



Validation of the Korean Version of the Pediatric Eating Assessment Tool-10 (K-Pedi-EAT-10) with Correlation to Videofluoroscopic Swallowing Study

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Objective: This cross-sectional pilot study aimed to translate, culturally adapt, and validate the Korean version of the Pediatric Eating Assessment Tool-10 (K-Pedi-EAT-10).

Methods: To translate, culturally adapt, and validate the Korean version of the Pediatric Eating Assessment Tool-10 (K-Pedi-EAT-10).

Results: The K-Pedi-EAT-10 demonstrated excellent internal consistency (Cronbach's $\alpha=0.956$) and strong test-retest reliability (ICC=0.988; 95% CI, 0.971–0.995). Content validity indices were high (I-CVI>0.80 for all items; S-CVI/Ave=0.92 for relevance, 0.88 for clarity). Children with dysphagia showed markedly higher K-Pedi-EAT-10 total scores (16.15 ± 9.24) than controls (0.31 ± 0.72 ; $U=9.5$, $Z=-4.053$, $p<0.001$), confirming discriminative validity. Higher K-Pedi-EAT-10 scores were observed in children with aspiration (Penetration-Aspiration Scale [PAS] ≥ 6) than in those without ($p<0.05$). Significant correlations were found between K-Pedi-EAT-10 total and PAS scores ($r=0.705$, $p=0.007$), confirming its potential utility as a screening tool that reflects aspiration severity without radiation exposure from videofluoroscopic swallowing study. Receiver operating characteristic analysis yielded an area under the curve of 0.98 (95% CI, 0.95–1.00) and identified a cut-off score of 19 for predicting aspiration, with 100% sensitivity and 85.7% specificity.

Conclusion: The K-Pedi-EAT-10 is a reliable, valid, and non-invasive tool for screening pediatric dysphagia. Its strong psychometric performance supports its potential use for the early identification and timely intervention of children at risk for dysphagia in clinical practice.

Keywords: Deglutition disorders, Dysphagia, Children with disabilities, Patient Health Questionnaire

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INTRODUCTION

Dysphagia requires prompt diagnosis and intervention to prevent complications such as malnutrition, dehydration, and aspiration pneumonia [1,2]. In the pediatric population, dysphagia can lead to chronic health issues, affecting physical growth and

overall development, underscoring the need for early detection and timely intervention [3]. Children with central nervous system or neuromuscular disorders are at high risk of progressive dysphagia [2,4,5]. As such, accurate screening tools can be critical to detecting dysphagia at an early stage and improving clinical outcomes [6].

Videofluoroscopic swallowing study (VFSS) and fiberoptic endoscopic evaluation of swallowing (FEES) remain the most popular diagnostic tools for pediatric dysphagia [7]. Although accurate, they are invasive, with VFSS involving dangerous radiation exposure for younger children and FEES triggering discomfort, pain, and intranasal bleeding [8,9]. Therefore, non-invasive, reliable, and child-friendly screening tools, such as caregiver-administered questionnaires, are increasingly being recognized as both practical and efficient in identifying those at risk and helping minimize the reliance on invasive, traditional procedures [10].

A well-established tool for non-invasive screening of dysphagia is the Pediatric Eating Assessment Tool-10 (Pedi-EAT-10), adapted from the adult version [11], which has been validated and extensively used to assess dysphagia severity in adults with various conditions, such as stroke, dementia, amyotrophic lateral sclerosis, chronic obstructive pulmonary disease, and head and neck cancers [12-14]. The Pedi-EAT-10, comprising a 10-item caregiver-administered questionnaire, has also demonstrated strong validity and reliability in pediatric populations [15-17]. Validation studies for Pedi-EAT-10 in Arabic, Spanish, and Italian populations have further confirmed its internal consistency, test-retest reliability, and effectiveness in multiple languages to identify dysphagia in children with neurological and genetic disorders [18-20].

Although the Pedi-EAT-10 has been widely validated in several languages [18-20], no studies have been conducted in Asian populations. This study aimed to translate, culturally adapt, and validate the Korean version of Pedi-EAT-10 (K-Pedi-EAT-10), in accordance with the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) guidelines to ensure methodological rigor in the cross-cultural adaptation process [21,22]. We hypothesized that the K-Pedi-EAT-10 would demonstrate strong reliability and validity and serve as a non-invasive, caregiver-administered screening tool for early detection of pediatric dysphagia and aspiration risk, thereby facilitating preliminary clinical triage and guiding the appropriate use of confirmatory instrumental evaluations such as VFSS or FEES when indicated.

METHODS

Study design

This prospective, cross-sectional pilot study was conducted in two phases: (1) translation and cultural adaptation of the

Pedi-EAT-10 into Korean, and (2) psychometric validation of the K-Pedi-EAT-10 in children with dysphagia and typically developing controls (Fig. 1). The study followed the ISPOR Task Force guidelines for the translation and cultural adaptation of patient-reported outcome measures (Supplementary Table S1) [22].

A multidisciplinary expert committee composed of seven physiatrists (four with expertise in adult dysphagia and three in pediatric rehabilitation) and three pediatric swallowing therapists, all possessing more than five years of clinical experience regarding dysphagia, reviewed the two forward translations (BT1, BT2) and the original Pedi-EAT-10 to ensure semantic, experiential, and conceptual equivalence. Cognitive debriefing was subsequently conducted through focused interviews with five caregivers of children diagnosed with dysphagia confirmed by VFSS (Penetration-Aspiration Scale, PAS $\geq$ 3) within the preceding three months. Caregivers evaluated the clarity, relevance, and comprehensibility of each item and response option, and their feedback was systematically analyzed in conjunction with the content validity assessment results. Based on the integrated analysis of cognitive debriefing outcomes and expert consensus discussions, the committee refined linguistic precision and cultural appropriateness, leading to the development of the finalized Pedi-EAT-10_Korean Version 3 (K-Pedi-EAT-10) for psychometric evaluation (Fig. 1).

Children aged 3 to <18 years were enrolled. The clinical group included children with dysphagia who had undergone VFSS within the preceding three months. The control group consisted of typically developing children without swallowing or neurological disorders. Children were excluded if they were totally tube-fed, medically unstable, or unable to complete the assessment due to poor cooperation or lack of caregiver support. Demographic and clinical data—including age, sex, and Functional Oral Intake Scale (FOIS) level [23] (Supplementary Table S2)—were collected from medical records or caregiver reports.

The study was approved by the Institutional Review Board of Seoul National University Hospital (IRB No. H-2308-140-1459). Written informed consent was obtained from legal guardians, and assent was also obtained from participants aged 7 years or older.

VFSS analysis

VFSS was performed with children seated upright in a chair or feeder seat, depending on clinical status. Standardized boluses

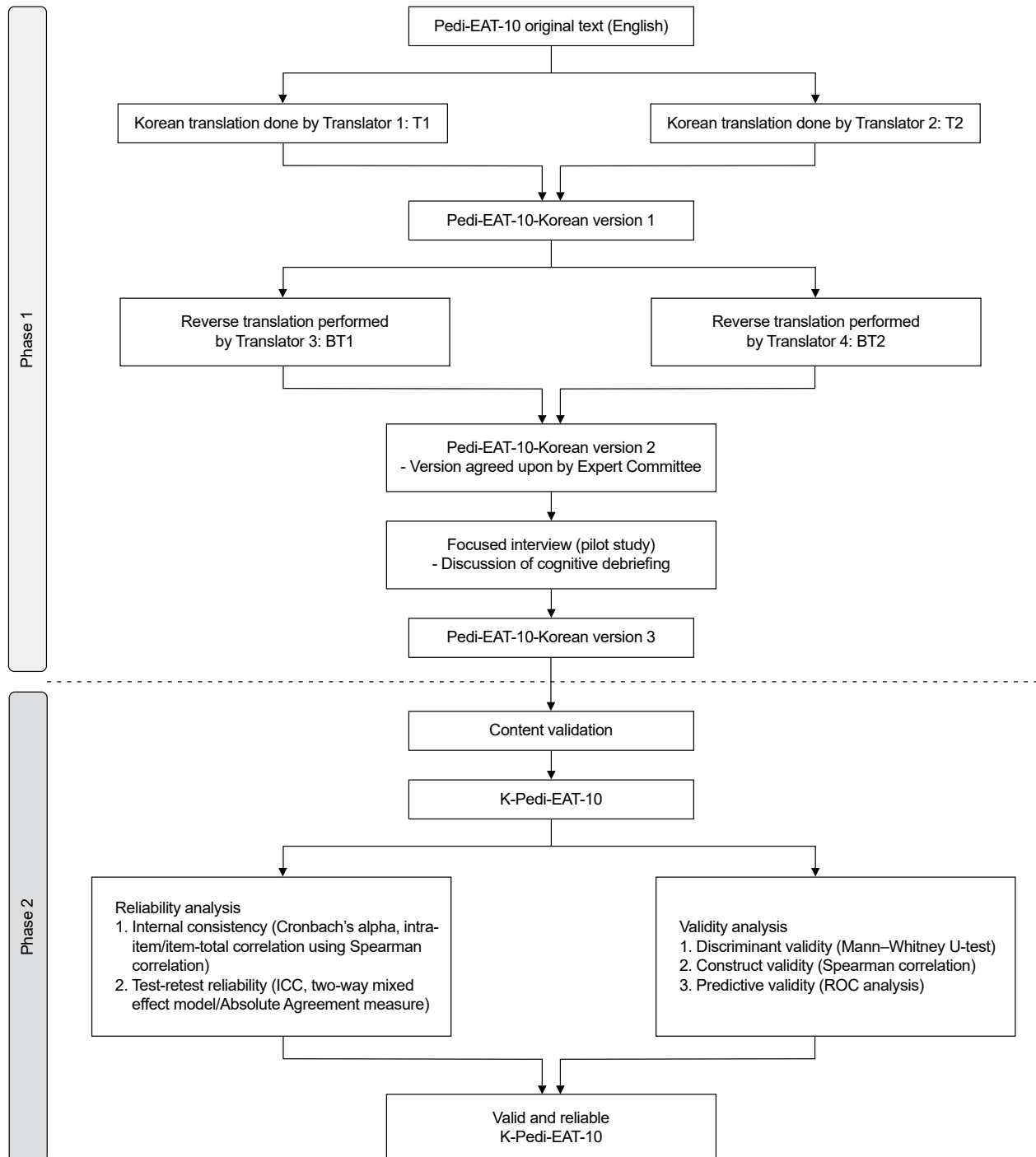


Fig. 1. Research methodology flow chart illustrating the two-phase process of translation, cultural adaptation, and psychometric validation of the Korean version of the Pediatric Eating Assessment Tool-10 (K-Pedi-EAT-10). ICC, intraclass correlation coefficient; ROC, receiver operating characteristic.

were administered, and the primary analysis focused on 2 mL liquid barium and yogurt trials, which were feasible for most participants. Outcome parameters included the PAS, pharyngeal

residue, oral transit time (OTT), and pharyngeal transit time (PTT). Detailed bolus types, scoring methods for PAS and residue, and definitions of OTT and PTT are provided in [Supple-](#)

mentary Tables S3, S4, and Fig. 2 [24–27]. VFSS data were retrospectively collected within three months of the K-Pedi-EAT-10 responses.

Sample size determination

We calculated the required sample size based on a previous study reporting the relationship between Pedi-EAT-10 and PAS, in which the $PAS \geq 6$ group had a mean Pedi-EAT-10 score of 33.3 ± 5.12 and the $PAS \leq 5$ group had a mean score of 22.0 ± 5.26 [18]. To detect differences in Pedi-EAT-10 scores between the clinical and normal groups, with a significance level of 0.05 and a power of 0.9, a sample size of 12 participants per group was required. Considering a potential dropout rate of 10%, we recruited 13 participants for the clinical group and 13 age-matched healthy participants for the normal group.

Statistical analysis

Internal consistency of the K-Pedi-EAT-10 was assessed with Cronbach's α , with values >0.8 indicating excellent reliability [28]. Item-to-item and item-to-total correlations were evaluated using Spearman correlation. Test-retest reliability was examined by re-administering the questionnaire 4–7 days later to

caregivers in both groups, excluding participants who underwent therapeutic or medical changes between tests. Intraclass correlation coefficients (ICCs) were calculated, with $ICC > 0.80$ reflecting excellent agreement.

Content validity was assessed using the item-level content validity index (I-CVI) and the scale-level content validity index based on the average method (S-CVI/Ave). Discriminant validity was examined by comparing K-Pedi-EAT-10 scores between clinical and control groups with the Mann–Whitney U-test ($\alpha=0.05$). Construct validity was evaluated in the clinical group using Spearman correlations between K-Pedi-EAT-10 scores and VFSS parameters, including PAS, vallecular and pyriform sinus residue, OTT, and PTT during Yoplait and small fluid trials. Because the sample size was limited and the data were not normally distributed, nonparametric analyses were applied. Validity was interpreted using correlation strength: excellent (0.90–1.00), good (0.70–0.89), moderate (0.50–0.69), weak (0.30–0.49), and poor (<0.30) [29,30]. Predictive validity was analyzed by assessing the ability of K-Pedi-EAT-10 to detect aspiration ($PAS \geq 6$). Diagnostic accuracy was evaluated by receiver operating characteristic (ROC) curve analysis, with sensitivity and specificity calculated to identify optimal cutoff values.

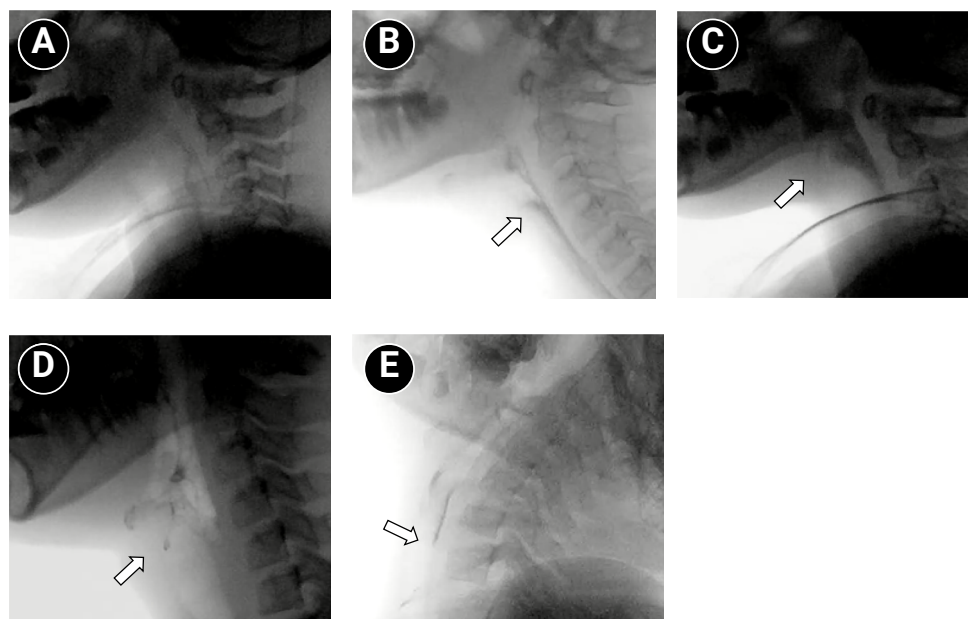


Fig. 2. Examples of the Penetration-Aspiration Scale (PAS) measured during videofluoroscopic swallowing study. (A) PAS 1, material does not enter the airway; (B) PAS 2, material enters the airway, remains above the vocal folds, and is ejected from the airway; (C) PAS 3, material enters the airway, remains above the vocal folds, and is not ejected from the airway; (D) PAS 5, material enters the airway, contacts the vocal folds, and is not ejected from the airway; and (E) PAS 8, material enters the airway, passes below the vocal folds, and no effort is made to eject. Arrows indicate penetrated or aspirated food materials.

RESULTS

Translation and cultural adaptation

The process of translation and cultural adaptation of the Pedi-EAT-10 into Korean was successfully completed through iterative revisions including feedback from focused interviews and expert committee reviews. During this process, semantic and conceptual clarifications were made to prevent confusion between similar terms such as “eating” and “swallowing,” “gags” and “vomiting,” and “pain” and “discomfort.” In addition, for Q3 and Q4 stating that “swallowing liquids or solids takes extra effort,” specific examples were added in parentheses to clarify the meaning of “extra effort.”

During the focused group interviews conducted with the Pedi-EAT-10-Korean version 2, the average response time to complete answering 10 questions was 75.4±19.0 seconds. Four respondents reported that all the questions were clear and easy to understand, while one respondent answered that Q2 and Q8 were “somewhat difficult to understand,” scoring 3 on a 4-point Likert scale. Consequently, further revisions were made on Q2 and Q8 to complete the Pedi-EAT-10-Korean version 3. Additional revisions were implemented to improve both relevance and clarity following the content validity evaluation of Q2, Q3, Q4, Q6, Q8, and Q10 by the expert committee discussions (Fig. 1). The final version of the K-Pedi-EAT-10 after completing the translation, cultural adaptation, and refinement process is presented in [Supplementary Table S5](#).

Participants

For Phase 2, 13 patients in the clinical group (7 male; mean age: 10.2±4.2 years; median age: 11 years [range: 3–17 years]) and 13 individuals in the age-matched control group (7 male; mean age=9.5±5.0 years; median age: 10 years [range: 3–17 years]) were enrolled ([Table 1](#)). Patients in the clinical group were diagnosed with central nervous system lesions (n=7, 53.8%), including glioblastoma, West syndrome, and Lennox-Gastaut syndrome and neuromuscular diseases (n=6, 46.2%), such as nemaline rod myopathy, spinal muscular atrophy type 1, and chronic inflammatory demyelinating polyneuropathy. In the clinical group, four patients (30.8%) were classified as FOIS level 4, one patient (7.7%) as FOIS level 5, three patients (23.1%) as FOIS level 6, and five patients (38.5%) as FOIS level 7. In contrast, all participants in the normal group were classified as FOIS level 7.

Reliability

The internal consistency presented as inter-item analysis was excellent (Cronbach’s α =0.956). The item-to-item and item-to-total score correlations were also significant, with all items demonstrating strong correlations ([Table 2](#)). For the test-retest reliability, four participants in the clinical group failed to answer the re-test within 7 days after the first answer, owing to dietary changes (n=1), aggravation of the medical condition (n=2), and non-compliance (n=1). In the normal group, one participant was excluded due to non-compliance. The test-retest reliability showed ICC values of 0.836–0.990 for individual items, indicat-

Table 1. Demographics and clinical characteristics of participants

	Clinical group (n=13)	Normal group (n=13)	p-value
Age (yr)	10.2±4.2	9.5±5.0	0.71
Sex, male:female	7 (53.8):6 (46.2)	7 (53.8):6 (46.2)	
Height (cm)	124.5±28.4	137.1±27.0	0.28
Body weight (kg)	29.1±18.3	37.6±17.8	0.26
Body mass index (kg/m ²)	16.8±3.93	18.6±2.6	0.21
FOIS			
4	4 (30.8)		
5	1 (7.7)		
6	3 (23.1)		
7	5 (38.5)	13 (100)	
Underlying disease			
CNS lesions	7 (53.8)		
NMDa)	6 (46.2)		

Values are presented as mean±standard deviation or number (%).

FOIS, Functional Oral Intake Scale (no participants scored FOIS levels 1–3 in this study); CNS, central nervous system; NMD, neuromuscular disease.

^{a)}The NMD category included diagnoses of nemaline myopathy, juvenile dermatomyositis, spinal muscular atrophy type 1, and chronic inflammatory demyelinating polyneuropathy.

Table 2. Internal consistency using spearman correlation and test-retest reliability using intra class correlation

	Internal consistency										Test-retest reliability	
	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total	ICC	95% CI
Q1	.838	.884	.866	.658	.634	.784	.664	.666	.907	.884	0.836	0.595–0.933
Q2		.871	.876	.632	.536	.670	.677	.574	.872	.837	0.936	0.842–0.974
Q3			.924	.736	.626	.798	.734	.723	.926	.909	0.954	0.886–0.981
Q4				.695	.722	.804	.729	.678	.932	.904	0.970	0.925–0.988
Q5					.641	.720	.901	.822	.716	.860	0.930	0.827–0.972
Q6						.753	.651	.595	.673	.702	0.888	0.724–0.955
Q7							.711	.615	.770	.828	0.945	0.865–0.978
Q8								.707	.749	.832	0.938	0.846–0.975
Q9									.706	.818	0.990	0.975–0.996
Q10										.907	0.976	0.940–0.990

All correlations demonstrated statistical significance ($p < 0.001$).

ICC, intraclass correlation coefficient; CI, confidence interval.

ing good to excellent reliability (Table 2). The overall ICC for all items combined was 0.988 (95% confidence interval [CI], 0.971–0.995), demonstrating excellent test-retest reliability.

Validity

The I-CVI for both relevance and clarity were above 0.8 for all items (Table 3), and the S-CVI/Ave was 0.92 for relevance and 0.88 for clarity, indicating excellent content validity. The discriminant validity was confirmed through the comparison of mean total scores of the K-Pedi-EAT-10: clinical group, mean±standard deviation (SD): 16.15±9.24, median: 19 (range: 0–32); normal group, mean±SD: 0.31±0.72, median: 0 (range: 0–2). The Mann–Whitney U-test yielded a U-value of 9.5, with a corresponding Z-value of -4.053 ($p < 0.001$), indicating a significant difference between the groups and demonstrating the ability of K-Pedi-EAT-10 to differentiate between children with dysphagia and healthy children. The comparison of K-Pedi-EAT-10 scores between the groups stratified by age and diagnosis is detailed in Table 4. Furthermore, the Mann–Whitney U-test comparing item-specific and total K-Pedi-EAT-10 scores between the aspiration ($PAS \geq 6$) and non-aspiration ($PAS \leq 5$) subgroups within the clinical group revealed significant differences in Q1 ($U = 5.5$, $p = 0.022$), Q2 ($U = 3.5$, $p = 0.009$), Q4 ($U = 4.0$, $p = 0.013$), Q5 ($U = 7.0$, $p = 0.036$), Q8 ($U = 7.0$, $p = 0.034$), and the total score ($U = 1.0$, $p = 0.004$), with higher scores consistently observed in the aspiration group (Table 5).

The K-Pedi-EAT-10 total score and PAS scores were significantly correlated ($r = 0.705$, $p = 0.007$), whereas vallecular or pyriform sinus residue levels were not correlated (Fig. 3). When analyzing the correlations between individual K-Pedi-EAT-10 item scores and PAS scores, significant correlations were ob-

Table 3. Content validity of Korean version of Pediatric Eating Assessment Tool-10 (n=10)

Item	I-CVI (relevance)	I-CVI (clarity)
1	0.96	0.96
2	0.96	0.86
3	0.93	0.82
4	0.89	0.82
5	0.89	0.86
6	0.89	0.93
7	0.93	0.89
8	0.86	0.82
9	1.00	1.00
10	0.89	0.86

I-CVI, item-level content validity index.

Table 4. Pediatric Eating Assessment Tool-10 total scores, stratified by age and disease group

Age (yr)	Clinical group		Normal group	
	N	Mean±SD	N	Mean±SD
3–6	4	18.50±11.19	4	1.00±1.00
7–10	2	8.00±3.00	3	0.00±0.00
11–14	5	16.00±8.81	3	0.00±0.00
15–17	2	20.00±3.00	3	0.00±0.00
Total	13	16.15±9.24	13	0.31±0.72
Disease group				
CNS lesions	7	16.00±10.20		
NMD	6	16.33±7.97		

CNS, central nervous system; NMD, neuromuscular disease; SD, standard deviation.

served for Q2 ($r = 0.764$, $p = 0.002$) and Q4 ($r = 0.684$, $p = 0.010$). No significant correlations were observed between individual K-Pedi-EAT-10 item scores and vallecular residue levels. However, significant positive correlations were found between pyriform sinus residue levels and Q5 ($r = 0.583$, $p = 0.036$), as well

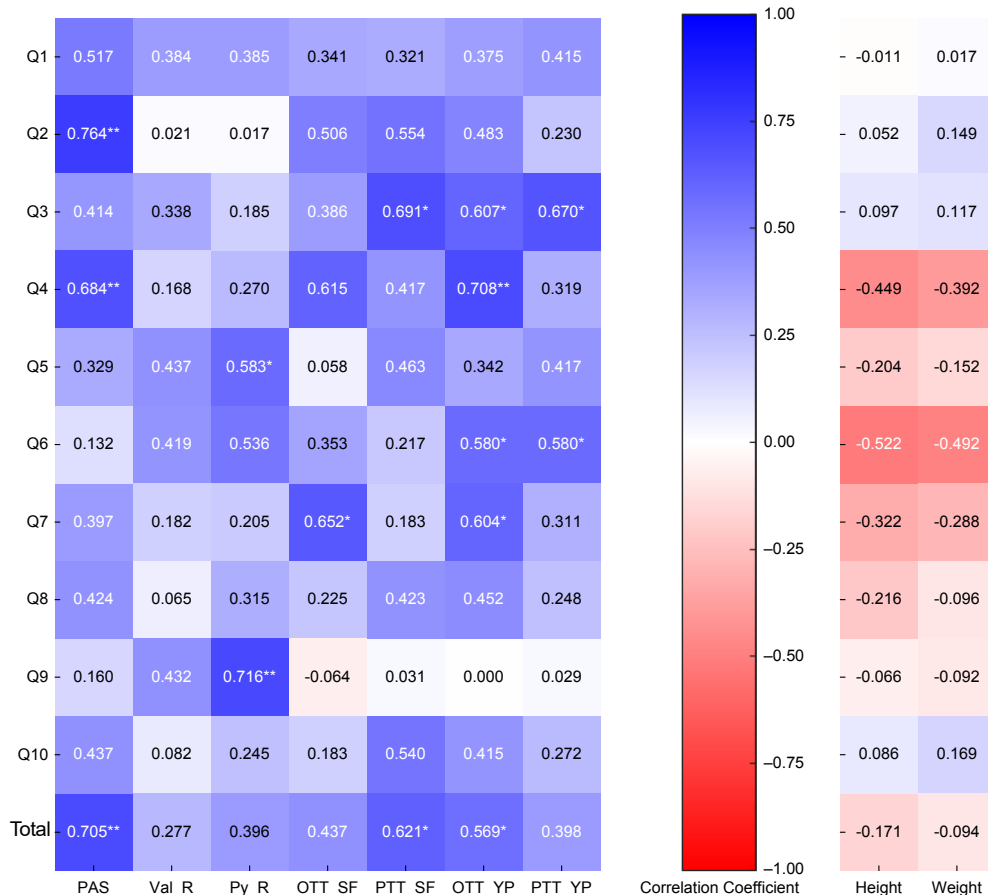
Table 5. Comparison of K-Pedi-EAT-10 item and total scores between aspiration (PAS $\geq$ 6) and non-aspiration (PAS $\leq$ 5) subgroups among children with dysphagia

	Aspiration group (n=6, 46.2%)	Non-aspiration group (n=7, 53.8%)	p-value
	Mann-Whitney U	Z-score	
Q1	5.5	-2.291	0.022
Q2	3.5	-2.614	0.009
Q3	10.5	-1.564	0.118
Q4	4.0	-2.495	0.013
Q5	7.0	-2.094	0.036
Q6	12.0	-1.371	0.170
Q7	9.5	-1.172	0.085
Q8	7.0	-2.123	0.034
Q9	11.0	-1.496	0.135
Q10	10.0	-1.638	0.101
Total score	1.0	-2.873	0.004

K-Pedi-EAT-10, Korean version of the Pediatric Eating Assessment Tool-10; PAS, Penetration-Aspiration Scale.

as Q9 ($r=0.716$, $p=0.006$) (Fig. 3). During the small fluid trials, significant correlations were only found between OTT and Q7 ($r=0.652$, $p=0.041$). For PTT, significant correlations were observed with Q3 ($r=0.691$, $p=0.019$) and total score ($r=0.621$, $p=0.042$). During the Yoplait trials, OTT showed a significant correlation with Q3 ($r=0.607$, $p=0.028$), Q4 ($r=0.708$, $p=0.007$), Q6 ($r=0.580$, $p=0.038$), Q7 ($r=0.604$, $p=0.029$), and the total score ($r=0.569$, $p=0.042$), whereas PTT was significantly correlated with Q3 ($r=0.607$, $p=0.012$) and Q6 ($r=0.580$, $p=0.038$). However, no significant correlations were found between height or weight and either individual K-Pedi-EAT-10 item scores or the total score.

The ROC curve analysis for the diagnostic performance of the K-Pedi-EAT-10 demonstrated an area under the curve (AUC) of 0.98 (95% CI, 0.95–1.00; $p<0.001$) (Fig. 4). A cut-off

**Fig. 3.** Spearman correlation heatmap showing correlations among Korean version of Pediatric Eating Assessment Tool-10 scores, Penetration-Aspiration Scale (PAS) scores, residue severity, and oropharyngeal transit time. Darker colors indicate stronger correlations. Val_R, vallecular residue; Py_R, pyriform sinus residue; OTT, oral transit time; SF, small fluid; PTT, pharyngeal transit time; YP, yoplait. * $p<0.05$, ** $p<0.01$.

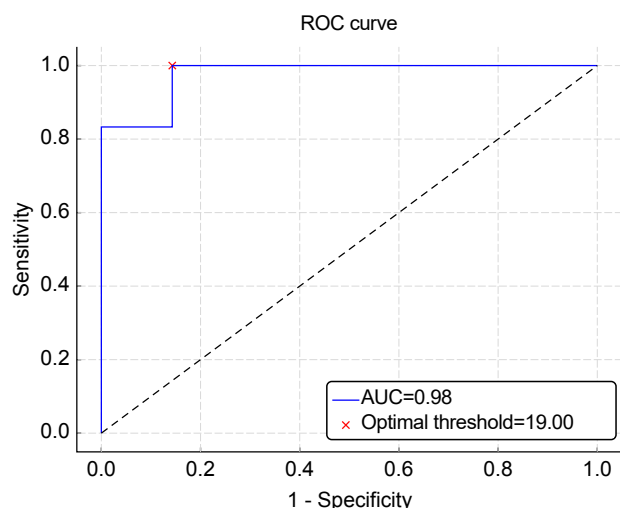


Fig. 4. Receiver-operating characteristic (ROC) curve for the Korean version of Pediatric Eating Assessment Tool-10 (K-Pedi-EAT-10) for detecting aspiration risk. The optimal cut-off score, sensitivity, specificity, and area under the curve (AUC) are indicated.

score of 19 was identified as optimal for detecting aspiration risk ($PAS \geq 6$), yielding a sensitivity of 100% and specificity of 85.7%. Furthermore, the positive predictive value (PPV) and negative predictive value (NPV) were calculated as 85.7% and 100%, respectively, confirming the tool's reliability in identifying children at risk of aspiration.

DISCUSSION

This study successfully translated, culturally adapted, and validated the K-Pedi-EAT-10 to ensure methodological equivalence with the original instrument. The K-Pedi-EAT-10 demonstrated excellent internal consistency (Cronbach's $\alpha=0.956$) and strong test-retest reliability ($ICC=0.988$), confirming its stability and reliability as a useful caregiver-administered screening tool. Discriminant validity was supported by markedly higher K-Pedi-EAT-10 total scores in children with dysphagia than in age-matched healthy controls ($U=9.5$, $Z=-4.053$, $p<0.001$). Construct validity was further established through significant correlations between K-Pedi-EAT-10 scores and objective VFSS parameters, particularly PAS scores ($r=0.705$, $p=0.007$). In addition, ROC curve analysis demonstrated excellent predictive validity, identifying a total score of 19 as the optimal threshold for detecting aspiration risk ($AUC=0.98$, 98% CI 0.95-1.00). Collectively, these results confirm that the K-Pedi-EAT-10 is a reliable, valid,

and clinically feasible screening tool for early identification of dysphagia and aspiration risk in children.

During the process of translation and cultural adaptation including focused group interviews and expert committee reviews, minor modifications were made to enhance conceptual equivalence at each step. For example, "while eating" in Q8 was initially revised to "while swallowing food" for clarification, but it was further adjusted to "when eating food" to prevent a shift in meaning, as "eating" and "swallowing" have distinct definitions. In the questions regarding whether extra effort is required when swallowing liquids (Q3) or solid foods (Q4), many participants from the focused interview found the concept of "extra effort" too ambiguous, making it difficult to answer. To address this issue, expert opinions were incorporated through a Korean cultural adaptation process, and specific examples were added to clarify the meaning of "extra effort" in Q3 and Q4 (e.g., use of thickening agents, preparation of a dysphagia diet, use of assistive devices such as straws, and consumption in small amounts for Q3; minced food for Q4). These systematic modifications adhered to ISPOR guidelines, ensuring the preservation of linguistic and psychometric integrity and resulting in an effective K-Pedi-EAT-10 that demonstrated high consistency, reliability, and validity comparable to those translated to other languages [21,22]. The Spanish (0.865) and Italian (0.89) versions exhibited lower internal consistency than that for K-Pedi-EAT-10, whereas the Arabic version (0.968) reported a slightly higher but comparable Cronbach's alpha. Test-retest reliability was not assessed in the Spanish and Italian studies, whereas the Arabic version demonstrated ICC values ranging from 0.97 to 1, also comparable to that observed in this study (0.988) [18-20]. Discriminant validity findings in this study were also consistent with prior research results [11]. The original Pedi-EAT-10 validation demonstrated a significantly higher score in children with cerebral palsy (19.5 ± 11.0) compared to the score in typically developing children (0.26 ± 1.83 , $Z=10.01$, $p<0.001$) [11]. Similarly, validation studies in Italian, Spanish, and Arabic populations reported significantly higher scores in children with dysphagia than in healthy controls while the distribution of total scores varied across studies [18-20].

Predictive validity was also comparable to that reported in previous studies, despite a variation in cut-off scores across studies [18-20]. The original Pedi-EAT-10 validation study, which focused on children with neurological impairments, reported a lower cut-off score of 13 (sensitivity=77%, specificity=64%, PPV=69%, NPV=64%) [15]. The Arabic validation

study using FEES rather than VFSS reported an AUC of 0.92 (0.89–0.96) with a cut-off score of 28, yielding a sensitivity of 89% and specificity of 87.5% (PPV=84.5%, NPV=90.5%). Because of procedural discomfort and limited pediatric cooperation, FEES may have lower sensitivity for aspiration, resulting in a higher cut-off score [18]. The Spanish and Italian validation studies did not incorporate VFSS or FEES, and therefore did not report ROC analyses or cut-off scores for aspiration risk, limiting direct comparisons [19,20]. Differences in participant characteristics, dysphagia severity, and aspiration assessment methods (VFSS vs. FEES) are the potential causes of variations in optimal thresholds across studies.

A key strength of this study lies in the incorporation of objective VFSS parameters derived from a pediatric population, providing a robust physiological foundation for validating the K-Pedi-EAT-10. Unlike previous validation studies, which primarily relied on questionnaire-based definition of dysphagia or FEES findings, which are often difficult to quantify, the present study directly correlated Pedi-EAT-10 scores with VFSS outcome measures. Because VFSS involves radiation exposure, obtaining such VFSS outcome data in pediatric populations is inherently challenging, and pediatric VFSS-based validation studies have not been reported previously [18–20]. By recruiting participants who had already undergone VFSS for pre-existing clinical indications, this study uniquely bridges subjective caregiver-reported symptoms with objective swallowing physiology. Through analysis of aspiration severity (PAS scores), amount of pharyngeal residue, and oropharyngeal transit times, the findings demonstrate that integrating subjective and objective measures reinforces the clinical utility of the K-Pedi-EAT-10 for early identification of both aspiration risk and oropharyngeal dysphagia. Furthermore, if total or each item-specific K-Pedi-EAT-10 scores are applied appropriately to stratify the risk of aspiration or malnutrition, the K-Pedi-EAT-10 could function as an adjunctive screening step within the clinical decision-making process. Such an approach may help clinicians identify children who warrant confirmatory instrumental evaluations (e.g., VFSS or FEES) and optimize the timing and necessity of these assessments, thereby promoting safer and more efficient diagnostic pathways in pediatric dysphagia management.

Limitations

This study has several limitations. The small sample size and heterogeneity of participants limited the statistical power and

generalizability of the findings. As data were collected from a single tertiary center, a risk of selection bias exists. Thus, relatively high AUC values observed in the ROC analysis should be interpreted with caution, as overfitting cannot be entirely excluded given the limited sample size. Also, the cognitive debriefing process involved only five caregivers, which falls short of the recommended sample size (≥ 10) suggested by international guidelines. Consequently, all analyses should be regarded as exploratory, and the findings considered preliminary evidence supporting the reliability and validity of the K-Pedi-EAT-10. In addition, because the K-Pedi-EAT-10 utilizes an ordinal scale, the ROC curve lacked smoothness. The study could not establish disease-specific cut-off scores for the K-Pedi-EAT-10, as subgroup analyses based on the underlying etiologies were not feasible. Future multicenter studies with larger and more diverse cohorts, including caregivers from varied age, educational, and socioeconomic backgrounds, are warranted to confirm external validity, refine item-specific interpretations, establish disease-specific cutoff scores, and further enhance the cultural and clinical applicability of the K-Pedi-EAT-10.

Conclusion

In conclusion, this study successfully translated, culturally adapted, and validated the K-Pedi-EAT-10, demonstrating excellent reliability and validity for assessing dysphagia in children. By integrating subjective caregiver-reported K-Pedi-EAT-10 scores and objective VFSS findings, particularly PAS scores, this study provides strong evidence supporting the construct and predictive validity of the K-Pedi-EAT-10. The identified optimal cut-off score of 19 effectively discriminated aspiration risk ($PAS \geq 6$), with high diagnostic accuracy, underscoring its potential as a reliable clinical screening instrument.

Owing to its non-invasive, caregiver-administered nature, the K-Pedi-EAT-10 provides a practical and feasible means for the early identification of dysphagia and aspiration risk in children. The K-Pedi-EAT-10 could serve as a complementary screening instrument to identify children who may benefit from further instrumental assessments such as VFSS or FEES. Future longitudinal and multicenter studies assessing its predictive value in monitoring dysphagia progression and treatment outcomes would further strengthen its clinical applicability.

CONFLICTS OF INTEREST

Hyun Iee Shin is an Associate Editor of *Annals of Rehabilitation*

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AUTHOR CONTRIBUTION

Conceptualization: Hyun SE, Kim S, Hyung-Ik Shin. Methodology: Hyun SE, Kim S, Hyung-Ik Shin. Data collection: Kim S, Hyun SE, Hyung-Ik Shin, Hyun Iee Shin. Formal analysis: Kim S, Hyun SE, Hyung-Ik Shin, Hyun Iee Shin. Funding acquisition: Hyun SE. Project administration: Hyun SE. Visualization: Kim S. Supervision: Hyung-Ik Shin, Hyun SE. Writing – original draft: Kim S, Hyun SE. Writing – review and editing: Kim S, Hyun SE, Hyung-Ik Shin, Hyun Iee Shin. Approval of final manuscript: all authors.

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SUPPLEMENTARY MATERIALS

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REFERENCES

1. Kurosu A, Affoo RH, Hachey S, Rogus-Pulia N. Swallowing, dysphagia, and aspiration pneumonia. In: Hogue CM, Ruiz JG, editors. Oral health and aging. Springer; 2022. p. 47-84.
2. van den Engel-Hoek L, de Groot IJ, de Swart BJ, Erasmus CE. Feed-

ing and swallowing disorders in pediatric neuromuscular diseases: an overview. *J Neuromuscul Dis* 2015;2:357-69.

3. Morgan AT, Dodrill P, Ward EC. Interventions for oropharyngeal dysphagia in children with neurological impairment. *Cochrane Database Syst Rev* 2012;10:CD009456.
4. Calis EA, Veugelaers R, Sheppard JJ, Tibboel D, Evenhuis HM, Penning C. Dysphagia in children with severe generalized cerebral palsy and intellectual disability. *Dev Med Child Neurol* 2008;50:625-30.
5. Mukand JA, Blackinton DD, Crincoli MG, Lee JJ, Santos BB. Incidence of neurologic deficits and rehabilitation of patients with brain tumors. *Am J Phys Med Rehabil* 2001;80:346-50.
6. Lefton-Greif MA, Arvedson JC. Pediatric feeding and swallowing disorders: state of health, population trends, and application of the international classification of functioning, disability, and health. *Semin Speech Lang* 2007;28:161-5.
7. Dodrill P, Gosa MM. Pediatric dysphagia: physiology, assessment, and management. *Ann Nutr Metab* 2015;66 Suppl 5:24-31.
8. Im HW, Kim SY, Oh BM, Han TR, Seo HG. Radiation dose during videofluoroscopic swallowing studies and associated factors in pediatric patients. *Dysphagia* 2020;35:84-9.
9. Zang J, Nienstedt JC, Koseki JC, Nießen A, Flügel T, Kim SH, et al. Pediatric flexible endoscopic evaluation of swallowing: critical analysis of implementation and future perspectives. *Dysphagia* 2022;37:622-8.
10. Heckathorn DE, Speyer R, Taylor J, Cordier R. Systematic review: non-instrumental swallowing and feeding assessments in pediatrics. *Dysphagia* 2016;31:1-23.
11. Serel Arslan S, Demir N, Karaduman AA, Belafsky PC. The Pediatric version of the Eating Assessment Tool: a caregiver administered dysphagia-specific outcome instrument for children. *Disabil Rehabil* 2018;40:2088-92.
12. Belafsky PC, Mouadeb DA, Rees CJ, Pryor JC, Postma GN, Allen J, et al. Validity and reliability of the Eating Assessment Tool (EAT-10). *Ann Otol Rhinol Laryngol* 2008;117:919-24.
13. Regan J, Lawson S, De Aguiar V. The Eating Assessment Tool-10 predicts aspiration in adults with stable chronic obstructive pulmonary disease. *Dysphagia* 2017;32:714-20.
14. Plowman EK, Tabor LC, Robison R, Gaziano J, Dion C, Watts SA, et al. Discriminant ability of the Eating Assessment Tool-10 to detect aspiration in individuals with amyotrophic lateral sclerosis. *Neurogastroenterol Motil* 2016;28:85-90.
15. Serel Arslan S, Kılınc HE, Yaşaroğlu ÖF, Demir N, Karaduman AA. The pediatric version of the eating assessment tool-10 has discriminant ability to detect aspiration in children with neurological impairments. *Neurogastroenterol Motil* 2018;30:e13432.

16. Keles MN, Ertoý Karagöl HL, Serel Arslan S, Egritas Gurkan O, Sari S, Elbasan B, et al.; Gazi University Pediatric Eosinophilic Gastrointestinal Diseases Working Group. Oropharyngeal dysphagia in children with eosinophilic esophagitis. *Dysphagia* 2023;38:474-82.
17. Soyer T, Yalcin S, Arslan SS, Demir N, Tanyel FC. Pediatric Eating Assessment Tool-10 as an indicator to predict aspiration in children with esophageal atresia. *J Pediatr Surg* 2017;52:1576-9.
18. Adel SM, Gaafar AH, Fasseeh N, Abdou RM, Hamouda NH. Validation and cultural adaptation of an Arabic version of Pediatric Eating Assessment Tool (Pedi-EAT-10Arabic). *Dysphagia* 2022;37:1440-50.
19. Onesimo R, Sforza E, Triumbari EKA, Proli F, Leoni C, Giorgio V, et al. Validation and cross-cultural adaptation of the Italian version of the paediatric eating assessment tool (I-PEDI-EAT-10) in genetic syndromes. *Int J Lang Commun Disord* 2024;59:1152-62.
20. Murray Hurtado M, Blanco Castilla I, Hernández Coronado N, Milà Villarroel R, el Grupo de Trabajo de Disfagia. Translation and validation of the Spanish version of the Pedi-EAT-10 questionnaire for screening of dysphagia. *An Pediatr (Engl Ed)* 2023;98:249-56.
21. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine (Phila Pa 1976)* 2000;25:3186-91.
22. Wild D, Grove A, Martin M, Eremenco S, McElroy S, Verjee-Lorenz A, et al.; ISPOR Task Force for Translation and Cultural Adaptation. Principles of Good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation. *Value Health* 2005;8:94-104.
23. Crary MA, Mann GD, Groher ME. Initial psychometric assessment of a Functional Oral Intake Scale for dysphagia in stroke patients. *Arch Phys Med Rehabil* 2005;86:1516-20.
24. Rosenbek JC, Robbins JA, Roecker EB, Coyle JL, Wood JL. A penetration-aspiration scale. *Dysphagia* 1996;11:93-8.
25. Pearson WG Jr, Molfenter SM, Smith ZM, Steele CM. Image-based measurement of post-swallow residue: the normalized residue ratio scale. *Dysphagia* 2013;28:167-77.
26. Han TR, Paik NJ, Park JW. Quantifying swallowing function after stroke: a functional dysphagia scale based on videofluoroscopic studies. *Arch Phys Med Rehabil* 2001;82:677-82.
27. Kim JM, Park JE, Baek SJ, Yang SN. Quantitative analysis of temporal parameters correlated with aspiration and lesion location in stroke patients. *Dysphagia* 2023;38:1487-96.
28. Sen R, Yip C, Severson K. PRM208 - The use of intra-class correlation coefficients to assess test-retest reliabilities in psychometric evaluations of patient reported outcome measures. 2017;20:A768.
29. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Routledge; 2013. p. 77-83.
30. Schober P, Boer C, Schwarte LA. Correlation coefficients: appropriate use and interpretation. *Anesth Analg* 2018;126:1763-8.