. In the validity analysis of the scale, explanatory factor analysis and confirmatory factor analysis were used. In the reliability analysis, Cronbach α coefficient and Pearson correlation analysis were used to examine item-total score correlations, and Student *t*-test was used for test-retest analysis.
Results: The scale, characterized by a two-dimensional structure confirmed through factor analysis, exhibited an explained variance rate of 60.44%. The factor loadings exceeded the threshold of 0.30, and all fitness indices surpassed the criterion of 0.90. Furthermore, the root-mean-square error of approximation (RMSEA) fell below 0.080 and demonstrated statistical significance. The scale demonstrated strong internal consistency, as indicated by the overall Cronbach α coefficient of 0.930, with its subdimensions exhibiting similarly high reliability, reflected in Cronbach α values of 0.871 and 0.912, respectively.
Conclusion: The NSS-CTS is a valid and reliable tool specifically developed for evaluating nurses' self-efficacy in the context of oncology wards, particularly in managing cardiotoxicity resulting from cancer treatments.
Implications for Nursing Practice: This newly developed scale holds significant promise in gauging nurses' confidence levels when confronted with the intricacies of cardiotoxicity management. It responds to the growing imperative for nurses to continually enhance their knowledge and skills to effectively address the evolving challenges associated with cardiotoxicity in cancer care.

Introduction

Cancer is currently recognized as a significant global public health concern, prompting extensive research and attention.[1,2] The use of chemotherapy and radiotherapy techniques in cancer treatment, while effective in targeting cancer cells, introduces various side effects.[3,4] Among these, cardiovascular toxicity, commonly referred to as cardiotoxicity, emerges as a substantial concern.[5,6] Cardiotoxicity can impede cancer treatment success and compromise patient overall well-being.

Cardiotoxicity, which can occur during various cancer treatments including chemotherapy, targeted therapies, and radiotherapy, presents a substantial challenge for both patients currently undergoing treatment and cancer survivors.[4,7] However, studies have shown that patients may be reluctant to undertake lifestyle changes, such as improving physical activity, quitting smoking, and making dietary modifications, despite the potential benefits in preventing and managing treatment-associated cardiotoxicity.[3,8] This highlights the need for healthcare providers, including nurses, to address barriers and provide support to patients in making necessary lifestyle changes.[9] The role of oncology nurses is pivotal in supporting patients to manage these side effects, ultimately reducing cardiotoxicity risks and elevating patient quality of life.[7]

Nurses exhibiting high self-efficacy levels can promptly recognize cardiotoxic symptoms and implement suitable strategies for effective management.[6] Moreover, nurses specialized in oncology with elevated self-efficacy foster more effective communication with patients and their families, enabling a deeper understanding of treatment processes and providing insights into cardiotoxicity-related risks and precautions.[10,11] Self-efficacy plays a crucial role in cardiotoxicity nursing, representing nurses' confidence level in their ability to effectively perform evidence-based tasks for the optimal management of both short-term and long-term cardiovascular toxicity.[6]

* Address correspondence to: Aslı Akdeniz Kudubes, RN, PhD, Department of Pediatric Nursing, Bilecik Şeyh Edebali University Faculty of Health Sciences, Gülümbe, Bilecik.
E-mail address: asliakdeniz@hotmail.com (A. Akdeniz Kudubes).

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As shown by Bandura's Social Cognitive Theory, nursing performance, behaviors, and outcomes are significantly influenced by self-efficacy. Higher levels of self-efficacy are predicted to positively correlate with nursing competence in controlling cardiotoxicity.[12] According to Bandura's theory, people's perceptions of their skills and capacity for problem-solving are influenced by their level of self-efficacy or their conviction that they can carry out the activities necessary to manage future circumstances.[13] This self-belief is essential to nursing since it influences performance and the capacity to handle challenging assignments well. Additionally, according to Bandura's theory, mastery experiences, verbal encouragement, and role modeling may all increase an individual's perception of self-efficacy.[14] These ideas can be implemented into teaching and learning tactics to help nursing students perform better.[15]

The assessment of nursing self-efficacy in managing cardiotoxicity resulting from cancer treatment plays a pivotal role in pinpointing educational deficiencies and promoting the enhancement of nursing expertise in this specialized domain of cancer care.[6] Oncology nurses, central to the healthcare team involved in cancer treatment, significantly contribute to cardiotoxicity management[7,9] Elevated self-efficacy within this context is instrumental in averting complications tied to cardiotoxicity and improving patients' quality of life.[6] Nevertheless, to the best of our knowledge, a scale to assess nursing self-efficacy in managing cancer treatment-related cardiotoxicity is unavailable in our country. Thus, this study aims to assess the Turkish psychometric attributes of the Nursing Self-Efficacy Scale for Managing Cancer Treatment-Related Cardiotoxicity (NSS-CTC) among oncology nurses. This scale adaptation will gauge nurses' competence in this realm and contribute to the formulation of targeted educational programs. By fostering the enhancement of oncology nurses' self-efficacy in managing cardiotoxicity, this study aims to empower proactive, effective patient care, thereby elevating patients' quality of life and preventing potential cardiac complications.

Method

Study Design

This research was planned with a methodological and descriptive design. The study aims to adapt the NSS-CTC developed by Magon et al (2023) into Turkish and determine its validity and reliability.

Study Setting

This study was conducted with oncology nurses in Turkey between May 2023 and September 2023. The nurses were reached through members of the Oncology Nursing Association work groups.

Study Sample

The study was conducted among oncology nurses employed at both a hospital affiliated with the Ministry of Health and a private hospital in Turkey. The determination of the sample size was grounded in the guideline stipulating that sample sizes for scale validity and reliability studies should ideally range from 5 to 10 times the number of scale items or fall within the bracket of 200 to 300.[16] Considering that the NSS-CTC comprises 15 items, the primary objective was to achieve a sample size of 204 participants, ensuring robustness in the analysis of scale validity and reliability

The inclusion criteria were being an oncology nurse, having proficiency in Turkish language, not having auditory or visual impairments, and being willing to participate in the study.

The exclusion criteria were incomplete filling out of data forms, withdrawal from the research, and not having completed the 3-month orientation process in the oncology clinic.

Data Collection Tools

Descriptive form

The researchers created the questionnaire following a comprehensive literature review.[6,17] It encompasses a total of nine inquiries that pertain to the sociodemographic and professional attributes of the participants, encompassing factors such as age, sex, workplace, tenure in the field of oncology, nursing role, among others.

NSS-CTC

The scale was developed by Magon and colleagues in 2023. The scale consists of 15 items and measures the self-efficacy of oncology nurses in managing cardiotoxicity related to cancer treatment. The scale uses a 5-point Likert type response format (1 = strongly disagree, 2 = disagree somewhat, 3 = neutral, 4 = agree somewhat, 5 = strongly agree). The scale is divided into two subscales: self-efficacy related to knowledge (items 1–5) and self-efficacy related to application (items 6–15). The NSS-CTS instrument sets itself apart from other generic assessment tools by virtue of its unique item content, which serves as indicators for observed variables used in the computation of distinct scores corresponding to the scale's two specific domains, as outlined in Appendix 3. It is important to highlight that none of the items within the scale are subjected to reverse scoring. Moreover, the global Cronbach α coefficient for the entire scale is notably high at 0.975, while the self-efficacy subscale pertaining to knowledge demonstrates a commendable reliability coefficient of 0.924, and the self-efficacy subscale addressing application-related aspects exhibits a robust reliability coefficient of 0.937.[6]

Validity and Reliability Stages

Language validity

On obtaining the necessary permissions, the procedure for modifying the assessment tools commenced, following the methodology advocated by the World Health Organization for the translation of instruments initially conceived in a language distinct from the one intended for the target audience.[18,19] To ensure both linguistic accuracy and the substantive validity of the scale, the first step encompassed the translation of the NSS-CTC from English into Turkish. This task was undertaken by two independent professionals affiliated with a reputable translation company specializing in health-related translations and proficient in both Turkish and English at a native level.

Subsequently, the Turkish version of the scale was translated back into English by an individual well-versed in both languages. In ensuring the accuracy of meaning and grammatical aspects, a comprehensive discussion occurred between the translators and the researchers, facilitating necessary adjustments to the Turkish scale versions.

Content validity

This process aims to assess whether each item within the scale effectively measures the targeted concept and whether it encompasses any unintended concepts. For content validity assessment, insights from a minimum of five experts within the pertinent field, well-versed in scale item formulation techniques and methodologies, are essential.[20] To assess content validity in this study, the form of the scale and the linguistically validated version were sent to 19 nurses with competence in scale creation and adaptation.

To ascertain content validity, the Davis technique was employed, as outlined by Rubio et al (2003). In this technique, experts assess their opinions on each item using a 4-point scale comprising: (4) appropriate, (3) fairly appropriate with minor revisions, (2) somewhat appropriate—needs significant revision, and (1) not appropriate.[21] Content validity indexes are anticipated to surpass 0.80, computed by dividing the count of experts endorsing options 3 and 4 for each item by the total number of experts providing evaluations.

Preliminary test

The Process of Adapting Measurement Instruments guide provided by the World Health Organization (2009) emphasizes the significance of conducting back-translation after obtaining expert opinions.[19] It is underscored that back-translation should be executed by at least two translators.[22] In line with these recommendations, this study initiated the back-translation process following the solicitation of expert opinions. The scale was translated from Turkish to English by two skilled linguists fluent in Turkish and English. The researchers then thoroughly evaluated the original scale and the translated English version. Adjustments were performed as needed, culminating in the scale's readiness for the pilot phase.

The scale was administered to a cohort of 30 oncology nurses affiliated with the Oncology Nursing Association as part of the pretesting phase. These individuals shared comparable characteristics with the study's intended participants but were not formally enrolled.[23] Following the pretest, each item's comprehensibility was scrutinized, and any required corrections were promptly implemented. The final iteration of the scale was meticulously fine-tuned and poised for full-scale implementation.

Data collection

Using the platform provided by the Oncology Nursing Association, contact was established with oncology nurses through the association's work groups on social media. As the first step, nurses were provided with comprehensive research information. Subsequently, research links were dispatched exclusively to those nurses who willingly expressed their intent to participate. Data acquisition was facilitated using the Google Forms survey tool, which relied on self-reports from the nurses. The nurses successfully completed the survey and the scale, a process that required an average duration of 5–10 minutes.

Data analysis

IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY), in combination with the AMOS 26 software package, facilitated the data analysis process. When analyzing the demographic features of nurses, categorical data were examined using percentages and frequency distributions, while quantitative data were summarized using statistical variables such as the mean, standard deviation, and median (interquartile range). Confirmatory factor analysis (CFA) investigates whether there is a compatibility between the factors determined in explanatory factor analysis (EFA) and the factors put forward theoretically. In scale adaptation, validity and reliability studies, CFA should be used to test the validity of the structure obtained after EFA.[24] In scale adaptation studies in health research with a limited sample, it is recommended to first perform an EFA and then a CFA using the same data set.[25] In the literature, it is recommended not to use this method, especially in smaller samples, as performing EFA and CFA analyzes by dividing the data into two with a sample size of less than 500 people will cause biased results.[26] In line with the literature information, both EFA and CFA analyzes were conducted on the same sample due to the limited number of samples in our research and the study in a special group. Fig 1 illustrates the statistical approaches used in the study.

Ethical consideration

The research study's execution received ethical clearance from an university Social Research Ethics Committee under the reference number 2023.185.IRB3.081. Authorization to use the scale in the research was acquired through email correspondence with the scale's original author. Prior to distributing the survey forms to nurses who willingly expressed interest in participating, a comprehensive briefing on the study's aims was provided, and their formal written consent was duly obtained.

Results

It was determined that the mean age of the nurses participating in the study was 35.52 ± 8.10, 91.2% were women, and 51.5% worked in adult oncology units. The descriptive characteristics of the nurses are presented in Table 1.

Results of Validity Analysis

Experts reached a substantial consensus on each individual item, as measured by the Item Content Validity Index (I-CVI), with agreement levels spanning from 0.94 to 0.99. Additionally, the Scale Content Validity Index (S-CVI) achieved a noteworthy rating of 0.97 for the entire scale, emphasizing the robust agreement among experts concerning the overall content validity of the scale.

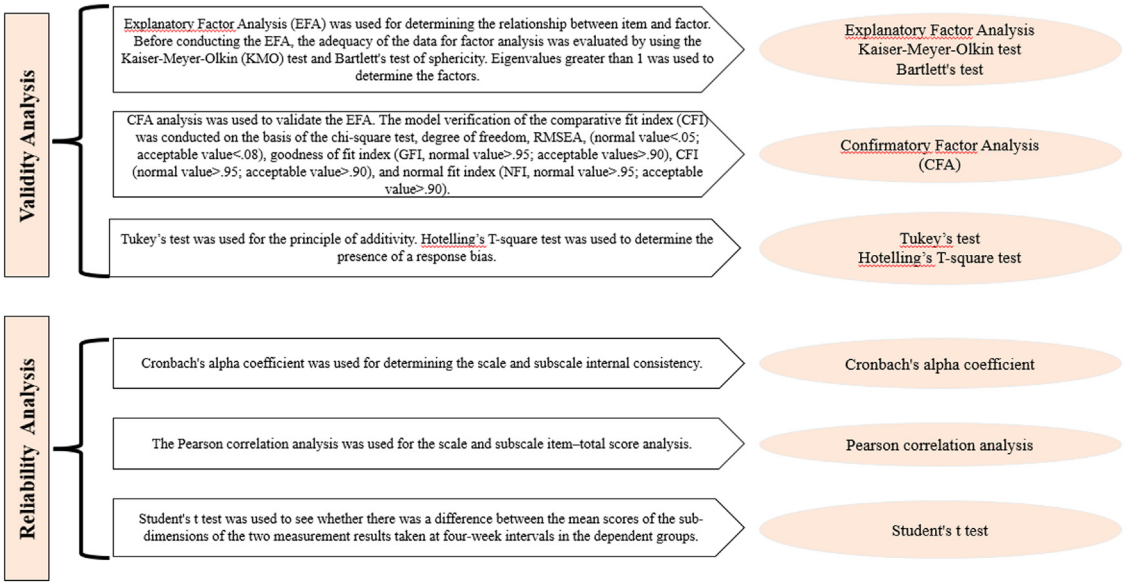

FIG 1. Statistical analysis.

TABLE 1
Characteristics of Nurses.

		Mean ± SD	Min-Max
Age (years)		35.52 ± 8.10	23–54
Professional experience period (years)		13.50 ± 8.94	1–35
Length of experience in the oncology clinics (years)		8.21 ± 2.49	1–30
		n	**%**
Sex	Male	18	8.8
	Female	186	91.2
Education status (Graduated schoole)	Health vocational high school	10	4.9
	University	140	68.6
	Master degree	47	23.0
	Doctoral degree	7	3.4
Marital status	Married	143	70.1
	Single	61	29.9
Working clinic type	Adult oncology clinics	105	51.5
	Pediatric oncology clinics	99	48.5
Working oncology clinic type	Medical oncology	47	23.0
	Bone marrow transplantation unit	16	7.8
	Pediatric oncology-hematology clinic	84	41.2
	Outpatient unit	27	13.2
	Adult hematology clinic	16	7.8
	Others	14	6.9
The state of receiving cardiotoxicity-specific education	Yes	60	29.4
	No	144	70.6

SD, standard deviation

Using the Varimax rotation technique, the results of the EFA revealed a strong two-subscale structure within the scale. A comprehensive summary of these findings is available in Table 2. Additionally, Table 2 presents a detailed display of the factor loadings for the scale items, along with the corresponding explained variance rates for the scale.

The results of the CFA reaffirmed the existence of the two-subscale structure in the scale. For an in-depth analysis of the CFA

TABLE 2
Results of Exploratory Factor Analysis.

Items	Self-Efficacy Related to Knowledge Subscale	Self-Efficacy Related to Application Subscale
1. Recognize which chemotherapy treatments can damage the heart in reversible and irreversible ways	0.794	
2. Recognize chemotherapy treatments that may lead to both early and late cardiovascular damage	0.823	
3. Recognize the symptoms and signs of secondary cardiotoxicity caused by chemotherapy treatments	0.664	
4. Identify risk factors, both modifiable and not, for chemotherapy- related cardiovascular complications	0.811	
5. Adjust the modifiable risk factors resulting from the use of cardiotoxic chemotherapeutic treatments	0.696	
6. Find and interpret the recommendations and evidence available in the literature related to chemotherapy cardiotoxicity		0.613
7. Utilize the recommendations and evidence on chemotherapy cardiotoxicity that are available in the literature		0.456
8. Interpret the results of laboratory tests to determine their predictive value of cardiovascular damage		0.630
9. Determine the levels of understanding, knowledge, and lifestyles (eg, eating habits, physical activity, smoking, and sedentary behaviors) in a patient receiving cardiotoxic chemotherapeutic treatments		0.769
10. Monitor for signs and symptoms of deteriorating cardiovascular functions over time		0.640
11. Monitor the factors that may have a negative impact on cardiovascular clinical outcomes over time		0.747
12. Monitor lifestyle changes over time and compliance with cardiotoxicity recommendations		0.738
13. Provide cardiotoxic chemotherapy patients with information about healthy lifestyles to adopt (eg, nutrition, physical activity, smoking cessation)		0.687
14. Educate the patient undergoing cardiotoxic chemotherapy on how to recognize the symptoms and indicators of altered cardiovascular function (eg, fatigue, pain, dizziness)		0.743
15. Educate the patient undergoing cardiotoxic chemotherapy on how to control the variables that may have a detrimental impact on their clinical cardiovascular outcomes (eg, chronic diseases such as arterial hypertension and diabetes mellitus)		0.653
Subscale explained variance	9.86%	50.58%
Total explained variance	60.44%	
Kaiser-Meyer-Olkin coefficient	0.824	
Barlett test	2225.562 0.000	

TABLE 3
Model Fit İndices of the Scale.

	χ^2	df[a]	χ^2/df	RMSEA[b]	GFI[c]	CFI[d]	IFI[e]	RFI[f]	NFI[g]	TLI[h]
Two-factor model	351.300	89	3.947	0.079	0.91	0.92	0.91	0.93	0.92	0.91

a, degree of freedom; b, root-mean-square error of approximation; c, goodness of fit index; d, comparative fit index; e, incremental fit index; f, relative fit index; g, normed fit index; TLI (NNFI), Trucker-Lewıs index.

findings, including detailed metrics and visual representations, please consult Table 3 and Fig 2.

The assessment of internal consistency and temporal stability yielded a Hotelling T square value of 558.362 and an *F*-statistic of 37.175. It is worth noting that there was no significant indication of response bias in the scale ($P < .01$). Additionally, the summability analysis produced an *F*-statistic of 0.772 with a corresponding *P* value of .840, affirming the reliability of the scale.

Results of Reliability Analysis

The Cronbach α for the complete scale was calculated at a substantial level of .930. Moreover, the α coefficient for the Self-Efficacy

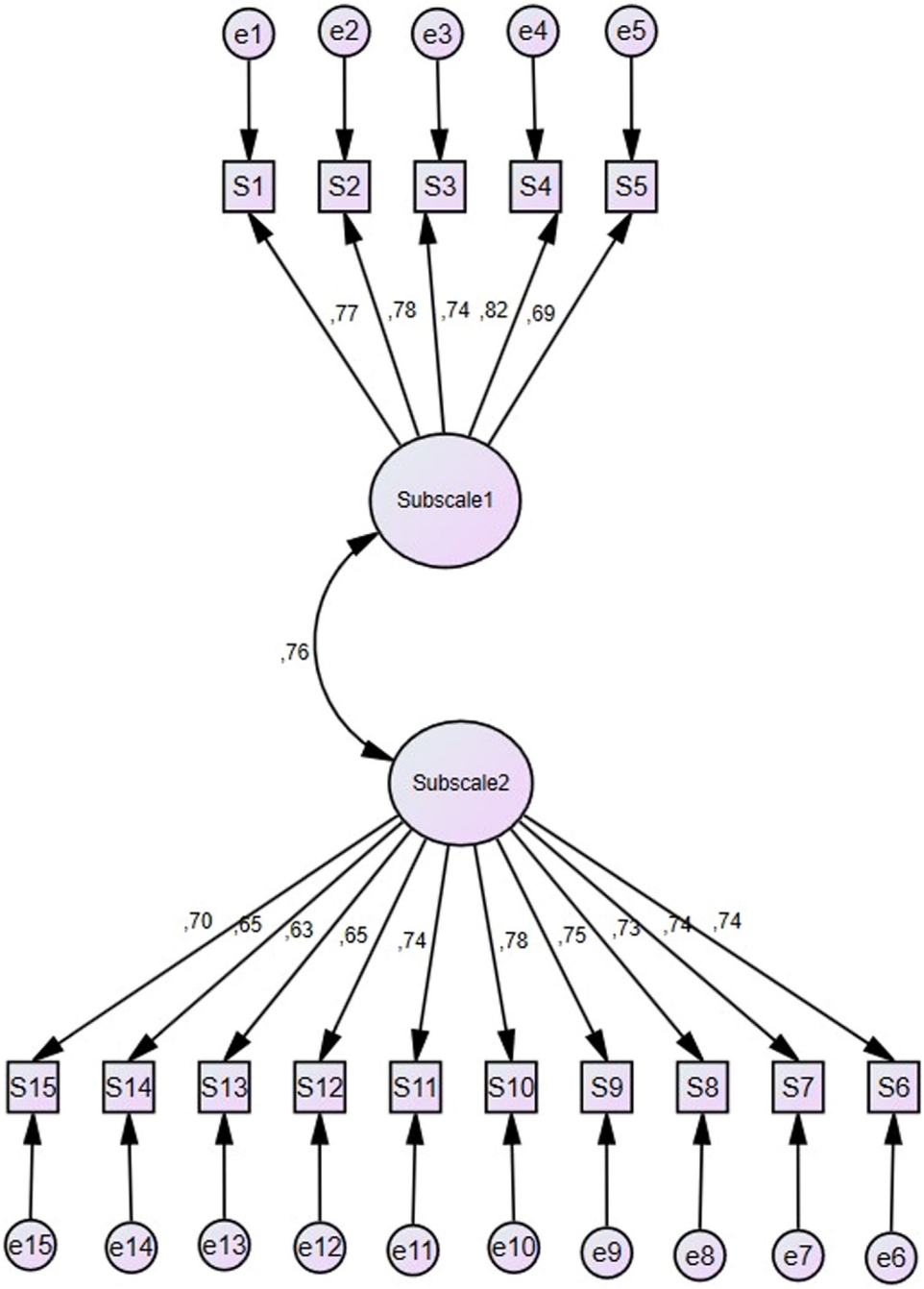

FIG 2. Results of confirmatory factor analysis.

Related to Knowledge Subscale demonstrated a value of .871, while for the Self-Efficacy Related to Application Subscale, it reached .912, signifying robust internal consistency. Detailed findings from the split-half analysis for the scale can be found in Table 4.

The Pearson correlation analysis indicated that the items displayed diverse levels of association with the total score, with correlations ranging from 0.64 to 0.76. Additionally, there were significant correlations between individual items and their respective subscale scores, with values ranging between 0.70 and 0.84. Furthermore, the test-retest correlations for item scores, as outlined in Table 5, spanned from 0.70 to 0.88.

The Pearson moments multiplication correlation, commonly referred to as the test-retest reliability coefficient, was employed to assess the scale's consistency when administered at two different points with a 4-week gap. The results of the test-retest scores revealed a statistically significant positive correlation ($r = 0.77$, $P = .000$), as shown in Table 6. Additionally, a paired Student t-test was conducted to explore whether there were any significant differences in mean scores between the two administrations of the scale separated by the 4-week intervals ($t = 0.165$, $P = .870$), as illustrated in Table 6.

Discussion

This study aimed to adapt the Turkish validity and reliability study of the NSS-CTC developed by Magon et al. In this study, Bandura's Social Cognitive Theory was used to understand a promising framework for comprehending self-efficacy and its impact on nursing competence.[14,27] The usefulness of the theory in evaluating and improving nursing competence is further demonstrated by its application in the development and validation of self-efficacy measuring scales for nursing practices.[28,29] Based on this framework, the study results showed that higher nursing self-efficacy positively correlates with better nursing competency in dealing with cardiotoxicity scores.

Evaluating content validity is a critical step in determining whether the items in a measurement tool effectively represent the intended phenomenon. To establish content validity, expert opinions were solicited to evaluate the appropriateness of the item pool created by the researcher. It is important to highlight that a commonly suggested criterion is that the CVI for the entire scale should ideally meet or exceed a minimum threshold of 80% to ensure strong content validity.[30–33] In this study, the I-CVI for each item ranged from 0.94 to 0.99, resulting in an overall S-CVI of 0.97. These findings indicate that the scale is clear, accurately represents its constituent items, and possesses strong content validity. Additionally, in both the initial scale development and our research, the content validity ratio (CVR) was calculated for each item and fell within the range of 0.83 to 1.00. This supplementary analysis further reinforces the content validity of the scale.[6]

EFA is a highly significant statistical technique in the development and validation of theoretical frameworks and measurement instruments. In our research, we used EFA to establish the construct validity of the scale. To evaluate the factor structure, we conducted the Kaiser-Meyer-Olkin (KMO) test and the Bartlett test of sphericity. The KMO test assesses the adequacy of the sample for data analysis, with ratings on a scale where values between 0.90 and 1.00 are deemed excellent, 0.80–0.89 as fairly good, 0.70–0.79 as good, 0.60-0.69 as moderate, 0.50–0.59 as poor, and values below 0.50 are considered unacceptable[32,33] In our research, we determined a KMO coefficient of 0.824, which serves as an indicator of the sample's appropriateness for factor analysis. A KMO value approaching 1 reflects a strong suitability of the dataset for factor analysis, affirming the adequacy of our data. Furthermore, we conducted the Bartlett test of sphericity to assess the intervariable correlations. Our analysis led us to reject the null hypothesis at $P < .001$, signifying a significant association among the items and reaffirming the suitability of the data for factor analysis.[32,33] It is important to highlight that in the initial study for scale development, the KMO coefficient also exhibited a substantial value of 0.940, and the Bartlett test generated a statistically significant result. This alignment in the outcomes of the factor analysis

TABLE 4
Results of the Reliability Analyses of the Scale and Sub Scale (n = 204).

Subscales	Cronbach α	First Half of Cronbach α	Second Half of Cronbach α	Spearman-Brown	Guttman Split-Half	Correlation between Two Halves	M ± SD (Min–Max)
Scale total	0.930	0.89	0.88	0.84	0.84	0.73	40.77 ± 11.54 (15–60)
First subscale	0.871						13.05 ± 4.30 (5–20)
Second subscale	0.912						27.74 ± 8.16 (10–40)

SD, standard deviation.

TABLE 5
Results of the Reliability Analyses of the Scale and Correlations of the Item Total Score and Subdimension Total Score.

Items	χ ± SD	Item-Total Score Correlation	Item-Subscale Total Score Correlation	Test-Retest Correlations of Items (n = 26)
1	2.54 ± 1.08	0.693	0.819	0.838
2	2.66 ± 1.09	0.686	0.834	0.817
3	2.67 ± 1.05	0.724	0.790	0.843
4	2.65 ± 1.01	0.726	0.849	0.845
5	2.53 ± 1.05	0.641	0.771	0.845
6	2.65 ± 1.10	0.738	0.753	0.819
7	2.70 ± 1.11	0.753	0.732	0.888
8	2.79 ± 1.05	0.741	0.748	0.889
9	2.81 ± 1.10	0.717	0.781	0.706
10	2.74 ± 1.12	0.765	0.792	0.814
11	2.85 ± 1.08	0.728	0.776	0.885
12	2.78 ± 1.10	0.667	0.717	0.825
13	2.83 ± 1.10	0.679	0.707	0.737
14	2.79 ± 1.10	0.666	0.721	0.827
15	2.81 ± 1.01	0.731	0.745	0.837

SD, standard deviation.

TABLE 6
Test-Retest Score Mean Obtained from the Scale and Their Comparison (n = 26).

	Scale Score Mean		Analysis Results			
	First Implementation $\chi \pm SD$	Second Implementation $\chi \pm SD$	r	*P*	*t*	*P*
Scale	54.26 ± 11.13	54.03 ± 9.63	0.774	.000	0.165	.870

SD, standard deviation.

between the original research and our current investigation underscores the coherence and strength of our findings.[6]

Construct validity is a pivotal facet in evaluating assessment instruments, and it is generally viewed favorably when a scale accounts for more than 40% of the variance, particularly in multidimensional scales. A higher proportion of explained variance indicates enhanced construct validity.[16,32] In our research, we noted that the explained variance exceeded 50%, signifying robust construct validity. In the original study, the first subdimension contributed to 27% of the total variance, while the second subdimension substantially contributed 51.99%, collectively explaining 78.99% of the total variance. Interestingly, it is worth mentioning that the level of explained variance observed in the original study exceeded that which we found in our investigation.[6]

EFA is used to determine the most suitable subdimension for organizing items within a scale. It is recommended to keep items with factor loadings of 0.30 or higher, while items with loadings below this threshold are generally suggested for exclusion from the scale.[32] In our research, the factor loadings of items in the two subdimensions varied between 0.45 and 0.82. Conversely, in the original version of the scale, factor loadings for items in the two subdimensions were in the range of 0.53 to 0.99.[6] The findings from our study closely align with the factor loadings observed in the original scale, underscoring the presence of a robust and consistent factor structure.

CFA is used to validate the findings derived from EFA. In this process, we assess whether the factors identified in EFA exhibit a valid and well-fitting structure by using fit indices derived from the analyzed dataset.[34,35] The results of the CFA revealed a two-factor structure for the scale items. Various fit indices, including χ^2, χ^2/SD, GFI, RMSEA, NFI, and CFI, were used in the CFA. Notably, the RMSEA value, uaed as a fit index, was found to be less than 0.08, indicating the model's adequacy. Furthermore, the GFI, NFI, and CFI values all met or exceeded the threshold of 0.90, further affirming the adequacy of the fit indices.[34,35] As a result, these findings indicate that the scale data exhibit a strong fit, statistical reliability, and construct validity. Based on this analysis, we concluded that all items and both subscales effectively measure the self-efficacy of oncology nurses in managing cardiotoxicity associated with cancer treatment, which justifies retaining all items within the scale. These results from CFA align with established criteria in the literature. Furthermore, when comparing the CFA results from our study with those from the original study, it becomes apparent that the RMSEA value in our study is more favorable.[6]

Reliability, as a measurement metric, assesses the extent of consistency and stability in the measurements obtained from a scale. A reliable scale should produce consistent results when used under similar conditions and at different time intervals. Reliability essentially underscores the consistency in evaluating all items within a scale and the enduring nature of the assessed phenomenon.[18,36] In our research, the Cronbach α coefficient for the self-efficacy related to knowledge subscale was .871, for self-efficacy related to application, it was .912, and for the overall score, it reached 0.930. It is worth highlighting that in the original study for scale development, the α values exceeded .90.[6] These results confirm the reliability and consistency of the scale across all its assessed items.

In split-half analysis, a commonly used technique to assess a scale's reliability, it is generally expected that the coefficients should exceed the threshold of 0.70.[36,37] In our study, the coefficients exceed 0.70, indicating a robust and statistically significant correlation between the two halves of the scale. Nevertheless, it is important to emphasize that a direct comparison of the results between the two studies was not possible due to the absence of split-half analysis findings in the original study.[6]

The homogeneity test assesses whether the intended concept(s) is appropriately represented in the assessments of validity and reliability for the scale.[38–40] In our research, we evaluated the homogeneity of responses from the sampled nurses towards the scale items by applying the Hotelling T^2 test. This analysis confirmed that the NSS-CTC maintained its consistency and impartiality, thereby ensuring the precise measurement of the intended concept.

Performing an item-total score analysis is a recommended step in the assessment process to determine the extent to which the individual items within the scale accurately measure the targeted variable. This analysis serves to provide insights into the relationships between the scores obtained from each of the scale's items and the cumulative score of the entire scale, shedding light on how well each item contributes to the overall assessment of the intended variable.[41] In this context, a value exceeding 0.20 is generally deemed acceptable for this association, and ideally, it should approach a value of 1 in a positive direction.[41] In our study, the obtained results surpassed the 0.20 threshold, affirming a favorable relationship. Nonetheless, it is important to note that a direct comparison with the original scale research was not feasible due to the absence of Pearson correlation analysis results in the original study.[6] While a satisfactory test-retest correlation coefficient is a positive indicator, it is prudent to conduct a comprehensive examination of the mean and standard deviations of the two sets of measurements to ensure their comparability and consistency.[42] In our research, we used the "*t*-test for dependent groups" to explore whether there existed a statistically significant distinction between the mean scores when the scale was administered with a 4-week interval. The analysis disclosed no statistically significant difference between the mean scores ($P > 0.05$, as depicted in Table 6). However, it is crucial to emphasize that while overall scores may not exhibit significant differences, individual responses to each item may still vary. Consequently, it remains essential to carefully consider the consistency of the materials and conditions used in both administrations.[42] Moreover, in the evaluation of the correlation between the scores obtained from the initial and subsequent administrations of each item, the test-retest reliability coefficients for the scale items were found to be statistically significant ($P = .000$). This signifies that the scale items consistently yielded reliable results in both assessment instances, implying clarity and consistency in their expressions over time. It is important to note, however, that the absence of test-retest analysis results in the original scale study precluded a direct comparative assessment.[6] Using a variety of retest tests, getting input on construct stability, examining item-level data for changes, and gathering more data to comprehend response consistency are all necessary steps in establishing a priori reliability criteria. However, other conclusions, such as the retest interval, need to be better supported by the data, and moderate retest correlations are frequently considered sufficient. Retest evaluations are rarely carried out prior to the finalization of a measure, which makes it difficult to utilize retest data to choose trustworthy items.[43]

Limitations

Although this study has several notable strengths, it has some limitations. First, the study aimed to achieve a robust sample size according to established guidelines. The study used a convenience sample of oncology nurses from specific hospital settings. This may introduce selection bias and limit the generalizability of the findings to the

broader population of oncology nurses. Second, the exclusion criteria included not having completed the 3-month orientation process in the oncology clinic. This criterion may have excluded potential participants with valuable insights or experiences relevant to the study objectives. In conclusion, while this study provides valuable insights into adapting and validating the NSS-CTC scale in the Turkish context, these limitations should be considered when interpreting and applying the findings. Future research can aim to address some of these limitations for a more comprehensive understanding of the scale's utility and applicability.

Conclusion

The NSS-CTS emerges as a robust and dependable tool designed to assess the self-efficacy of nurses working in oncology wards, specifically concerning their competence in handling cardiotoxicity induced by cancer treatments. This newly developed scale holds significant promise in gauging nurses' confidence levels when confronted with the intricacies of cardiotoxicity management. It responds to the growing imperative for nurses to continually enhance their knowledge and skills to effectively address the evolving challenges associated with cardiotoxicity in cancer care. By doing so, it not only promotes patient safety but also contributes to the overall quality of care provided in oncology settings. Furthermore, the NSS-CTS introduces a valuable means to measure nurses' self-efficacy in the management of cardiotoxicity induced by cancer treatments. This, in turn, offers potential insights and directions for future experimental research in the ever-evolving field of oncology care. It is important to acknowledge that further research is necessary to reinforce the construct validity of this measurement tool and to assess its applicability across diverse national and cultural contexts. Ensuring the scale's reliability and relevance in various healthcare settings will enhance its utility and broaden its potential impact in oncology nursing practice.

Conducting the NSS-CTS validity and reliability study is an important step to determine the self-efficacy level of Turkish oncology nurses in the management of cardiotoxicity. Using the scale and disseminating its use will help determine nurses' self-efficacy levels in cardiotoxicity management. In addition, it is thought that increasing the use of NSS-CTS in oncology nurses in Turkey will contribute to the spread of cardiotoxicity studies related to cancer treatment, which have gained momentum in the field of nursing in recent years, in Turkey.

Implications for Nursing Practice

The NSS-CTC emerges as a robust and dependable tool designed to assess the self-efficacy of nurses working in oncology wards, specifically concerning their competence in handling cardiotoxicity induced by cancer treatments. This newly developed scale holds significant promise in gauging nurses' confidence levels when confronted with the intricacies of cardiotoxicity management. It responds to the growing imperative for nurses to continually enhance their knowledge and skills to effectively address the evolving challenges associated with cardiotoxicity in cancer care. By doing so, it not only promotes patient safety but also contributes to the overall quality of care provided in oncology settings.

This study has many strengths. In parallel with the acceleration in the opening of cardio-oncology clinics and the creation of cardio-oncology programs around the world, the concept of cardio-oncology has begun to develop rapidly in Turkey. Therefore, it is planned to contribute to the development of both oncology nursing education and care practices by determining the self-efficacy levels of nurses who will serve in this field using NSS-CTS.

It is aimed that the use of NSS-CTS in oncology nurses in Turkey will raise awareness about cardiotoxicity associated with cancer treatment and draw attention to this issue. Thus, it is thought that this subject can be given more space in the training of oncology nurses in Turkey and will contribute to the enrichment of cardiotoxicity management knowledge and skills.

Determining the self-efficacy level of oncology nurses and using the theoretical framework in the original study of the scale will contribute to the creation of training program contents used when training oncology nurses. It may be planned to organize sessions on cardiotoxicity in events such as congresses, courses and symposiums held in the field of oncology nursing in Turkey.

The training programs to be provided for cardiotoxicity management will enable oncology nurses to be well aware of the cardiotoxic effects that may occur in relation to cancer treatment and to diagnose acute/life-threatening situations early and manage them successfully. In addition, their involvement in the early diagnosis of cardiotoxicity will be an important step in preventing negativities such as changing, postponing or stopping patients' treatments due to cardiotoxic reasons.

Authors Contributions

All the authors contributed to the concept and design, acquisition and interpretation of data, and drafting of the article and gave final approval of the version to be published.

Declaration of Competing Interest

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CRediT authorship contribution statement

Aslı Akdeniz Kudubes: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Remziye Semerci:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Ethical Statement

The research study's execution received ethical clearance from the Koç University Social Research Ethics Committee under the reference number 2023.185.IRB3.081. Authorization to utilize the scale in the research was acquired through email correspondence with the scale's original author. Prior to distributing the survey forms to nurses who willingly expressed interest in participating, a comprehensive briefing on the study's aims was provided, and their formal written consent was duly obtained.

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