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Assessment of the Turkish Version of the King's Stool Chart for Evaluating Stool Output and Diarrhea Among Patients Receiving Enteral Nutrition

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ABSTRACT

The purpose of this study was to evaluate the reliability and validity of the Turkish version of the King's Stool Chart (KSC-Tr) in patients receiving enteral nutrition. In total, 212 stool samples taken from 25 patients receiving enteral nutrition during 393 sick days in two intensive care units were assessed using the KSC-Tr. Overall, 110 of 212 stools (51.9%) were characterized as liquid and 111 of 212 stools (52.4%) were characterized as less than 100 g. The daily stool score of patients receiving antibiotics, a risk factor for diarrhea, was higher (mean = 13.6; SD = 10.1) than that of patients not receiving antibiotics (mean = 9.3; SD = 5.0) (p = .001). Diarrhea occurred on more days when patients received antibiotics (62/329; 18.8%) than on days when they did not (3/64; 4.7%) (p = .005). Interobserver agreement of two independent nurses' assessments on 44 stool samples was examined and was good for both stool consistency (κ = 0.76) and stool weight (κ = 0.75). In the intensive care unit, the KSC-Tr can be used as a valid and reliable tool for monitoring diarrhea and stool output in patients receiving enteral nutrition.

Objective assessment of stool output and diarrhea in patients receiving enteral nutrition enables rapid implementation of effective interventions against this common complication. The incidence of diarrhea during enteral nutrition in general patients ranges from 2% to 68% (Bengmark, 2002; Luft, Beghetto, Mello, & Polanczyk, 2008; McNaught et al., 2005; Weisen, Van Gossum, & Preiser, 2006), whereas in the intensive care unit it ranges from 2% to 95% (Lopez-Herce, 2009). Researchers have assessed the prevalence, using different criteria for stool frequency and stool consistency. The wide range in prevalence of diarrhea is therefore attributed in part to the fact that the criteria and measuring instruments used in the characterization of diarrhea were different (Eisenberg, 2002; Lebak, Bliss, Savin, & Patten-Mars, 2003; Lopez-Herce, 2009).

During previous studies in patients receiving enteral nutrition, 33 different definitions of diarrhea were used (Lebak et al., 2003). These studies used criteria based upon stool characteristics such as frequency (>3 per day, >4 per day), consistency (loose stool), weight (>300 g/d for 2 days), or a combination of these (>2 liquid stool/day; >200 g of liquid stool/day) (Lebak et al., 2003; Whelan, Judd, & Taylor, 2004). Lack of consensus on the criteria to define diarrhea and standard approaches to measuring these stool characteristics make it difficult to compare the results on prevention and treatment initiatives for diarrhea in patients receiving enteral nutrition. Defining diarrhea in clinical practice is based on subjective assessments by healthcare

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professionals, especially nurses. Whelan, Judd, and Taylor (2003) found that healthcare professionals (nurses, dieticians, and gastroenterologists) do not have consensus in the importance of different stool characteristics in defining diarrhea. In a recent study, stool consistency and stool frequency were considered highly important in defining diarrhea; however, the importance of different characteristics varied between nurses, dietitians, and patients (Majid, Emery, & Whelan, 2012).

A number of stool charts have been developed to monitor stool output in a range of settings. Perhaps the most widely used is the Bristol Stool Form Scale consisting of verbal and pictorial descriptors of seven stool consistencies (Lewis & Heaton, 1997). Although it has been shown to correlate with gut transit time (Lewis & Heaton, 1997), it has not undergone extensive reliability assessment, is not able to measure stool weight, and has not been validated in patients receiving enteral nutrition.

A number of other stool charts and scoring systems have been developed to characterize stool output and define diarrhea in patients receiving enteral nutrition, including those developed by Hart and Dobb (1988) and Guenter and Sweed (1998). The most extensively validated in this patient group is the King's Stool Chart (KSC) (Whelan et al., 2004). The KSC measures consistency, weight, and frequency with pictorial images to aid accurate characterization (Whelan et al., 2004; Whelan, Judd, Preedy, & Taylor, 2008).

The KSC includes four categories of stool consistency (hard and formed, soft and formed, loose and unformed, liquid) and three categories of weight (<100 g, 100–200 g, and >200 g). The categorization of stool weight is aided by comparing the size of the stool sample with the pictorial image, which is presented with a 10-cm scale. The KSC therefore includes 12 stool consistency/weight categories. Each is assigned an alphabetical code to facilitate communication between healthcare professionals using standard verbal and pictorial descriptors (Figure 1). In addition, each stool consistency/weight category is given a score allowing calculation of a daily stool score by summing the scores recorded over a 24-hour period, with a daily stool score of 15 or more, resulting in a diagnosis of diarrhea.

The KSC has previously been validated in patients receiving enteral nutrition. During development, its content validity was assessed by a survey of gastroenterologists, nurses, and dietitians. The KSC was validated in a clinical study and demonstrated statistically significant differences in stool frequency, stool consistency, stool score, and incidence of diarrhea for contrasting patient groups expected to have different fecal output (construct validity). There was also almost perfect agreement for stool consistency (95% agreement, $k = 0.91$) and substantial agreement for stool weight (83%; $k = 0.75$) when two nurses rated the same stools (interrater reliability) (Whelan et al., 2004). The KSC has also been validated covertly, such that nursing staff were unaware of the analysis to capture a more realistic assessment of validity in practice, and using the KSC resulted in stools assigned into the four different consistency categories having different stool water content (Whelan et al., 2008).

A valid and reliable instrument to assess stool output and diarrhea in patients receiving enteral nutrition is not currently available in the Turkish language. Translation of an existing instrument has the advantage of avoiding the initial lengthy stages of development of a new instrument and it enables comparative international multicenter studies. However, assessment of the validity and reliability of the translated instrument is required because translators may not always undertake perfect translation, and the cultural influences on language make words and their meanings context specific. Indeed pictorial descriptors, as contained on the KSC, may assist in its application across different languages. Therefore, the purpose of this study was to assess the validity and reliability of the Turkish form of the KSC in patients receiving enteral nutrition in Turkey.

Materials and Methods

Translating the KSC

The KSC was translated from English to Turkish (KSC-Tr) by the lead researcher, three faculty members, and an assistant professor. The KSC-Tr then underwent a process of back-translation to ensure accurate wording. The KSC-Tr was translated back into English by a Turkish-native translator who was fluent in both Turkish and English and who had not previously seen the English version of the KSC. The translation of the KSC-Tr back into English did not result in any change in words. These translations were evaluated by the researcher and the KSC-Tr version was finalized.

Content Validity

Following translation, expert opinions were obtained to test the content validity of the KSC-Tr. The KSC-Tr was sent to 22 academic members working in the surgical nursing departments of 20 University Hospitals, six supervisor nurses from the internal diseases department and anesthesia and surgical intensive care unit of Akdeniz University Hospital, and two supervisor nurses from the anesthesia and surgical intensive care unit of Dokuz Eylul University. These nurses were specialists in intensive care nursing caring for patients with trauma and patients in the postoperative period (neurosurgery; orthopedics; general surgery; plastic surgery; urology; earsurgery; nose, and throat surgery;

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KING STOOL CHART Tr-FORM

Patient Name, Last name: Clinical/ ICU:

	(1) Less than 100g	(2) Between 100 – 200g	(3) More than 200g
(A) Hard & Formed - hard or firm texture - retains a definite shape - like a banana a cigar or marbles	A1	A2	A3
(B) Soft & Formed - retains general shape - like peanut butter	B1	B2	B3
(C) Loose & Unformed - lacks a shape of its own - may spread easily - like porridge or thick milkshake	C1	C2	C3
(D) Liquid - runny - like water	D1	D2	D3

King's Stool Chart © 2001 King's College London
www.kcl.ac.uk/stoolchart

Scale 0 cm 10 cm

Scores assigned to each of the stool consistency and stool weight categories			
Stool Consistency	Stool Weight		
	Less than 100 g	Between 100-200 g	More than 200 g
Hard and formed	A1 = 1	A2 = 2	A3 = 3
Soft and formed	B1 = 2	B2 = 3	B3 = 4
Loose and unformed	C1 = 4	C2 = 6	C3 = 8
Liquid	D1 = 8	D2 = 10	D3 = 12

Instructions for use
1.Consider the consistency of the stool by comparison with both the verbal and photographic descriptors (A, B, C, D).
2. Consider the weight of the faecal sample by comparison with the photographic descriptors (1, 2, 3). Compare the size of the sample, using the life size 10cm scale, and compare it to the 10cm scale on each photographic descriptor.
3.Record the frequency of stool output over a 24 hour period.
4.Any other characteristics of faecal output which are considered to be important must also be recorded e.g. incontinence, colour etc. .

Date/time		Code	Score	Comments
Date	Time			
24 hour stool score				
Total Stool frequency				

NOTE: Daily stool score of 15 or more is defined as Diarrhea

FIGURE 1. The King's Stool Chart Tr-Form. Note that in the figure the language has been translated to English for the journal readership, however, the Turkish language version is available from www.kcl.ac.uk/stoolchart.

and eye surgery patients). The nurses commonly managed the complications of enteral nutrition, including diarrhea. The expert reviewers were chosen because they have expertise of both the conceptual and practical framework of stool output in patients receiving enteral nutrition.

Those agreeing to be surveyed were sent an expert opinion questionnaire for the KSC-Tr. The questionnaire assessed the content validity of the KSC-Tr form by surveying the suitability of items (stool frequency, consistency, weight) using the Likert scale (1 = not suitable, 2 = needs to be optimized, 3 = suitable but needs minor changes, and 4 = very suitable). In addition, the questionnaire surveyed whether the KSC-Tr contained all of the features relevant to the assessment of stool output and whether or not there were criteria included that should not be.

Clinical Study: Construct Validity and Interobserver Agreement

The clinical validation study was conducted on patients receiving enteral nutrition who were hospitalized in the two anesthesiology and intensive care units of a university hospital in Antalya Province, Turkey. In total, 25 patients, who were hospitalized in the intensive care unit, above the age of 18 years, and receiving enteral nutrition in the last 24 hours, were included in the study.

Construct validity determines whether an instrument produces results that relate to other variables in the way that would be expected. This is often assessed using the contrasted groups approach, by comparing the results from an instrument between subjects expected to behave differently (Bland & Altman, 2002). Construct validity of the KSC-Tr was measured using the contrasting groups approach, whereby the results were compared between two patient groups expected to have differences in stool output and diarrhea. Therefore, data from the KSC-Tr were compared between patients receiving and not receiving antibiotics, a known risk factor for developing diarrhea in enteral nutrition (Whelan & Schneider, 2011). Data were recorded regarding sociodemographics (age, gender, diagnosis), enteral nutrition (date of commencement, method, energy delivery), enteral tube (enteral tube type and number), and

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antibiotic use (whether or not they were receiving antibiotics, number received).

Nurses in the intensive care unit were trained in the use of KSC-Tr by the lead researcher. During the first 2 weeks following the introduction of the KSC-Tr, the researcher observed its use on the intensive care unit and provided nurses with guidance in bedside assessment of stool output.

A KSC-Tr was added to the files of all patients participating in the study and stool output was recorded. All stools passed by the 25 patients were recorded using the KSC-Tr for a minimum of 3 days until the cessation of enteral nutrition.

To assess interobserver agreement, 44 stool samples passed by the patients were assessed by two nurses and the values were independently recorded on different forms. These nurses were specialists in intensive care nursing and routinely cared for patients receiving enteral nutrition. The sample size was calculated to measure 80% agreement between two observers, using 80% power, with an error margin of 0.05. This resulted in the requirement to compare agreement on 40 stool samples according to the NCSS-PASS (Statistics, Graphics, Power Analysis, & Sample Size) analysis.

Ethical Permissions

Approval to undertake the study was obtained from Dokuz Eylül University Nursing School Ethics Board. Approval was also obtained from the Department of Anaesthesiology and Intensive Care Department chief physician of the University Hospital. Approval to adapt the KSC was obtained from the copyright owner who was also involved in analyzing and interpreting the data. In addition, consent was obtained from the nurses participating in the study and from the patients (if conscious) or relatives (if unconscious).

Statistical Analysis

The data were analyzed using IBM SPSS 20.0. The demographic and clinical characteristics of patients are described using descriptive statistics (e.g., mean, median, mode, standard deviation, frequency, and percentage). The expert opinions (content validity) were analyzed by Kendall Coefficient of Concordance and were expressed as n (%). A t test for nonpaired samples was used to determine whether patients receiving antibiotics had more stools than patients who did not receive antibiotics. A chi-square test was used to determine whether patients receiving antibiotics had more stools in the looser stool categories or were more likely to experience diarrhea than those who did not receive antibiotics. In addition, interobserver agreement between two independent observers in categorizing stool consistency and weight was analyzed using the kappa statistic.

Results

Content Validity

Thirteen academic faculty members and eight supervisor nurses agreed to provide their expert opinions on the KSC-Tr. All experts found the stool characteristics (stool frequency, consistency, and weight) important in defining diarrhea in patients receiving enteral nutrition (Table 1). The experts more frequently indicated stool frequency as being "very important" (76.2% considering it important), followed by stool consistency (38.1%) and then by stool weight (14.3%) when evaluating stool output in patients receiving enteral nutrition (Table 1). The majority (71.4%) did not consider there to be other important properties to monitor, whereas the remainder indicated stool color and odor as being important. All experts thought that the photographs used in the KSC-Tr reflected the stool properties seen in clinical practice and that they would help in accurate estimation of stool consistency and weight. All experts considered that the KSC-Tr would be useful to record stool output in patients receiving enteral nutrition and provide accurate, reliable, and valid recording.

Clinical Study

In the clinical study, 25 ICU patients were recruited with the following diagnoses: cardiac arrest (3; 12%), respiratory failure (4; 16%), postoperative (11; 44%), and general internal medicine (stroke, hypertension, and oncology) (7; 28%). The mean (SD) age of patients in the sample group was 61.6 (20.2) years. In total, 11 (44%) were female and 14 (56%) were male. The average enteral nutrition received by patients was 1913 kcal/day (348) (median: 1,900 kcal/day; min: 1,400; max: 2,884). Eighteen patients (68%) received standard polymeric formula and seven (32%) received polymeric fiber formula. Patients were fed via a polyurethane tube (14; 56%) or silicon tube (11; 44%), which ranged from 12 to 18 French gauge.

TABLE 1. Perceptions of Nurses Regarding the Importance of Characteristics in Defining Diarrhea in Patients Receiving Enteral Nutrition

	Very Important, *n* (%)	Important, *n* (%)	Slightly Important, *n* (%)
Stool frequency	16 (76.2)	4 (19.0)	1 (4.8)
Stool consistency	8 (38.1)	9 (42.9)	4 (19.0)
Stool weight	3 (14.3)	5 (23.8)	13 (61.9)

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TABLE 2. Stool Consistency and Stool Weight of 25 Patients Receiving Enteral Nutrition on the Intensive Care Unit, Categorized According to the Turkish Version of the King's Stool Chart

Stool Consistency, *n* (%)	Stool Weight, *n* (%)			
	<100 g	100–200 g	>200 g	Total
Hard and formed	4 (1.9)	3 (1.4)	1 (0.5)	8 (3.8)
Soft and formed	16 (7.5)	1 (0.5)	3 (1.4)	20 (9.4)
Loose and unformed	29 (13.7)	18 (8.5)	27 (12.7)	74 (34.9)
Liquid	62 (29.2)	35 (16.5)	13 (6.1)	110 (51.9)
Total	111 (52.4)	57 (26.9)	44 (20.7)	212 (100)

Stool Characteristics

In total, 212 stool samples were measured from these 25 patients during 393 patient follow-up days (Table 2). Stool frequency, assessed using the KSC-Tr, was 1.8 ± 1.1 per day. There were no differences in stool frequency between patients receiving and not receiving antibiotics ($p > .05$; Table 3).

When the stool consistency was measured using the KSC-Tr, 110/212 (51.9%) were of liquid consistency (Table 2). There were no differences in stool consistency categories between patients receiving and not receiving antibiotics ($p > .05$; Table 3). Two independent observer nurses assessed the characteristics of 44 stools using the KSC-Tr. Nurses agreed on the stool consistency category on 82% of occasions. The interobserver agreement between these two nurses was good ($\kappa = 0.76$).

When the stool weight was measured using the KSC-Tr, 111/212 (52.4%) were less than 100 g

TABLE 3. Comparison of Stool Frequency, Stool Consistency, Stool Weight, and Prevalence of Diarrhea, Measured Using the Turkish Version of the King's Stool Chart, Between Patients Prescribed Antibiotics and Those Not Prescribed Antibiotics

	Antibiotic Prescription		*p*
	At Least One	None	
Stool frequency	329 patient days	64 patient days	
Daily stool frequency, mean (SD)	1.8 (1.1)	1.7 (1.1)	.75[a]
Stool consistency	182 stools	30 stools	.65[b]
Hard and formed, n (%)	6 (3.3)	2 (6.6)	
Soft and formed, n (%)	15 (8.2)	5 (16.7)	
Loose and unformed, n (%)	59 (32.4)	15 (50)	
Liquid, n (%)	102 (56.1)	8 (26.7)	
Stool weight	186 stools	26 stools	.64[b]
<100 g, n (%)	96 (51.6)	15 (57.7)	
100–200 g, n (%)	52 (28.0)	5 (19.2)	
>200 g, n (%)	38 (20.4)	6 (23.1)	
Daily stool score			
Score, mean (SD)	13.6 (10.1)	9.3 (5)	.001[a]
Prevalence of diarrhea	329 patient days	64 patient days	
Diarrhea (stool score ≥15), n (%)	62 (18.8)	3 (4.7)	.005[b]

[a]Compared using an unpaired *t* test.
[b]Compared using a chi-square test.

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(Table 2). There were no differences in stool weight categories between patients receiving and not receiving antibiotics ($p > .05$; Table 3). Nurses agreed on the stool weight category on 81% of occasions. The interobserver agreement between these two nurses was good ($\kappa = 0.75$).

Stool Score

The median (IQR) daily stool score was 10 (1–60) and the mean (SD) was 13.0 (9.6). The daily stool score of patients receiving antibiotic treatment was higher (mean = 13.6; SD = 10.1) than that of patients not receiving antibiotic treatment (mean = 9.3; SD = 5.0) ($p = .001$; Table 3).

Diarrhea

Using the KSC-Tr and a daily stool score of 15 or more to indicate diarrhea, 14 of 25 patients (56%) had diarrhea at least once. Three out of these 14 patients (21.4%) who developed diarrhea did so for 1 day, and 11 of 14 patients (78.6%) developed diarrhea for 2 or more days. Patients who developed diarrhea at least once received enteral nutrition for a median of 19.5 (min 4, max 36) days compared with a median of 4 (min 3, max 30) days in patients who did not develop diarrhea ($p = .004$).

When expressed as the percentage of patient days with diarrhea, of the 393 follow-up days, diarrhea occurred on 65 of 393 days (16.5%). When comparing the prevalence of diarrhea and antibiotic usage, diarrhea occurred on 62 of 329 days (18.8%) when antibiotics were received compared with 3 of 64 patient days (4.7%) when no antibiotics were received ($p = .005$; Table 3).

DISCUSSION

The use of instruments to facilitate accurate clinical measurement is very important in nursing science and all healthcare disciplines. To develop nursing care, accurate and comprehensive data collection is required. The assessment of stool output and diarrhea in patients receiving enteral nutrition is not standardized in the literature. The purpose of this study was to assess the validity and reliability of the KSC-Tr in patients receiving enteral nutrition. The use of such instruments should contribute to improving the assessment of stool output and diarrhea in patient management in clinical practice and the comparison of research studies of diarrhea in enteral nutrition.

Translation of instruments into other languages can result in inevitable changes to the concept and meaning of the instrument. Minimizing these differences requires careful translation to ensure that the instrument is meaningful to those who speak the target language (Ægisdóttir, Gerstein, & Çinarbaş, 2008).

In the content validity assessment, the KSC-Tr was shown to be practical and understandable for visual assessment of stool characteristics (i.e., consistency and weight) in patients receiving enteral nutrition. The KSC-Tr was then finalized prior to further validity testing in the clinical study.

There are many factors that impact on the prevalence of diarrhea, including intragastric feeding, microbial contamination, alteration in intestinal microbiota, the composition of the enteral formula (e.g., low fiber content), antibiotic treatment, and hypoalbunemia (Sabol & Carlson, 2007; Whelan & Schneider, 2011). The construct validity of the KSC-Tr was investigated using the contrasting groups approach, whereby data from patients receiving and not receiving antibiotics in whom the prevalence of diarrhea was expected to be different, were compared.

The construct validity of the KSC-Tr in measuring stool consistency and stool weight was therefore assessed by comparing these between patients receiving and not receiving antibiotics. Stools from patients receiving antibiotics were more likely to be liquid, although this was not statistically significant (Table 3). The absence of statistically significant differences might be the result of the patients' underlying medical condition, the duration of hospitalization, and the variation in enteral formulas used. The proportion of liquid stools in patients who had received antibiotic treatment (56.1%) was similar to that from a previous study (61%) (Whelan et al., 2008).

When the stool weights were assessed using the KSC-Tr, more than half (52.4%) were found to be less than 100 g, similar to a previous study (45%; Whelan et al., 2008). It is predicted that the use of the KSC-Tr by nurses will enable characterization of stool weight using standardized language and categories that had previously not existed.

Using stool scores to determine the degree of severity of stool output will provide objective data for use in clinical practice. The results will be able to be used in patient management, assessment of the effectiveness of treatment, and comparison of the effect of intervention studies (Whelan et al., 2004, 2008). In this study, the stool scoring system used in the KSC-Tr and the validity of the stool score in determining the presence of diarrhea were evaluated. The daily stool score and the prevalence of diarrhea (daily stool score $\geq$15) were statistically significantly greater in patients receiving antibiotic treatment, indicating construct validity.

The cutoff point to diagnose diarrhea (daily stool score of $\geq$15) was chosen in the original studies to ensure that passage of one stool could not be defined as diarrhea whereas passage of two or more liquid stools would (Whelan et al., 2004, 2008). The combination of stool frequency and consistency was chosen

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to reflect the preferences of healthcare professionals in defining diarrhea (Whelan et al., 2003). However, a cutoff point should also reflect a threshold above which negative consequences are more likely to occur.

Assessing stool output and using the stool score in patients receiving enteral nutrition have been undertaken in previous studies, although tools are not always extensively validated (Hart & Dobb, 1988). In the study by Hart and Dobb (1988), the consistency and weight categories and scores were different to the KSC. Existence of a single liquid stool more than 250 ml is considered diarrhea in the Hart and Dobb score, but not in the KSC. In the Guenter and Sweed (1998) stool output assessment form, the stool consistency and stool weight categories are different to the KSC.

One of the methods used in assessing the reliability of an instrument is to assess interobserver agreement (Gleason, Harris, Sheean, Boushey, & Bruemmer, 2010). Interobserver agreement is applied in cases where clinical data need to be collected by more than one observer. To show interobserver agreement between two or more observers and reduce the effect of agreement by chance, the kappa statistic is used (Gleason et al., 2010; Watkins & Pacheco, 2000). It is reported that a kappa value more than 0.70 would be sufficient in interobserver agreement, and this was achieved here.

The researchers have received positive feedback from the intensive care nurses on the use of the KSC-Tr during this study and the KSC-Tr is now used in clinical practice. During this process, it was observed that the KSC-Tr was easily adopted into routine clinical practice by nurses. Nurses have reported that assessment of stool output and characterization of diarrhea are now easier and more understandable with the use of this KSC-Tr.

The use of the KSC-Tr will enable the systematic collection of stool output data, and variations in the approach to defining diarrhea will be minimized. This will enable nurses to record objective data to undertake evidence-based clinical decision making in nursing practice.

The use of the KSC-Tr may well be possible in other patient groups including those with diarrhea symptoms from chemotherapy and radiation therapy, gastroenteritis, ulcerative colitis, and Crohn disease. However, it must first be validated for use in these groups, especially as the data recording may be undertaken by the patient/family member, and therefore training in independent self-assessment will be required.

Limitations

It is very important to examine specificity and sensitivity, negative and positive predictive values in the assessment of reliability and validity of instruments. However, this requires a gold standard diagnostic tool, which is not currently available for defining diarrhea. For this reason, construct validity was measured using the contrasting groups approach. Quantitative objective assessments, such as measuring actual stool weight, would have strengthened this validation study.

CONCLUSION

The KSC-Tr was demonstrated to be a valid and reliable instrument for the assessment of stool output and diarrhea in patients receiving enteral nutrition. The KSC-Tr is a practical and useful tool that can be used to assess diarrhea, which is a common complication in patients receiving enteral nutrition, and to ensure standardization of stool descriptions undertaken by different members of the nursing team. ✪

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