

Developing and validating the Earthquake-Related Crush Syndrome Knowledge Scale using tetrachoric and Rasch analyses

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ABSTRACT

BACKGROUND: A substantial proportion of earthquake-related fatalities result from severe trauma at the time of the event and entrapment under debris. Prolonged compression significantly increases the risk of developing crush syndrome, which is considered a critical determinant of mortality and morbidity. This study aimed to develop and evaluate a scale designed to assess pediatric surgical nurses' knowledge of earthquake-related crush syndrome.

METHODS: This methodological study was conducted between August and September 2023. The sample consisted of 77 pediatric surgical nurses working in pediatric surgery units of a city hospital who voluntarily participated in the study. Data were collected using a data collection form and a draft 30-item version of the scale. Content and construct validity were assessed to validate the instrument. Tetrachoric factor analysis was used to examine construct validity. Reliability was evaluated using the Kuder–Richardson Formula 20 coefficient and the person reliability coefficient. Rasch analysis was performed to assess item difficulty and discrimination.

RESULTS: The Content Validity Index for the Earthquake-Related Crush Syndrome Knowledge Scale was 0.99. Tetrachoric factor analysis revealed two subdimensions comprising nine items. Goodness-of-fit indices for the confirmatory two-factor model indicated an acceptable to excellent fit. The Kuder–Richardson Formula 20 reliability coefficients were 0.90 for Factor 1 and 0.88 for Factor 2. According to Rasch analysis, the scale demonstrated a two-subdimension structure comprising seven items, with factor loadings ranging from 0.59 to 0.90; the factors were interrelated. In the Rasch model, the person reliability coefficient was 0.433, indicating low reliability. The mean absolute deviation of Q3 residual correlations (MADaQ3), used to assess model fit, was 0.116, while the information-weighted fit (infit) and outlier-sensitive fit (outfit) statistics were within the acceptable range (0.5–1.5).

CONCLUSION: Preliminary findings suggest that the scale demonstrates acceptable validity and reliability for assessing pediatric surgical nurses' knowledge of earthquake-related crush syndrome.

Keywords: Crush syndrome; earthquake injuries; knowledge scale; nurse; trauma.

INTRODUCTION

Earthquakes are devastating natural disasters that cause extensive injuries and high mortality due to their sudden and unpredictable nature.^[1] A substantial proportion of earth-

quake-related deaths result from severe trauma at the time of the event or from entrapment under debris. The risk of developing earthquake-related crush syndrome (ECS) increases significantly in individuals exposed to prolonged compression, which is a key determinant of mortality and morbidity.^[2] The

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Kahramanmaraş earthquakes, among the most destructive in recent Turkish history, resulted in at least 56,000 deaths and caused severe trauma in a large number of patients.^[3] A study by Kulakoğlu et al.^[4] reported that 33.1% of 957 trauma patients admitted after the earthquake were aged 0 to 20 years, and ECS developed in 7.7% of these patients.

Crush syndrome is a severe clinical condition caused by prolonged compression of the extremities or other body parts, leading to muscle edema, rhabdomyolysis, and subsequent systemic complications.^[5] The major life-threatening manifestations of crush syndrome (CS) include acute renal failure, hyperkalemia, hypocalcemia, metabolic acidosis, and compartment syndrome. These complications primarily result from the release of nephrotoxic substances from damaged muscle cells, hypovolemia, and metabolic disturbances.^[6] Early fluid resuscitation and timely medical intervention, particularly within the first six hours following injury, are essential to reduce crush syndrome-related mortality and morbidity.^[7]

Children who survive earthquakes require care from healthcare professionals with expertise in pediatric practice.^[8,9] According to the American Pediatric Surgical Nurses Association, pediatric surgical nurses provide evidence-based, patient- and family-centered care aimed at promoting, protecting, and optimizing the health of children with surgical conditions from infancy through young adulthood.^[10] Their advanced clinical expertise and leadership competencies enable them to provide comprehensive care across the pre-crisis, crisis, and post-crisis phases.^[11]

The Disaster Nursing Competencies framework published by the International Council of Nurses defines the competencies required of nurses in disaster situations and outlines the essential knowledge, skills, and attitudes they are expected to possess.^[12] One key competency is the ability to effectively manage disaster-related conditions such as multiple trauma and CS. Therefore, assessing the clinical manifestations of ECS and implementing evidence-based nursing interventions for pediatric earthquake survivors are critical responsibilities of pediatric surgical nurses.^[13] However, evidence suggests that nurses are still insufficiently prepared to manage disaster situations and often lack clarity regarding their roles during such events.^[14] Studies by Guner and Oncu^[13] and Özpulat et al.^[15] reported that nurses possess insufficient knowledge of ECS. Similarly, Moghaddam et al.^[16] found that nurses emphasized the need for additional training in clinical skills, including the provision of emotional support and care for survivors affected by ECS.

The use of valid and reliable measurement instruments to assess healthcare professionals' knowledge, skills, and attitudes provides valuable evidence for both the literature and clinical practice.^[16] Although several tools exist to evaluate nurses' preparedness and awareness in disaster contexts,^[17-21] no valid and reliable instrument specific to ECS—a condition frequently observed in patients with post-earthquake trauma—has been identified in the literature.

The aim of this study is to develop a measurement tool, the Earthquake-Related Crush Syndrome Knowledge Scale (ECSKS), to assess pediatric surgical nurses' knowledge of ECS and to evaluate its validity and reliability. Additionally, the study seeks to determine nurses' knowledge levels regarding ECS management and to contribute to the development of targeted training programs.

MATERIALS AND METHODS

Study Design and Settings

This methodological study was conducted to assess pediatric surgical nurses' knowledge of ECS. The research took place between August and September 2023 in a city hospital that served as a referral center for pediatric survivors following the Kahramanmaraş earthquakes. The study was carried out in the pediatric surgical intensive care unit, two pediatric surgical wards, and a pediatric burn center of a hospital located in Ankara, the capital of Türkiye and home to the country's second-largest city hospital.

Sample Size and Study Population

The study population consisted of 77 pediatric surgical nurses working in the aforementioned units, all of whom were included in the study. In scale development research, it is generally recommended that the sample size be at least five to ten times the number of items in the draft scale.^[16] However, this study was conducted in a tertiary city hospital that functioned as a referral and disaster response center following the Kahramanmaraş earthquakes. Therefore, the sample comprised all eligible pediatric surgical nurses who voluntarily agreed to participate (n=77). Due to the limited number of pediatric surgical nurses employed in earthquake-prone tertiary care settings, it was not feasible to increase the sample size beyond the available population. This limitation should be considered when interpreting the findings, as it reflects the specialized nature and restricted workforce distribution of this nursing group.

Instrument Development

The ECSKS was developed in nine stages, following the scale development framework proposed by Comrey and Lee.^[22]

Stage I: Identification of Basic Concepts and Stage 2: Item Pool Generation

The researchers (D.S., E.K.) conducted a literature review to define the scope of the draft scale. Three electronic databases, PubMed, Google Scholar, and ScienceDirect, were searched. The following English keywords were used: earthquake, crush syndrome, children, nurse, knowledge, practice, tool, and scale. This search yielded 92 articles published between 2013 and 2023. After reviewing studies related to ECS,^[2,5,13,23-28] an initial pool of 30 items was generated.

Stage III: Content Validity

Expert opinions were obtained to assess the content validity

of the items in the pool. The expert panel consisted of five academicians in pediatric nursing, three specialist physicians in pediatric surgery, and two specialist nurses working in a pediatric surgery clinic at a different hospital. Using the “Expert Evaluation Form,” the experts evaluated the extent to which each item represented the intended construct and its clarity for the target population. Items were rated according to the Davis technique as follows: 1=not appropriate, 2=requires major revision, 3= appropriate but requires minor revision, and 4=appropriate. The Content Validity Ratio (CVR) for each item was calculated by dividing the number of experts who rated the item as 3 or 4 by the total number of experts.^[29] The Content Validity Index (CVI) was then computed as the average of the CVR values across all items.^[23]

Stage IV: Pilot Study

A pilot study was conducted to evaluate the face validity of the scale. The 30-item draft scale was administered to 15 nurses working in pediatric urology surgery clinics. The results indicated that the items were comprehensible, and no revisions were required. The 15 nurses who participated in the pilot study were excluded from the main data collection.

Stage V: Application of the Study

Data were collected using the Descriptive Data Collection Form and the draft version of the ECSKS. The Descriptive Data Collection Form, developed by the researchers based on a literature review, consisted of six items assessing participants' age, sex, educational level, years of professional experience, experience providing care to patients with crush syndrome, and prior training on crush syndrome.^[2,5,13,24-28]

The draft ECSKS was a 30-item instrument designed to assess pediatric surgical nurses' knowledge and practices related to crush syndrome. The items were formatted as binary Likert-type responses (“true”/“false”). Each correct response was scored as 1 point, while incorrect or unanswered items were scored as 0. The ECSKS comprised two domains: “general knowledge” and “evaluation.” Following the literature review, the theoretical framework and key problem areas were identified, and items aligned with the study objectives were developed for each domain. Each was constructed based on pre-defined content areas and related variables. The preliminary version of the scale was reviewed in detail by the researchers and approved for suitability. A total of 30 items were retained for subsequent face and content validity analyses.

Stage VI: Retest Application

As only five nurses agreed to participate in the retest procedure, statistical analysis could not be performed.

Stage VII: Validity Assessment of the ECSKS

The construct validity of ECSKS was evaluated, with findings presented in the Results and Discussion sections.

Stage VIII: Reliability Assessment of the ECSKS

The consistency of the ECSKS was assessed by calculating

Kuder–Richardson Formula 20 (KR-20) coefficients and person reliability values; the findings are reported in the Results and Discussion sections.

Stage IX: Final ECSKS

The overall validity and reliability of the ECSKS are discussed in the Conclusion section.

Ethical Considerations

The study protocol was approved by the Ethics Committee No. II of Ankara Bilkent City Hospital (approval number: E2-23-4738). Informed consent was obtained from all participants prior to data collection. The study was conducted in accordance with the principles of the Declaration of Helsinki. All healthcare professionals were informed about the study, and written informed consent was obtained before participation.

Data Collection

Data were collected under the supervision of the researchers after participants were informed about the purpose of the study. The data collection form was administered in a quiet and private setting. Participants were instructed to select the responses that best reflected their views and completed the forms independently, without guidance. Completion of the data collection form required approximately 20 minutes.

Data Analysis

The research data were analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, NY, USA), Factor version 12.04.04 for Windows, and Jamovi version 2.6.13. Descriptive statistics for numerical variables were expressed as mean±standard deviation, as well as median, minimum, and maximum values. Categorical variables were summarized using numbers and percentages. The validity of the scale was evaluated in terms of content, face, and construct validity. Expert opinions on the draft ECSKS were assessed using Davis's technique to calculate the content validity index, along with Kendall's coefficient of concordance. Construct validity was examined using tetrachoric factor analysis. When analyzing dichotomous data, tetrachoric correlations are required to ensure that factor analysis appropriately reflects the nature of the data, allowing for a more accurate representation of the underlying structure. For reliability analysis, internal consistency was assessed using Kuder–Richardson Formula 20 coefficient.

The Rasch model was applied to determine item difficulty levels and participants' ability levels. The Mann–Whitney U test was used to compare non-normally distributed scores between lower and upper groups. Statistical significance was set at $p < 0.05$.

RESULTS

Characteristics of the Participants

The mean age of the participants was 28.09 ± 3.11 years. Of the participants, 68.8% ($n=53$) were female, and 87% ($n=67$)

held a bachelor's degree. Additionally, 75.3% (n=58) had 1–5 years of professional experience. While 70.1% (n=54) had previously cared for a patient with crush syndrome, 74% (n=57) had not received any formal education on the condition. The participants' characteristics are presented in Table 1.

Validity Results

Content and construct validity were assessed as part of validity analyses. The findings indicated that the developed measurement instrument demonstrated a high level of validity.

Content Validity

The content validity of the scale was evaluated based on the opinions of 10 experts. The CVI was calculated as 0.99. Since all experts agreed on the 30 items included in the draft scale and the CVI value of the Earthquake-Related Crush Syndrome Knowledge Scale exceeded 0.80, all items were retained in the draft form. Furthermore, Kendall's coefficient of concordance indicated a high level of agreement among experts (W=0.78), which was statistically significant (p=0.001).

Construct Validity

The draft form of the instrument was first administered to assess construct validity. Bartlett's test of sphericity was statistically significant ($\chi^2=201.3$, $sd=21$, $p<0.001$), and the Kaiser–Meyer–Olkin (KMO) value was 0.61.

Based on the multicollinearity assessment, items 18 and 19 were excluded from the analysis. Subsequently, construct validity analysis was conducted using the remaining items.

Tetrachoric factor analysis was performed to determine the underlying factor structure of the scale. The results indicated that 21 items (items 1, 3, 4, 5, 9, 10, 11, 13, 14, 15, 16, 20, 21, 23, 24, 25, 26, 27, 28, 29, and 30) were excluded due to factor loadings below 0.32. The final scale consisted of seven items across two sub-dimensions, labeled "Knowledge" and "Evaluation" (Table 2). Fit indices obtained from the tetrachoric factor analysis indicated an acceptable fit for the chi-square to degrees of freedom ratio (χ^2/df), and excellent fit levels for the Adjusted Goodness-of-Fit Index (AGFI), Comparative Fit Index (CFI), Goodness-of-Fit Index (GFI), and Root Mean Square Error of Approximation (RMSEA) (Table 3).

Results of Reliability

Following factor analysis, the Kuder–Richardson Formula 20 reliability coefficients were calculated as 0.90 for Factor 1 and 0.88 for Factor 2 (Table 2).

Item Difficulty and Discrimination

According to the Rasch analysis, the person reliability coefficient of the scale was 0.433. The Mean Absolute Deviation of adjusted Q3 (MADaQ3) value, calculated to assess model fit, was 0.116, with a p-value of 0.062 (Table 4).

The proportion of correct responses ranged from 42.3% (Item M22) to 85.9% (Item M8). Rasch measures varied between -2.258 and 0.401, where negative values indicate easier

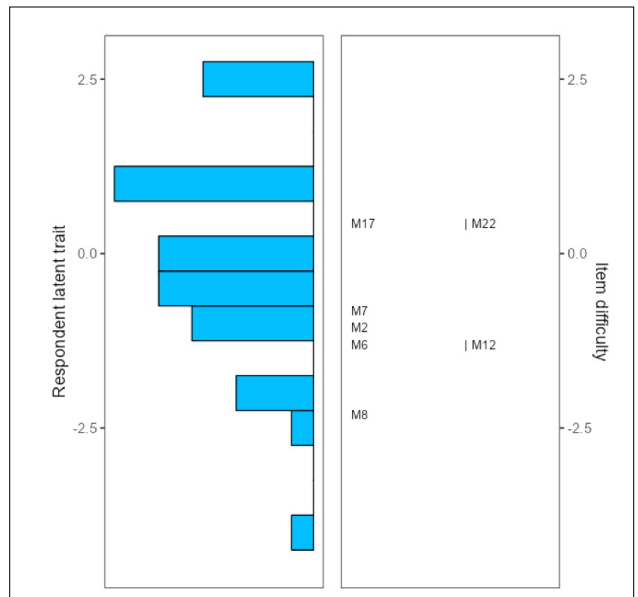


Figure 1. Wright map of the scale.

Table 1. Descriptive characteristics of participants (n=77)

Variables	n	%
Mean age, years (range)	28.09±3.11	(24-44)
Sex		
Female	53	68.8
Male	24	31.2
Educational level		
Associate degree	1	1.3
Bachelor's degree	67	87
Master's degree	8	10.4
Doctoral degree	1	1.3
Professional experience (years)		
<1 year	4	5.2
1-5 years	58	75.3
6-10 years	7	9.1
11-15 years	4	5.2
16-20 years	4	5.2
Experience caring for patients with crush syndrome		
Yes	54	70.1
No	23	29.9
Received training on crush syndrome		
Yes	20	26
No	57	74
Total	77	100

*n: Number of participants; %: Percentage.

Table 2. Eigenvalues, variance, and factor loadings from tetrachoric factor analysis

Factor	Items	Eigenvalue	Cumulative variance (%)	KR-20 reliability	Factor Determinacy Index	Interfactor correlation
Factor 1	M2, M6, M8, M12	1.48	0.43	0.90	0.949	0.216
Factor 2	M7, M17, M22	3.03	0.64	0.88	0.936	

	Items	Factor 1	Factor 2
M8	In most cases of crush syndrome, early initiation of appropriate fluid therapy can prevent the development of acute kidney injury.	0.850	–
M6	Clinical signs of crush syndrome are primarily due to systemic effects of muscle tissue damage, with rhabdomyolysis being a common cause of acute kidney injury.	0.846	–
M12	Compartment syndrome is characterized by increased intracompartmental pressure caused by hypoxia and neuromuscular and microvascular changes due to muscle edema.	0.703	–
M2	Earthquakes, as natural disasters, are the most common cause of crush syndrome.	0.662	
M17	Since cardiac function is generally preserved in patients with crush syndrome, monitoring with pulse oximetry alone is sufficient.	–	0.909
M7	Clinical signs and symptoms of acute kidney injury should be carefully evaluated in all patients with crush syndrome.	–	0.796
M22	Due to the risk of hyperkalemia, patients with crush syndrome should be provided with a potassium-restricted diet.	–	0.594

*KR-20: Kuder–Richardson Formula 20.

Table 3. Goodness-of-fit indices from tetrachoric factor analysis

Fit index	Criteria for excellent fit	Criteria for acceptable fit	Calculated value	Fit level
χ^2/df	$0 \leq \chi^2/df \leq 2$	$2 \leq \chi^2/df \leq 3$	2.480	Acceptable fit
GFI	$0.95 \leq GFI \leq 1$	$0.90 \leq GFI \leq 0.95$	0.988	Excellent fit
AGFI	$0.90 \leq AGFI \leq 1.00$	$0.85 \leq AGFI \leq 0.90$	0.968	Excellent fit
CFI	$0.95 \leq CFI \leq 1.00$	$0.90 \leq CFI \leq 0.95$	0.999	Excellent fit
RMSEA	$0.00 \leq RMSEA \leq 0.05$	$0.90 \leq GFI \leq 0.95$	0.001	Excellent fit

*AGFI: Adjusted Goodness-of-Fit Index; CFI: Comparative Fit Index; df: Degrees of freedom; GFI: Goodness-of-Fit Index; RMSEA: Root Mean Square Error of Approximation; χ^2 : Chi-square.

Table 4. Rasch model fit statistics

	Min–Max	Mean±SD	Median	Person reliability	MADaQ3	p
Scale	0–7	4.53±1.78	5.00	0.433	0.116	0.062

*MADaQ3: Mean absolute deviation of centered Q₃ residual correlations; P indicates model fit to the Rasch model.

items and positive values indicate more difficult items. Accordingly, Item M8 (Measure=-2.258) was the easiest, while Item M22 (Measure=0.401) was the most difficult (Fig. 1, Table 5). Item information-weighted fit (infit) statistics ranged from 0.947 (Item M8) to 1.082 (Item M22), all within the ac-

ceptable range of 0.7–1.3. Similarly, outlier-sensitive fit (outfit) values ranged from 0.921 (Item M2) to 1.116 (Item M22), also indicating acceptable fit (Table 5).

The Wright map (person-item map) presented in Figure 1 illustrates, based on Rasch analysis, participants' latent trait

Table 5. Item statistics in Rasch analysis

	Proportion (%)	Item difficulty	SE	Infit	Outfit
M2	0.679	-0.961	0.273	0.957	0.921
M6	0.744	-1.355	0.289	0.968	0.946
M7	0.654	-0.815	0.269	1.014	0.992
M8	0.859	-2.258	0.354	0.947	0.969
M12	0.731	-1.272	0.286	1.012	1.034
M17	0.436	0.334	0.259	0.992	1.015
M22	0.423	0.401	0.260	1.082	1.116

*Infit: Information-weighted mean square; Outfit: Outlier-sensitive mean square, SE: Standard error.

Table 6. Comparison of the lowest- and highest-scoring 27% groups

Group	Median	Min	Max	Mean±SD	Test statistic	p
Lowest-scoring 27% group	2.00	0.00	3.00	2.19±0.98	231.000	<0.001
Highest-scoring 27% group	6.00	6.00	7.00	6.48±0.51		

*n: Number of participants; %: Percentage; Mean±SD: Mean±standard deviation.

levels (left panel) and item difficulty levels (right panel) on the same logit scale. The distribution on the left side of the map, represented by blue bars, reflects participants' trait levels. Item difficulty levels are displayed on the right panel. Item M8 has the lowest difficulty level, whereas Items M22 and M17 are the most difficult. Additionally, Items M6, M12, M2, and M7 are relatively easier and are positioned closer to the center of the scale.

Total scores on the scale ranged from 0 to 7, with a mean of 4.53 ± 1.78 and a median of 5.00. A significant difference was observed between the median scores of the lower and upper groups ($p < 0.001$). The median score was 2.00 for the lower group and 6.00 for the upper group (Table 6).

DISCUSSION

The present study employed the dichotomous Rasch model to evaluate the psychometric properties, namely structural validity, internal consistency, and measurement characteristics, of the seven-item Earthquake-Related Crush Syndrome Knowledge Scale, developed to assess pediatric surgical nurses' knowledge of ECS. Adequate knowledge of ECS is essential for nurses, as it is one of the most common conditions observed in patients hospitalized following earthquakes. Competency in this area directly influences the effectiveness of post-disaster interventions and improves patient outcomes.^[12,14,28,30] The ECSKS is the first instrument in the literature specifically designed to measure ECS knowledge among

pediatric surgical nurses caring for child earthquake survivors in hospital settings.

Validity of the Scale

Content validity refers to the extent to which a scale and its subscales adequately represent the construct being measured, ensuring semantic clarity and conceptual consistency across items.^[31,32] This method is commonly used to evaluate content validity, and items with low CVI values may be revised.^[32] A CVI of at least 0.80 is generally considered acceptable for content validity.^[33,34] In this study, the CVI value was high, indicating that the ECSKS draft demonstrated adequate content validity. A Kendall's W value exceeding 0.70 indicates a strong level of agreement among experts,^[35] reflecting consistency in their evaluations of item relevance and clarity. In this study, the statistically significant result suggests that the observed agreement was unlikely to have occurred by chance, thereby supporting the content validity and conceptual representativeness of the scale items.

In the literature, it is recommended that sample size in scale development be at least five to ten times the number of items.^[23] In the present study, the sample consisted of nurses with highly specific characteristics who met the inclusion criteria and were working in a city hospital that served as a referral and disaster response center following the Kahramanmaraş earthquake. Therefore, the entire accessible population meeting these criteria was included. However, the number of participants did not meet the recommended item-to-sample ratio. Accordingly, the suitability of the dataset for factor

analysis and construct validity was assessed using the KMO measure and Bartlett's test of sphericity.^[36] The KMO value indicated that the sample was moderately adequate, suggesting that the dataset was acceptable for factor analysis. However, this value also implies that the sample size or the inter-correlations among variables were not particularly strong.^[36]

Construct validity analysis was conducted to determine whether the scale items work were consistent with the intended theoretical structure.^[37] In this study, the measurement model was evaluated using tetrachoric factor analysis. The presence of multicollinearity can lead to unstable parameter estimates and inflated standard errors, thereby reducing the precision of confidence intervals and the validity of hypothesis testing. To address this issue, it is recommended to remove one of the highly correlated variables.^[38,39] Accordingly, items 18 and 19 were excluded due to multicollinearity. An item-total correlation coefficient of 0.30 or higher is generally considered indicative of consistency between an item and the overall scale, as well as with other items within the same factor.^[40] Following factor analysis item-total evaluation, 21 items with low factor loadings were removed. Consequently, seven items that met the psychometric and theoretical adequacy criteria were retained. Although the number of items was reduced, this process ensured that the final version of the scale maintained statistical validity and conceptual coherence.

Tetrachoric factor analysis is appropriate for measurement instruments with dichotomous variables (e.g., yes/no or true/false).^[41] The tetrachoric factor analysis conducted in this study showed that all items in the "Knowledge" and "Evaluation" subdimensions had factor loadings above 0.40. Additionally, the fit indices indicated an excellent fit.^[42,43] All goodness-of-fit indices for the confirmatory two-factor model met acceptable threshold values. Specifically, the CFI (0.99>0.95), RMSEA (0.001<0.05), and AGFI (0.968>0.90) demonstrated excellent fit. Accordingly, the two-factor structure was confirmed.^[42,43] Following tetrachoric factor analysis, the ECSKS was found to consist of two subdimensions with seven items.

Reliability of the Scale

The Kuder-Richardson Formula 20 coefficient is a widely used reliability measure of internal consistency for instruments with dichotomous (true/false) response formats, with values ranging from 0 to 1.^[44,45] In this study, the KR-20 results indicated that the scale demonstrated excellent internal consistency.

The Rasch model findings further supported the reliability of the scale.^[46] This model enables the ordering of items from easiest to most difficult, identifying those that participants are least and most likely to answer correctly.^[47,48]

According to the Rasch analysis, the person reliability coefficient (0.433) indicated a limited ability of the scale to differentiate individuals across varying levels of the measured construct.^[49] The MADaQ3 value confirmed that the assumption

of local independence among items was met, and the model-data fit indices indicated an acceptable overall fit. Although the scale demonstrated adequate model fit, the low person reliability suggests that individuals could not be sufficiently distinguished along the latent trait continuum. To improve measurement precision, future studies should include a more heterogeneous sample (e.g., participants from different clinical units, with varying levels of experience, and those without prior experience in caring for child earthquake survivors). Additionally, adding items at both the lower and higher targeting ends of the difficulty spectrum may improve the scale's targeting capacity.

In this study, Item 8 was identified as the easiest item, indicating that participants had adequate knowledge of the administration and clinical importance of intravenous fluid therapy in child earthquake survivors.^[1] In contrast, Item 22 was the most difficult, as it required an understanding of the pathophysiology of earthquake-related crush syndrome. Consistent with these findings, previous studies have reported that nurses often lack sufficient knowledge of ECS and its management.^[13,14,16] The identification of this item as the most challenging highlights the need for targeted educational interventions to strengthen evidence-based knowledge and address misconceptions about ECS among pediatric surgical nurses. Moreover, the difference in scale scores between the highest- and lowest-performing groups provides additional evidence of the discriminative validity of the scale items.

Limitations

The primary limitation of this study is that the sample size was limited to 77 pediatric surgical nurses working in a city hospital in Türkiye that provided centralized care for pediatric earthquake survivors following the Kahramanmaraş earthquake. In scale development studies, it is generally recommended that the sample size be at least 5-10 times the number of items in the draft scale.^[23] However, because this hospital was designated by the Ministry of Health as a primary referral center for children affected by the earthquake, all eligible nurses working in this setting were included in the study. Consequently, the recommended sample size could not be achieved. The limited sample size may have reduced the ability of some items to adequately discriminate between different levels of knowledge. Nevertheless, the excellent fit statistics obtained from the Rasch analysis suggest that the instrument demonstrates validity and reliability, supporting its use in future research. Therefore, further studies with larger and more heterogeneous samples are recommended to more accurately assess individual discrimination.

CONCLUSION

Based on the preliminary findings of this study, the 7-item ECSKS demonstrates acceptable validity and reliability for assessing pediatric surgical nurses' knowledge of ECS. The results indicate that the scale shows adequate fit to the Rasch

model. Furthermore, the instrument may be used to evaluate the effectiveness of educational intervention aimed at improving pediatric surgical nurses' knowledge of ECS. Future studies should examine the applicability and validity of the ECSKS across different cultural contexts.

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Ethics Committee Approval: This study was approved by the Ankara Bilkent City Hospital Ethics Committee (Date: 09.08.2023, Decision No: E2-23-4738).

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ORIJİNAL ÇALIŞMA - ÖZ

Tetrachoric ve Rasch analizleri kullanarak Depremle İlgili Ezilme Sendromu Bilgi Ölçeğinin geliştirilmesi ve geçerliğinin doğrulanması

AMAÇ: Depremle ilişkili ölümlerin önemli bir kısmı, olay anında meydana gelen ciddi travma ve enkaz altında kalmaya bağlıdır. Uzun süreli basıya maruz kalan hastalarda ezilme sendromu gelişme riski riski belirgin şekilde artmakta olup, bu durum mortalite ve morbiditeyi etkileyen kritik faktörlerden biri olarak kabul edilmektedir. Bu çalışmanın amacı, çocuk cerrahisi hemşirelerinin depremle ilişkili ezilme sendromu hakkındaki bilgi düzeylerini değerlendirmeye yönelik bir ölçme aracı geliştirmek ve bu aracın psikometrik özelliklerini incelemektir.

GEREÇ VE YÖNTEM: Bu metodolojik çalışma Ağustos ve Eylül 2023 tarihleri arasında gerçekleştirilmiştir. Örneklem, bir şehir hastanesinin çocuk cerrahisi birimlerinde görev yapan ve çalışmaya gönüllü olarak katılan 77 hemşireden oluşmuştur. Veriler, bir veri toplama formu ve 30 maddeden oluşan ölçeğin taslak versiyonu ile toplanmıştır. Ölçeğin geçerliliğini doğrulamak için içerik ve yapı geçerliliği testleri uygulanmıştır. Ölçeğin yapı geçerliliğini belirlemek için Tetrachoric Faktör Analizi kullanılmıştır. Ölçeğin güvenilirliğini belirlemek için Kuder–Richardson (KR) 20 katsayısı ve kişi güvenilirlik katsayısı hesaplanmıştır. Madde güçlük ve ayırt edicilik indekslerini incelemek üzere Rasch analizi gerçekleştirilmiştir.

BULGULAR: Depremle İlgili Ezilme Sendromu Bilgi Ölçeği için Kapsam Geçerlilik Endeksi 0.99 olarak hesaplanmıştır. Tetrahoric faktör analizi sonucunda, dokuz maddeden oluşan iki alt boyutlu bir yapı ortaya çıkmıştır. İki faktörlü doğrulayıcı model için incelenen uyum indeksleri kabul edilebilir ve mükemmel uyum düzeyleri göstermiştir. KR-20 güvenilirlik katsayıları faktör 1 için 0.90, faktör 2 için 0.88 olarak hesaplanmıştır. Rasch analizi sonuçları, ölçeğin yedi maddeden oluşan iki alt boyutlu bir yapıya sahip olduğunu; madde yüklerinin 0.59 ile 0.90 arasında değiştiğini ve faktörlerin birbiriyle ilişkili olduğunu göstermiştir. Rasch modelinde kişi güvenilirlik katsayısı 0.433 olup düşük düzeydedir. Model uyumunu değerlendirmek amacıyla hesaplanan MADaQ3 değeri 0.116 olup kabul edilebilir düzeydedir; infit ve outfit istatistikleri ise 0.5–1.5 aralığında bulunarak uygun uyum göstermiştir.

SONUÇ: Ön bulgular, ölçeğin pediatrik cerrahi hemşirelerinin depremle ilişkili ezilme sendromuna ilişkin bilgi düzeylerini ölçmede kabul edilebilir geçerlik ve güvenilirlik gösterdiğini ortaya koymaktadır.

Anahtar sözcükler: Bilgi ölçeği; deprem yaralanmaları; ezilme sendromu; hemşire; travma.

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