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Validity and reliability study of the Turkish version of the Questionnaire on Best Practices for Short Peripheral Intravenous Catheter Maintenance: A methodological study

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Abstract

Aim: This study aimed to evaluate the validity and reliability of the Turkish version of the Questionnaire on Best Practices for Short Peripheral Intravenous Catheter Maintenance.

Methods: A methodological design was employed between February and May 2025, involving a sample of 276 nurses. Participants were drawn from emergency departments, internal medicine units, surgical wards, and intensive care units across hospitals in two provinces in eastern Turkey. Data were collected using two instruments: the Nurses' Information Form and the Questionnaire on Best Practices for Short Peripheral Intravenous Catheter Maintenance. Descriptive statistics, including frequencies, percentages, means, standard deviations, medians, and minimum and maximum values, were used to describe participant characteristics. Content validity was assessed through expert review, and the Content Validity Index was calculated using the Davis technique. Item discrimination and difficulty indices were computed using Microsoft Excel. Reliability analysis involved calculation of the Kuder–Richardson Formula 20 (KR-20) coefficient, alongside item–total score correlation analysis.

Results: The KR-20 coefficient for the Questionnaire on Best Practices for Short Peripheral Intravenous Catheter Maintenance was 0.974. Analysis of the test mean scores revealed that the items were generally easy but exhibited high discriminatory power.

Conclusion: The Turkish version of the Questionnaire on Best Practices for Short Peripheral Intravenous Catheter Maintenance demonstrated high reliability, as evidenced by its KR-20 value. The use of this questionnaire enables the identification of knowledge gaps among nursing professionals regarding best practices in short peripheral catheter care.

Keywords

Intravenous, nurses, knowledge, peripheral venous catheterization, practice, reliability and validity

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Introduction

Intravenous catheterization is an essential component of modern clinical practice, with peripheral, central, arterial, and venous catheters placed for various therapeutic and diagnostic purposes. Among these, short peripheral catheter (SPC) is the most frequently performed procedure,[1] enabling the administration of fluids, electrolytes, medications, and blood products to manage a wide range of

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clinical conditions.[2] More than 80% of hospitalized patients undergo intravenous therapy during their hospital stay. However, despite its widespread use, SPC is associated with significant failure rates, with studies reporting that 33%–69% of SPC insertions are unsuccessful.[3] Over the past decade, short peripheral catheters (SPCs) have emerged as the most commonly used venous access devices due to their cost-effectiveness and ease of insertion and removal. However, SPCs are not without challenges: they are associated with a high incidence of minor local complications and are implicated in 43%–59% of catheter failures, typically defined as the forced and unplanned removal of the device.[4]

To address these issues, evidence-based guidelines such as the EPIC (Evidence-based Prevention and Infection Control) guidelines and the Infusion Nursing Society (INS) Standards of Practice emphasize the importance of interprofessional leadership and adherence to standardized protocols in infusion therapy.[4,5] Nurses play a pivotal role in SPC care, bearing responsibility for preventing complications such as infiltration/extravasation, catheter displacement and/or occlusion, leakage, pain, hematoma, bruising, vein sclerosis, phlebitis, thrombophlebitis, and bloodstream infections.[6] Research indicates that many of these complications are preventable through the consistent application of evidence-based practices for catheter insertion, maintenance, and removal. In addition to preventing complications, proper SPC management can also prevent issues such as unnecessary diagnostic procedures and treatments, stress for patients and their families, extended hospital stays, increased workloads for healthcare personnel, and higher healthcare costs.[7]

The international literature[8,9] highlights the need for further research to test appropriate tools and determine which bundle of components is most effective in reducing complications and infections associated with SPC. Areas requiring further investigation active disinfection strategies, catheter stabilization methods, flushing techniques to prevent blood reflux into the catheter lumen, appropriate assessment intervals for insertion sites, and the signs of catheter-related complications.[6] To minimize SPC complications, nurses should identify related risk factors and provide care based on scientific evidence. This can be facilitated by increasing nurses' knowledge regarding the care of patients with SPC.[7]

For SPC administration and care, care protocols have been developed in accordance with the information provided by EPIC guidelines[4] and INS (2024)[5] guidelines. In Turkey, studies have been conducted with nurses using forms prepared based on these guidelines.[2,10–14] In the reviewed studies, it was observed that the forms were both comprehensive and time-consuming, focusing solely on the complications of SPC. Moreover, it was noted that there is no measurement scale in this field with established validity and reliability. This highlights a significant gap in the national literature. For nurses to provide safe and high-quality care, it is crucial to determine their levels of knowledge and implementation regarding SPC administration.[2] The Questionnaire on Best Practices for SPC Maintenance, developed by Doll et al.[6] in Brazil, is designed to evaluate healthcare professionals' knowledge of evidence-based SPC care. The present study aims to adapt this instrument for use in Turkey by testing its validity and reliability, thereby providing a tool for assessing and enhancing nursing practice in SPC management.

Research hypotheses

Hypothesis 1: The Turkish version of the Questionnaire on Best Practices for SPC Maintenance demonstrates satisfactory validity as an instrument for assessing SPC care practices among Turkish nurses.

Hypothesis 2: The Turkish version of the Questionnaire on Best Practices for SPC Maintenance demonstrates satisfactory reliability as an instrument for use in Turkish healthcare settings.

Methods

Study design

This study employed a methodological research design to adapt and evaluate the psychometric properties of the Questionnaire on Best Practices for SPC Maintenance for use in Turkey. The development and validation process adhered to the guidelines proposed by Beaton et al.[15] and followed the procedures outlined by Gjersing et al.[16]

Participants and study sample

The study population comprised nurses working in emergency departments, internal medicine wards, surgical units, and intensive care units in public and private hospitals located in the provinces of Mardin and Malatya, Turkey.

To determine an adequate sample size, a common guideline suggesting a minimum of 10 participants per scale item was applied. As the questionnaire contained 26 items, the required sample size was calculated to be at least 260 nurses to ensure robust psychometric analysis. To account for potential incomplete responses, a slightly larger sample was targeted.[17] Ultimately, data were collected from 276 nurses ($n = 276$), exceeding the minimum requirement and thereby enhancing the power and generalizability of the findings. In this study, quota sampling, a nonprobability sampling method, was used to select participants. In quota sampling, the researcher selects individuals from the population who share specific, distinctive characteristics. This method facilitates the identification of differences within subgroups.[18]

Inclusion criteria

Participants were eligible for inclusion if they met the following criteria: (i) aged 18 years or older; (ii) employed as registered nurses in emergency departments, internal medicine units, surgical wards, or intensive care units; (iii) had at least 1 year of clinical experience in their current unit; (iv) had no known communication barriers; and (v) provided voluntary informed consent to participate in the study.

Exclusion criteria

Nurses were excluded if they (i) were on annual or unpaid leave during the data collection period, (ii) submitted incomplete questionnaires, and (iii) declined to provide informed consent. Data collection coincided with a public holiday, during which 32 nurses were on leave and thus excluded. Additionally, six nurses were excluded due to incomplete responses, and 47 nurses declined participation, leaving a final sample of 276 nurses.

Measures

Nurses' Information Form. This form was developed based on the literature.[2,6,7] It includes nine questions regarding nurses' socio-demographic characteristics: age, gender, education level, workplace (clinic and type of institution), job role, total years of clinical experience, duration of employment in the current clinic, and total weekly working hours.

The Questionnaire on Best Practices for SPC maintenance. This questionnaire was originally developed in Brazil by Doll et al.[6] in accordance with the guidelines of the Infusion Nurses Society and the Brazilian National Health Surveillance Agency (ANVISA). It assesses the knowledge levels of healthcare workers regarding best practices in SPC care. The questionnaire comprises 26 items, grouped into five subdimensions: needleless connectors (valves; items 1–7), catheter stabilization (items 8 and 9), dressing (items 10–15), solution administration (items 16–22), and catheter duration (items 23–26).

The questionnaire employs a dichotomous scoring system:

- For questions with a single correct answer:
  - Incorrect responses or "I don't know" responses are scored as 0.
  - Correct responses are scored as 1.
- For questions with more than one correct answer:
  - Selecting any incorrect option results in a score of 0.
  - Selecting all correct options earns a score of 1.
  - Selecting one or more correct options without any incorrect options earns 0.5.

Total scores range from 0 to 26, with higher scores indicating greater knowledge of best practices in SPC care.[6]

Language equivalence of the questionnaire. The adaptation of the Questionnaire on Best Practices for SPC Maintenance into Turkish was conducted in accordance with the International Test Commission (ITC)[19] guidelines for translating and adapting tests.[20] To ensure linguistic validity, the original English version of the questionnaire was independently translated into Turkish by two bilingual experts with proficiency in both languages and familiarity with their respective cultural contexts. The two Turkish versions were then reviewed and consolidated by the research team to produce a preliminary Turkish version. This preliminary version was subsequently evaluated by a Turkish language expert to ensure linguistic clarity, grammatical accuracy, and cultural appropriateness. Finally, the revised Turkish version was back-translated into English by an independent translator, and the versions were compared. The translation was pilot tested with a small group of nurses prior to full data collection.

Data collection procedure. After obtaining approval from the ethics committee, data collection was carried out between February and May 2025. Prior to participation, nurses were provided with information about the study's purpose, procedures, and confidentiality assurances, and written informed consent was obtained from all participants. Data were collected through face-to-face interviews conducted in the afternoon hours (1:00 PM–4:00 PM) to accommodate the nurses' work schedules and minimize disruption to clinical workflows. This timing was chosen to ensure that participants could respond thoughtfully without undue work-related stress. Each questionnaire required approximately 20 min to complete. Data collection concluded once the predetermined sample size was achieved.

Ethical considerations. Written permission to adapt and validate the Questionnaire on Best Practices for SPC Maintenance for use in Turkey was obtained via email from the original developer, Denise Miyuki Kusahara (dkusahara@unifesp.br). Prior to commencing the research, ethical approval (No. 2025/04-11, dated February 27, 2025) was obtained from the Non-Interventional Clinical Research Ethics Committee of Fırat University. Before participation, nurses were informed about the purpose, procedures, and confidentiality of the study. Written informed consent was obtained from all participants. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Data analysis. Data were analyzed using the Statistical Package for Social Sciences 23.0 (SPSS, IBM Corp., Armonk, NY, USA) and Microsoft Excel 2016 (Microsoft Corp., Redmond, WA, USA). Descriptive statistics for participants' socio-demographic characteristics were reported as frequencies and percentages for categorical variables and as means ± standard deviations and medians (minimum–maximum) for continuous variables. The study was conducted in two stages. In the first stage, the content validity of the developed questionnaire was evaluated by six experts, and the Content Validity Index (CVI) was calculated. In the second stage, item analysis and internal consistency reliability tests were conducted using data collected from 276 clinical nurses who completed the questionnaire. Because the measurement scale used in the research was an inventory depending on a knowledge test structured in the true–false format, item analysis was performed to evaluate the psychometric characteristics of the scale. Thus, the item difficulty index and item discrimination index of each item were calculated using Microsoft Excel. Items were classified according to their discrimination indices, and items with low discrimination values were critically evaluated for potential revision or removal.

Factor analysis and Rasch modeling, commonly used in scale development to explore latent structures,[21] were not conducted in this study. This decision aligns with recommendations for knowledge tests, where the primary focus is on item-level validity and reliability rather than factor structure.[22] The original scale's structure had already been established in the study by Doll et al.,[6] rendering further structural analysis unnecessary in this adaptation. The scoring system weighted correct responses as 1 point and incorrect or "I don't know" responses as 0 points. Prior studies have suggested that this item weighting approach enhances construct validity by maximizing score variability and improving discrimination between individuals.[23,24]

To assess internal consistency reliability, the Kuder–Richardson Formula 20 (KR-20) reliability coefficient was calculated using SPSS. In addition, item–total correlations and changes in the KR-20 coefficient upon item deletion were examined to evaluate each item's contribution to the overall scale integrity. The significance level was set at $p < 0.05$ for all analyses.

Results

Characteristics of the participants

It was found that 67% of the participants were female, 78.3% were bachelor's degree graduates, 33.7% worked in internal medicine units, and 76.8% were employed in the public sector. Regarding work schedules, 13.4% of the nurses worked the night shift, 16.7% worked the day shift, and 69.9% worked both day and night shifts.

In this study, the nurses' mean age was 31.5 years. They had a mean of 7.49 years of clinical experience, a mean of 5.27 years of experience working in their current clinic, and a mean weekly working hours of 55.66 (Table 1).

Validity of the questionnaire

Content validity. To ensure the content validity of the questionnaire, the Turkish version was sent to six faculty members who were experts in the field of nursing, and their opinions were solicited. These experts were asked to evaluate the questionnaire items for cultural appropriateness and comprehensibility using a 4-point Likert-type scale (1: not suitable; 2: somewhat suitable; 3: quite suitable; 4: completely suitable). The experts' evaluations were scored in accordance with the Davis technique. Following the scoring process, the CVI of the questionnaire was calculated.[25] For each item, the CVI was obtained by dividing the number of experts who rated the item as three or four by the total number of experts. A CVI value of 1.000 for individual items or for the scale as a whole was considered "excellent." The CVI values obtained were found to be above the acceptable threshold of 0.800, indicating that the scale items were appropriate in terms of both language and content validity.

Item analysis. As shown in Table 2, based on the item difficulty index, items with values of 0.29 or below are considered difficult, those between 0.30 and 0.49 are of medium difficulty, those between 0.50 and 0.69 are easy, and those between 0.70 and 1.00 are considered very easy.[26] In this context, all items are classified as very easy.

According to Büyüköztürk et al.,[26] an item discrimination value of 0.40 or above indicates a very good item; a value between 0.30 and 0.39 indicates a fairly good item that could nevertheless be improved; a value between 0.20 and 0.29 indicates an item that requires correction and improvement; and a value of 0.19 or below indicates a very weak item that should definitely be removed. In this context, the item with the highest discrimination index was Item 6, with a value of 0.76, whereas Item 25 had the lowest discrimination index, with a value of 0.20. In this context, Item 16, which had an item discrimination index of 0.19 or lower, was removed from the questionnaire. Items 1, 11, 17, 18, and 25, which had item discrimination index values between 0.20 and 0.29, were identified as items requiring revision and improvement (Table 2).

Construct validity. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were not performed for the Questionnaire on Best Practices for SPC Maintenance. This study focused on the adaptation process of a 26-item knowledge test structured in a true–false format. The instrument was not a newly developed scale but rather an adaptation of a previously established and

Table 1. Frequency distributions and descriptive statistics of the variables ($n = 276$).

Variables	Frequency Mean ± SD	Percentage Mean (min–max)
Gender		
Male	91	33
Female	185	67
Education level		
Health vocational high school	35	12.6
Bachelor's degree	216	78.3
Postgraduate	20	7.3
Doctorate	5	1.8
Place of work (clinic)		
Internal medicine units	93	33.7
Surgery units	85	30.8
Intensive care units	56	20.3
Emergency unit	42	15.2
Type of institution		
Public	212	76.8
Private	52	18.8
Private + public	12	4.3
Work schedule		
Night shift	37	13.4
Day shift	46	16.7
Day + night shift	193	69.9
Age	31.5 ± 6.65	30 (20–56)
Length of clinical experience (years)	7.49 ± 6.83	5 (1–56)
Length of experience in your current clinic (years)	5.27 ± 3.49	4 (0–16)
Total weekly working time (hours)	55.66 ± 8.74	56 (32–72)

SD: standard deviation; min: minimum; max: maximum.

structured scale to a different language and culture. Therefore, EFA was not employed, as it is typically used to identify the underlying structure of newly developed instruments, which was not necessary in the present study.

In addition, the measurement instrument in question is a knowledge test, and the responses are objectively evaluated as either correct or incorrect. Since this type of test does not aim to measure subjective opinions or opinion-based constructs, CFA was not conducted. CFA is typically used to verify a theoretical model in multidimensional psychological constructs; however, in the case of knowledge tests, item-level validity and reliability are prioritized over factor structure.

Item analysis was conducted to evaluate the psychometric properties of the test. The quality and discriminative power of the items were assessed by calculating the difficulty and discrimination indices for each item. This approach ensured that the results were appropriate and valid for a knowledge test.

Reliability of the questionnaire

Item analysis and internal consistency results of the questionnaire. The Questionnaire on Best Practices for SPC Maintenance demonstrated high reliability, with a KR-20 coefficient of 0.974 (Table 3).

Discussion

It is important to identify knowledge gaps and to bridge the divide between theory and practice regarding best practices for SPC care among nurses.[6] Accordingly, the Questionnaire on Best Practices for SPC Maintenance was adapted for use in the Turkish context in this study. The questionnaire provides concrete data to assess nurses' knowledge levels regarding best practices in SPC care. It also contributes to measuring nurses' understanding and to guiding improvements in their practice when caring for patients with SPCs. An analysis of the data obtained in this research showed that the results supported this hypothesis.

Reliability and validity are among the most fundamental aspects of evaluating any measurement tool used for data collection in rigorous research.[27] The use of valid and reliable measurements allows for monitoring the quality of care provided to patients, identifying avoidable risks, and firmly basing the planning of corrective actions. It also

Table 2. Item discrimination and item difficulty analysis results.

Items	Item discrimination index	Item difficulty index
How can passive disinfection of needleless connectors (valves) be achieved? (Item 1)	0.29	0.95
What is the recommended technique for active disinfection of needleless connectors (valves) prior to administering a solution through the infusion system? (Item 2)	0.37	0.93
What type of solution should be used for the active disinfection of needleless connectors (valves)? (Item 3)	0.33	0.94
For how long should needleless connectors (valves) be rubbed during active disinfection? (Item 4)	0.32	0.95
What is the recommended drying time following the disinfection of needleless connectors (valves)? (Item 5)	0.32	0.95
When should the needleless connectors (valves) of an SPC be replaced? (Item 6)	0.76	0.78
When replacing the needleless connectors (valves) of an SPC, should they be primed with 0.9% saline? (Item 7)	0.31	0.95
What are the standard methods for securing SPC? (Item 8)	0.37	0.93
If catheter displacement is suspected during inspection, should it be reinserted and resecured? (Item 9)	0.32	0.95
Should a razor blade be used to remove hair around the catheter insertion site when dressing an SPC in adult patients? (Item 10)	0.35	0.94
What type of gloves should be worn when changing the dressing of an SPC? (Item 11)	0.29	0.95
When should opaque (nontransparent) dressings be removed to inspect the insertion site of an SPC? (Item 12)	0.44	0.91
Under what conditions should semi-permeable opaque dressings be replaced? (Item 13)	0.35	0.94
When should sterile gauze dressings be changed? (Item 14)	0.32	0.95
During bathing, should the catheter insertion site and the infusion device (i.e. the connection between the IV set and the catheter) be protected with waterproof material only in patients with difficult venous access? (Item 15)	0.43	0.92
Should blood be aspirated and the catheter flushed before administering solutions through an SPC? (Item 17)	0.21	0.98
What is the recommended solution for flushing the infusion system in adults? (Item 18)	0.27	0.96
Can the solution used for flushing an SPC be taken from multidose bags or bottles? (Item 19)	0.31	0.95
What is the minimum recommended volume of solution for flushing the infusion system in adults? (Item 20)	0.47	0.91
What type of syringe is recommended for flushing an SPC? (Item 21)	0.39	0.93
Which technique(s) are recommended to minimize blood backflow into the SPC during flushing? (Item 22)	0.35	0.94
Should an SPC inserted under suboptimal antiseptic conditions (e.g. in emergency situations) be removed as soon as possible, preferably within 24–48 h? (Item 23)	0.33	0.94
How frequently should the SPC insertion site, the infusion system, and potential catheter-related complications be assessed? (Item 24)	0.36	0.94
What factors should be considered in the care and maintenance of an SPC? (Item 25)	0.20	0.98
Under what circumstances should an SPC be removed? (Item 26)	0.36	0.94

enables the guidance of strategies and the readjustment of goals through educational actions and professional evaluations. Moreover, employing valid and reliable instruments contributes to advancing professional knowledge and the theoretical foundations of practice.[28] For valid and reliable analyses, it is necessary that the number of participants be at least five to ten times the number of items on the scale.[29] In the present study, 276 nurses were recruited for the evaluation of a 26-item draft scale.

Validity in research refers to the extent to which a study accurately addresses the research question and reflects the strength of its findings. For outcome measures, such as surveys or tests, validity pertains to the accuracy with which the instrument measures the intended construct. Here, validity indicates how effectively the assessment tool measures the primary outcome of interest.[30] Multiple-choice tests offer several advantages: they are easy to score, allow for straightforward assessment of content validity, demonstrate high reliability, and enable precise determination of the difficulty level of each question. In such tests, distractors (incorrect options) are designed to identify individuals who have not fully internalized the concept, thereby revealing specific misconceptions held by respondents.[31] Davis stated that a CVI score of 80% or

Table 3. Items' descriptive statistics and reliability values.

Items	Mean	SD	Item total correlation	When the item is deleted KR-20
Item 1	0.920	0.271	0.728	0.973
Item 2	0.899	0.302	0.825	0.973
Item 3	0.455	0.144	0.845	0.973
Item 4	0.913	0.282	0.840	0.973
Item 5	0.457	0.141	0.839	0.973
Item 6	0.375	0.217	0.409	0.975
Item 7	0.917	0.277	0.837	0.973
Item 8	0.449	0.151	0.730	0.974
Item 9	0.913	0.282	0.803	0.973
Item 10	0.906	0.293	0.822	0.973
Item 11	0.920	0.271	0.771	0.973
Item 12	0.880	0.325	0.874	0.972
Item 13	0.453	0.146	0.878	0.973
Item 14	0.457	0.141	0.792	0.974
Item 15	0.884	0.321	0.842	0.973
Item 17	0.942	0.234	0.679	0.974
Item 18	0.928	0.260	0.808	0.973
Item 19	0.917	0.277	0.790	0.973
Item 20	0.873	0.333	0.923	0.972
Item 21	0.895	0.307	0.859	0.972
Item 22	0.453	0.146	0.851	0.973
Item 23	0.909	0.288	0.827	0.973
Item 24	0.451	0.149	0.866	0.973
Item 25	0.473	0.114	0.758	0.974
Item 26	0.451	0.149	0.851	0.973
KR-20 reliability coefficient total	0.974			

SD: standard deviation.

above indicates consensus among experts. If the score is less than 0.80, the item should be removed from the scale.[25,32] For the Turkish adaptation of the scale, expert opinions were solicited, and the CVI was calculated using the Davis method. This value indicates an excellent level of content validity and meets the necessary criteria for content validity. In the questionnaire study developed by Doll et al.,[6] a CVI value of 66.7 was found based on the views of six experts. The higher CVI score in this research can be attributed to the scale questions representing all aspects of Turkish society.

Item analysis is a critical step in determining whether to retain or remove items from a scale. Item validity is investigated through item analysis and is often determined by item discrimination. For item analysis, it is necessary to focus on item discrimination and item strength.[33] Correct items were coded in Microsoft Excel as 1.00, while incorrect and blank items were coded as 0.00. Item discrimination and strength analyses were performed for each item using the relevant software. When the item discrimination survey scores are ranked from highest to lowest, items answered correctly by the upper groups, but not by the lower groups, are considered discriminatory items. The results of the analysis indicate the extent to which the items discriminate between individuals based on their responses. Thus, when conducting this analysis, test scores are ordered, and groups representing the upper 27% and lower 27% are formed.[33] In this research, it was demonstrated that all items except Item 16 exhibited adequate discriminatory characteristics (0.29, 0.32, 0.29, 0.21, and 0.20). According to the upper and lower 27% group analysis, these items displayed sufficient discriminatory power. However, no statistically significant difference was observed between the upper and lower groups for Item 16, which asked, "Do health workers need to wash their hands before administering a solution by SPC, even if they do not touch the injection point of the needleless connector (valve)?" This item was considered unnecessary for measuring nurses' knowledge of best practices in SPC care and was therefore removed from the questionnaire. Its original wording, Item 16 appeared to assess a general infection control principle rather than SPC-specific procedural knowledge, and its low discriminatory power indicated that it did not effectively differentiate between nurses with

higher and lower levels of SPC-related knowledge. Furthermore, the adapted scale already includes other items that address hand hygiene in the context of SPC insertion and maintenance, ensuring that this critical concept is still represented in the questionnaire.

Although one item from the original scale was removed during the adaptation process due to its low discriminatory power and limited specificity to SPC-related procedures, the remaining items preserved the original construct structure, domains, and item wording. Therefore, the psychometric properties previously established in the original validation study were considered largely applicable to the adapted version. According to cross-cultural adaptation guidelines, minor modifications—such as the removal of an individual item without altering the underlying theoretical framework—do not necessarily require a complete revalidation using factor analysis or Rasch modeling, provided that the conceptual equivalence is maintained.[15,16] Moreover, the theoretical model and latent constructs underlying the original scale remained intact, meaning that the factorial structure previously established is still conceptually applicable to the adapted version. Conducting a complete revalidation in this context may lead to redundancy, as the statistical power to detect meaningful structural deviations could be limited when only a single item is removed.[34] However, we recognize that even minor structural modifications may have subtle effects on item interrelationships. For this reason, future research should further investigate the dimensionality of the adapted scale using advanced psychometric analyses, including factor analysis and Rasch modeling, particularly in larger and more diverse samples.

The difficulty index indicates how easy or difficult an item is for respondents in a questionnaire or scale. It reflects the level of the latent trait that the item measures. The difficulty index ranges from 0 to 1, with values close to 0 indicating a difficult item and values near 1 indicating an easy item.[33] It is generally recommended that the mean difficulty index of a test should be approximately 0.50.[35] In the present study, all subdimensions demonstrated acceptable levels of difficulty according to the item difficulty index (0.78, 0.93, 0.91, 0.91, and 0.94). The findings revealed that all items in the questionnaire had a difficulty index above 0.50. Therefore, all items in the questionnaire can be classified as very easy.

Reliability is a component of validity assessment. Internal consistency reliability refers to whether an assessment tool yields consistent results when administered to the same type of subjects under the same conditions.[27] The KR-20 reliability coefficient was calculated to determine the internal consistency of the scale. Both KR-20 and Cronbach's alpha (α) are widely used measures for evaluating the internal consistency of cognitive and personality tests. In the KR-20 formula, correct responses are scored as 1, while incorrect or blank responses are scored as 0. Cronbach's alpha, in contrast, is more appropriate for items with multiple-category responses.[36] In this study, the KR-20 reliability coefficient was applied to determine whether the items consistently measured the intended construct. Reliability coefficients range from 0.00 to 1.00, with values between 0.80 and 1.00 indicating high reliability, values between 0.60 and 0.80 indicating moderate reliability, and values below 0.60 suggesting low or very low reliability.[37] The KR-20 values for the overall questionnaire were 0.974. Based on these results, the questionnaire adapted for Turkish society demonstrated high reliability.

Item–total score correlation analysis examines the relationship between the total scale score and the scores obtained from individual items on the scale. This analysis is one of the methods used to assess scale reliability. Specifically, it evaluates the correlation between the overall questionnaire score and each item score.[37] A high positive correlation indicates that the items on the measurement scale reflect similar behaviors and that the scale demonstrates strong internal consistency.[26] When selecting items, a correlation coefficient above 0.25 is considered acceptable, and it is recommended that items with lower coefficients be removed from the scale.[26] In this study, with the exception of Item 16, which was removed, the correlation coefficients of all items were found to range between 0.40 and 0.92 and were statistically significant ($p=0.000$). These findings indicate that, apart from the eliminated Item 16, all items demonstrated an adequate correlation with the total score. Therefore, the retained items were shown to be aligned with the construct intended to be measured.

Limitations

This study has several limitations that should be acknowledged. First, data were collected from only two provinces using quota sampling, which restricts the generalizability of the findings. In addition, the types of health services provided by the hospitals from which the data were collected (e.g. primary, secondary, or tertiary health services; private or public hospitals) were not specified. This omission limits the ability to fully contextualize the participants' experiences. Limited geographical coverage and uncertainty regarding the variety of services undermine the external validity of the study. Therefore, in future research, a broader and more representative sampling method should be employed, including institutions from different geographical regions, provinces with diverse socioeconomic structures, and facilities providing health services at various levels. In this way, the findings can achieve a higher level of generalizability, allowing for more comprehensive inferences to be drawn in terms of health policies.

The measurement tool used in this study may present certain psychometric limitations. Some items appear prone

to ceiling effects, potentially reducing the scale's ability to discriminate among participants with higher levels of the measured construct. Additionally, several items demonstrated limited discriminatory power, resulting in homogeneous responses that may have constrained the sensitivity of the questionnaire. Moreover, item calibration issues were not thoroughly addressed, and evidence for construct validity within this context remains insufficient.

Another limitation of this study is that the internal consistency was calculated using KR-20 only for the total scale score. KR-20 was not computed for the subdomains because each contained a small number of items, which can result in unstable and potentially misleading reliability estimates.[38]

The questionnaire developed by Doll et al.[6] includes 26 items on SPC care, enhancing its comprehensiveness but also raising the risk of cognitive overload and participant fatigue. Similarly, the present study's instrument, comprising 25 items, achieved breadth in content coverage; however, participating nurses reported that the questions were challenging. Despite this, only six nurses left some items partially unanswered, suggesting overall engagement with the scale. Although Item 16, which addressed hand hygiene before SPC manipulation, was excluded from the adapted scale due to its low discriminatory power and limited specificity to SPC-related procedures, we acknowledge its clinical importance in infection prevention. Future research should consider incorporating context-specific items on hand hygiene to more accurately assess this aspect of best practices in SPC care.

These methodological limitations warrant caution in interpreting the findings and highlight the need for further validation studies to confirm the reliability and validity of the measurement tool across diverse populations and settings.

Clinical implications

The use of this questionnaire enables the identification of knowledge gaps among nursing professionals regarding best practices in SPC care. The identified gaps provide a critical foundation for improving the quality of SPC care and enhancing patient safety in clinical settings. Furthermore, they form the basis for developing targeted educational interventions and training programs to address deficiencies in knowledge and practice. The questionnaire may thus be considered a valuable tool for guiding initiatives aimed at improving patient outcomes in SPC care processes.

In line with the research findings, healthcare professionals, researchers, institutions, and managers will have the opportunity to identify existing deficiencies in SPC use and care and to develop effective, evidence-based solutions to address them.

Conclusions

In this study, the Questionnaire on Best Practices for SPC Maintenance was adapted for use in the Turkish context. The questionnaire comprises five subdimensions—needleless connectors (valves), catheter stabilization, dressing, solution administration, and catheter permanence—and includes a total of 25 items. The KR-20 values for the overall questionnaire were 0.974. These results indicate that the scale is a valid and reliable instrument for assessing nurses' knowledge of best practices in SPC care.

The questionnaire is expected to guide the development of educational and training strategies by identifying areas where nurses demonstrate lower levels of knowledge. It highlights the importance of prioritizing educational interventions in domains where knowledge gaps are evident. Investing in such strategies has the potential to improve clinical practice and reduce complications associated with SPC use.

Future research should include experimental, qualitative, and quantitative studies in clinical settings to further explore nurses' knowledge of best practices in SPC care and to identify factors influencing this knowledge.

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Author contributions

Hediye Özbay: Conceptualization; validation; methodology; data curation; formal analysis; investigation and writing—original draft; writing—review and editing; supervision. Seher Çevik Aktura: Data curation; writing—original draft, writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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