

# Optimizing Dysphagia Evaluation in Chile: Development of a Non-Nutritive Clinical Swallowing Examination for Adult Inpatients

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Optimización de la evaluación de la disfagia en Chile: Desarrollo de un Examen Clínico de Deglución no nutritivo para pacientes adultos hospitalizados

## ABSTRACT

Although robust screening protocols exist for the early detection of swallowing disorders, a detailed Clinical Swallow Examination (CSE) remains essential for guiding timely and effective intervention. The Mann Assessment of Swallowing Ability is a widely referenced tool, yet it omits several components critical to clinical practice. Following initial screening, Speech and Language Therapists (SLTs) often rely on non-standardized assessments developed locally. This lack of standardized tools with established psychometric properties hinders consistent clinical evaluation and the development of equitable treatment guidelines. **Aim:** To develop a standardized Spanish-language CSE focused on the non-nutritive component of oropharyngeal swallowing in adults, tailored for use by SLTs. **Methods:** The study was conducted in two phases. Phase 1 established content validity through expert consensus. Phase 2 evaluated psychometric properties, including internal consistency, inter-rater reliability, and construct and content validity. The instrument was tested with 132 participants (79 healthy individuals and 53 patients). Exploratory and confirmatory factor analyses initially supported the inclusion of 18 items. However, Cronbach's alpha indicated that three items—dentition, saliva accumulation, and odynophagia—did not significantly contribute to internal consistency. While two of these items were excluded, saliva accumulation was retained due to its positive contribution to model fit. The final version of the CSE included 16 items. **Results:** Two scoring approaches were explored: a standardized, factor-derived score and a clinically oriented

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score based on the percentage of total item scores. Both performed similarly, although the clinically oriented score proved more practical for real-world application due to its ease of interpretation. **Conclusions:** This standardized CSE provides SLTs with a reliable and validated tool for assessing oropharyngeal dysphagia, especially in low- and middle-income countries with limited access to instrumental assessments. Its use supports more equitable, consistent, and effective patient care. **Keywords:** Deglutition Disorders; Reproducibility of Results; Speech-Language Pathology; Surveys and Questionnaires; Validation Study.

### RESUMEN

A pesar de la existencia de pautas de cribado, sigue siendo fundamental realizar un Examen Clínico de la Deglución (ECD) detallado para orientar intervenciones oportunas en los trastornos de la deglución. Herramientas como la Evaluación de Mann omiten componentes clave, y muchos fonoaudiólogos utilizan protocolos no estandarizados, lo que dificulta la uniformidad clínica y el acceso equitativo al tratamiento. **Objetivo:** Desarrollar y validar un ECD estandarizado en español, centrado en la deglución no nutritiva. **Métodos:** Se validó el contenido mediante consenso de expertos y se evaluaron propiedades psicométricas (fiabilidad y validez). Participaron 132 adultos (79 sanos y 53 pacientes). El análisis factorial respaldó 18 ítems; sin embargo, tres mostraron baja consistencia interna, por lo que se conservaron 16, incluyendo "acumulación de saliva" debido a su relevancia clínica dentro del modelo. Se compararon dos métodos de puntuación: un método factorial y uno clínico. **Resultado:** Ambos métodos de puntuación mostraron resultados similares, aunque la puntuación clínica destacó por su facilidad de interpretación. El conjunto final de 16 ítems demostró adecuadas propiedades psicométricas para su uso en población adulta. **Conclusión:** EFODEA ofrece una herramienta útil y estandarizada, especialmente relevante en contextos con recursos limitados, permitiendo una evaluación más objetiva y eficaz de la disfagia en adultos.

**Palabras clave:** Desórdenes de la Deglución; Estudio de Validación; Encuestas y Cuestionarios; Patología del Habla y Lenguaje; Reproducibilidad de los Resultados.

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Videofluoroscopy (VFS) is the gold standard for evaluating all stages of swallowing and detecting aspiration risks<sup>1</sup>. Fiberoptic Endoscopic Evaluation of Swallowing (FEES), also a gold standard, focuses specifically on aspiration risk<sup>2</sup> and can be done bedside using a nasal fiberscope to assess the pharyngeal phase with various textures<sup>3</sup>. Despite these tools, many English-speaking countries use self-report questionnaire, screening tools, Clinical Swallow Examinations (CSE) to assess dysphagia in hospitalized adults.

A self-report questionnaire enables individuals to subjectively assess and report symptoms through structured items, supporting clinical screening and monitoring. The Eating Assessment Tool (EAT-10) is a validated instrument, internationally recognized and adapted for use in Spanish-speaking populations, including Chile<sup>4,5</sup>.

Screening tools are preliminary assessment instruments designed to identify individuals at risk for specific conditions, often administered by non-specialist healthcare professionals such as nurses, nutritionists, or allied health staff<sup>6</sup>. However, Spronk et al. (2019)<sup>7</sup> reported that when used by nursing personnel, swallowing screening tests may yield low dysphagia detection rates, underscoring the importance of adequate training. Various screening tools are described in the literature<sup>6</sup>, Toronto Bedside Swallowing Screening Test (TOR-BSST)<sup>8</sup>, Yale Swallow Protocol (YSP)<sup>9</sup>, Massey Bedside Swallow Screen<sup>10</sup>, Standardized Swallowing Assessment (SSA)<sup>11</sup>, Volume-Viscosity Test (V-VST), or Clinical Volume-Viscosity Exploration Method (MECV-V)<sup>12</sup>, 3-oz water swallow Test (WST)<sup>13</sup>, and Repetitive Saliva Swallowing Test (RSST)<sup>14</sup>. Psychometric properties have been reported for YSP, SSA, V-VST, MECV-V, WST, RSSA, and others. The Gugging Swallowing Screen (GUSS) is, to date, the only dysphagia screening tool translated and validated in Spanish within the Argentinian context<sup>15,16</sup>.

Unlike screening tools, the Clinical Swallowing Evaluation (CSE) offers a comprehensive assessment of the signs identified during initial screening, aiming to establish a safe and appropriate diet and reduce healthcare costs associated with hospitalization<sup>17,18</sup>. Due to its complexity and depth,

the CSE must be conducted by qualified Speech and Language Therapists (SLTs)<sup>19,20</sup>, as it provides essential information for diagnostic decision-making in dysphagia management. Nevertheless, several studies have reported considerable variability in the CSE process<sup>21</sup>, prompting the American Speech-Language-Hearing Association (ASHA) to emphasize the need for standardized training among SLTs<sup>21</sup>. The American Speech-Language-Hearing Association (ASHA) suggests that the CSE must be conducted by trained SLTs<sup>21</sup>. The CSE performed by SLTs commonly considers aspects such as (1) gathering anamnestic history, (2) level of consciousness, (3) cognitive status and cooperation, (4) ability to follow instructions, (5) anatomy functional assessment of orofacial structures, (6) sensitivity, (7) vocal quality, (8) presence of reflexes, (9) non-nutritive swallowing, and (10) nutritive swallowing<sup>17,18,22</sup>. The assessment of non-nutritive and nutritive swallowing is sometimes accompanied by instrumental exploration (IE) through VFS or FEES. Although there is a clear distinction between non-nutritive and nutritive swallowing evaluations, there is no objective parameter to guide the professional, especially one with limited clinical experience, on when it is safe to proceed to the nutritive swallowing assessment<sup>18</sup>. One tool reported in the literature as CSE is the Mann Assessment of Swallowing Ability (MASA), created by Gisselle Mann's first version in 2002. It has been validated for the first time in stroke patients<sup>23</sup>. It is an instrument that assesses swallowing in 24 different areas. In acute stroke patients, it has normative data and excellent interrater reliability ( $\kappa=0.82$ ) for dysphagia and ( $\kappa=0.75$ ) for aspiration<sup>24</sup>. Excellent internal consistency Cronbach's alpha = 0.9166<sup>24</sup> and normative sample Cronbach's alpha of 0.94 ( $n=12$ )<sup>25</sup>. Excellent criterion validity; sensitivity (92% and 87%), and specificity 86,3% and 84,2%<sup>25</sup>.

All these screenings and CSEs are validated in English-speaking countries, attending to the local needs of SLTs and their clinical guidelines. To date, there is no international consensus on which method is best to assess dysphagia in acute hospitalized patients. The limited availabi-

lity, accessibility, and economic cost of VFS and FEES<sup>26,27</sup>, especially in low-income countries, all lead healthcare professionals to implement screening guidelines and conduct a CSE using non-validated protocols<sup>28,29</sup>.

To date, no CSE or severity scale has been validated for Latin American Spanish speakers. Steele (2002)<sup>30</sup> emphasized early dysphagia assessment by SLTs in acute care settings. In low- and middle-income countries, access to VFS and FEES is limited, making inter-SLT measurement reliability essential. We therefore propose a clinical assessment tool suited to these contexts.

This study evaluates the psychometric properties of EFODEA (Evaluación Fonoaudiológica de la Deglución en Adultos), a free, digital tool designed for Spanish-speaking Speech and Language Therapists to assess oropharyngeal dysphagia in adults. EFODEA addresses the non-nutritive phase of the Clinical Swallowing Evaluation (CSE), a component that remains difficult to standardize. We assessed reliability (internal consistency, inter-rater agreement) and validity (content and construct) to support its use as a standardized instrument, particularly in low- and middle-income settings.

## Methods

The sample was selected using a non-probabilistic convenience sampling method, rather than randomized selection, due to limited resources and feasibility constraints. Our sample was based on Umay et al., 2018 which included 141 stroke patients<sup>31</sup>. We included 132 participants (79 healthy volunteers and 53 patients). Healthy volunteers (HVs) were adults over 18 with no neurological, respiratory, psychiatric, or swallowing disorders (EAT-10  $\leq 7$ ); those with orofacial, pharyngeal, or laryngeal lesions were excluded.

Patients were recruited from two public hospitals. Inclusion criteria: age  $\geq 18$ ,  $\geq 24$  hours post-extubation, referred for suspected dysphagia, GCS  $>14$ , medically stable, and no feeding route changes in the prior 24 hours. Exclusion criteria included structural anomalies, current intubation, or tracheostomy. Participant demographics and clinical data are shown in Table 1.

All participants provided written informed

consent prior to enrollment. This study obtained Medical Ethical approval from two public medical institutions: Complejo Asistencial Doctor Sótero del Río (CASR) under ID:1116 and Complejo Asistencial Barros Luco (CABL) under ID 134-07122020 (Table 1).

## Design of EFODEA

### Content validity

Four SLTs with over 10 years of experience in hospital-based dysphagia care reviewed key items from existing screening tools and CSEs (EAT-10, GUSS, YSP, MECV-V, TOR-BSST, MASA, RSST, WST; Appendix 1) to inform EFODEA's development. The initial 27-item version was evaluated by an expert panel (3 SLTs, 2 otolaryngologists, 1 physiotherapist, 1 nutritionist—all with  $>15$  years of experience). Content validity was assessed using the Lawshe model, modified by Tristan<sup>32,33</sup>. Nine items with CVR  $< 0.58$  were excluded, resulting in an 18-item draft with a CVI of 0.88 (Appendix 2a, 2b). EFODEA targets the non-nutritional phase of swallowing, with the following items: Orotracheal Intubation (OTI), Non-oral feeding (NOF), Altered states of consciousness (ASC), Cognitive and Behavioral impairment (CBI), Voice Quality (VQ), Alteration in orofacial structures (AOS), Oral-sensory disorders (OSDs), Orofacial myofunctional disorders (OMDs), Facial asymmetry (FA), Dentition alteration (DA), Impaired cough reflexes (ICR), Saliva stagnation (SS), Impaired ability to swallow saliva spontaneously (IASSS), Abnormal swallowing reflex (ASR), Absent hyolaryngeal excursion (AHE), Odynophagia (ODI), Wet voice (WV), and Wet cervical auscultation (WCA). These items were built as binary indicators with a value of 1 for the presence of the denoted characteristic, and 0 otherwise.

### Pilot

EFODEA was piloted by 4 trained SLTs (who did not participate in the expert judgment) in 20 HVs and 20 patients to analyze comprehensibility. Consequently, we uploaded this protocol in a Web-App version (available in [www.efodea.cl/](http://www.efodea.cl/) [www.efodea.com](http://www.efodea.com)) which was accepted to analyze in our psychometric cross-sectional study. This final

**Table 1.** Descriptive statistics of the sample.

	Control group HVs (n=79)	Patient group (n=53)	P-value <sup>1</sup>
<b>Gender, n (%)</b>			0.477
Female	39 (49.4)	22 (41.5)	
Male	40 (50.6)	31 (58.5)	
<b>Age groups, n (%)</b>			0.079
18 – 40 years	29 (36.7)	10 (18.9)	
41 – 60 years	22 (27.8)	17 (32.1)	
> 60 years old	28 (35.4)	26 (49.1)	
<b>Hospital, n (%)</b>			
Complejo Asistencial Barros Luco	-	24 (45.3)	
Complejo Asistencial Sótero del Río	-	29 (54.7)	
<b>Medical diagnosis, n (%)</b>			
Stroke	-	7 (13.2)	
Traumatic Brain Injury	-	6 (11.3)	
Head and neck cancer	-	3 (5.7)	
Infectious Disease	-	3 (5.7)	
Respiratory	-	7 (13.2)	
Metabolic	-	7 (13.2)	
Cardiological	-	2 (3.8)	
Mixed diagnosis <sup>2</sup>	-	18 (34.0)	
Candidate for non-nutritive swallowing evaluation, n (%)	79 (100)	53 (81.0)	0.000

<sup>1</sup>P-values were obtained according to Fisher's exact test for categorical variables. (\*) p<0.05.

<sup>2</sup>Mixed diagnosis: The presence of two or more medical condition.

version is presented in Appendix 4 along with a description of which of its items is present other clinical screening tools available.

### Procedures

The team of SLTs who participated in this study followed 10 training sessions prior to participant enrollment to use the platform. SLTs with more than 2 years of experience and specialized training in dysphagia. All clinicians independently registered the results of their evaluation in the

Web-App version of EFODEA.

A sub-sample of 29 patients had 2 evaluations with EFODEA done within 24 hours by an experienced SLT. For a better understanding of the study (Appendix 3).

### Statistical analysis

We performed a descriptive analysis to explore the prevalence of each EFODEA item in HVs and patients. We performed a Fisher's exact test to compare the prevalence of the items among

these 2 participant groups, excluding the variables from the domains of artificial airway, nutrition and consciousness given the inclusion and exclusion criteria of our healthy sample. The items of EFODEA are not directly compared; instead, we compare the groups in relation to them.

### **Reliability**

To evaluate internal consistency, we used a tetrachoric correlation analysis which let us evaluate the association between binary variables<sup>34</sup>. A positive tetrachoric correlation indicates a positive association between the two variables, while a negative tetrachoric correlation indicates a negative association. A value close to 0 indicates that there is no association between the binary variables. We opted for tetrachoric correlation since standard correlation measures assume that the variables have a bivariate normal distribution, which can be a problem in small samples or when the variables do not meet this assumption. Later we performed Cronbach's  $\alpha$  analysis<sup>35</sup>. Given that Cronbach's  $\alpha$  underestimates the reliability of a test and overestimates the first factor saturation<sup>36</sup>, we selected Guttman bounds as a complementary alternative described by Revelle & Zinbarg (2009). Guttman cut-offs are a series of six reliability coefficients based on the scale theory by Guttman, which states that a set of items is a Guttman scale if a positive response on one item implies a positive response on all the lower items of the scale. Guttman coefficients range from  $\lambda_1$ , which is the most conservative measure, to  $\lambda_6$ , which is the most liberal measure<sup>36</sup>.

### **Inter-rater**

To assess the inter-rater reliability among two experienced SLTs, we also used Cohen's kappa ( $\kappa$ ). SLTs independently assess the same patient on the same day.

### **Validity**

To evaluate construct validity, as part of our Exploratory Factor Analysis (EFA) we performed a Kaiser-Meyer-Olkin (KMO) test to determine data suitability for factor analysis. KMO measures the proportion of item variance that is explained

by the common factors and ranges from 0 to 1. A value close to 1 indicates that the items are highly correlated and are suitable for factor analysis. A value close to 0 reveals that the items are poorly correlated and factor analysis is not appropriate. To confirm the model proposed in EFA, we perform a Confirmatory Factorial Analysis (CFA). CFA was estimated by the weighted least squares mean and variance (WLSMV)<sup>37</sup>, where 5 indicators were examined Chi-squared ( $\chi^2$ ), Comparative fit index (CFI), Tucker-Lewis index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR)<sup>37</sup>.

### **Constructing an overall score of non-nutritive evaluation**

Finally, to build a final score for EFODEA we explored a standardized score derived from weighted CFA analysis to a normalized summative score (clinical simple score). The clinical simple score was based on the sum of the items normalized in a percentage score. We evaluated these two scores' correlation with a Pearson Correlation.

All analyses were conducted using R (version 4.2.1).

## **Results**

Our descriptive analysis results are presented in Figure 1. We observed significant differences in the groups regarding the EFODEA items' prevalence (Appendix 4).

### **Reliability**

Analyses of internal consistency by using tetrachoric correlation (Table 2) confirmed that 18 indicators were worth to consider for our analysis (Appendix 5). Cronbach's  $\alpha$  analysis considering the whole sample ( $n=132$ ) and the 18 EFODEA items suggested that 3 items did not contribute to the construction of EFODEA: DA, SS, and ODI (Table 3). However, for the patient group ( $n=53$ ) the global Cronbach  $\alpha$  was 0.868 and the item saliva stagnation showed  $\alpha = 0.866$ , suggesting the permanence of this item in EFODEA. Guttman bounds confirmed the selected indicators' reliability (Appendix 6).

**Inter-rater**

Cohen's  $\kappa$  was run to determine whether there was agreement between two SLT working at the same institution. The highest agreement between the two officers' judgements was  $\kappa = .102$ , 95% CI [-.067, .271],  $p = .217$ . The perfect agreement was found in OTI  $\kappa=1$  CI [1, 1]  $p < .001$ , NOF  $\kappa=1$  CI [1, 1]  $p < .001$ , SS  $\kappa=1$  CI [1, 1]  $p < .001$ . Near-perfect agreement was found in ASR  $\kappa = .869$  CI [.62, 1.12]  $p < .001$ , WCA  $\kappa = .79$  CI [.51, 1.07]  $p < .001$ . Substantial agreement appeared for ASC  $\kappa = .606$  CI [.20, 1.01]  $p < .001$ , CBI  $\kappa = .623$  CI

[.29, .96]  $p < .001$ , AOS  $\kappa = .621$  CI [.34, .90]  $p < .001$ , OSDs  $\kappa = .663$  CI [.37, .95]  $p < .001$ , FA  $\kappa = .669$  CI [.33, 1]  $p < .001$ , IASSS  $\kappa = .664$  CI [.32, 1.01]  $p < .001$ . Moderate agreement was found for OMDs  $\kappa = .569$  CI [.28, .86],  $p = .001$ , DA  $\kappa = .459$  CI [.13, .79]  $p = .011$ , OPR  $\kappa = .494$  CI [.19, .80]  $p = .004$ , AHE  $\kappa = .519$  CI [.19, .85]  $p = .005$ , ODI  $\kappa = .532$  CI [.16, .91]  $p = .001$  and WV  $\kappa = .583$  CI [.22, .94]  $p = .001$

**Validity**

Analysis of construct validity by implementing KMO tests, revealed that for our complete sample, the following items were not suitable for factor analysis: DA, SS and ODI. When considering our patient sample, two additional items appeared significant: OTI and WV (Appendix 7a, 7b, 8, 9).

In agreement with KMO tests, exploratory analysis and CFA considering the whole sample ( $n=132$ ) revealed that the items DA and ODI fit least well in the model (Appendix 10). The latent construct EFODEA presents loadings of 0.615 and 0.314 for each respective item, so there is a low association between the complete battery measured as a single construct (EFODEA) and the items DA and ODI. The variance explained by the EFODEA is quite low for the DA (37.9%) and the ODI (9.8%) (Appendix 10). These two items are not relevant for measuring the outcome compared to the rest of the items with factor loadings  $>0.77$  and  $R^2 > 0.59$ .

Similar results are replicated considering the patient sample (Appendix 10). We obtained similar values for factor loadings and variance explained

for the DA (0.388, 15.1%) and ODI (-0.009, 0.0%). However, the item OTI presents a loading of 0.209 with respect to the latent construct and an  $R^2$  of 4.4% (Appendix 10).

Table 4 shows the results of our CFA considering 3 models: a) EFODEA including the original 18 items, b) EFODEA with 16 items (excluding DA and ODI), and c) EFODEA with 15 items (excluding DA and ODI and SS). For the complete sample as well as considering only the patient sample, we could create a model without the items of DA alteration and ODI. The gain from eliminating SS in the EFODEA model that considered 15 items is smaller in terms of fit, so removing this item does not improve our results. Furthermore, considering the clinical relevance of SS in the CSE we did not remove this item. Finally, based on our reliability analyses, exploratory and confirmatory factor analyses, we selected the final version of EFODEA with 16 items, which removes DA alteration and ODI. The results of our models are summarized in Figure 2a and 2b (Appendix 11a, 11b) and Table 5 (Appendix 12,13).

**Constructing an overall score of non-nutritive evaluation**

From the above analyses, we estimated an EFODEA score. This allows us to identify patients' status to continue the CSE to the nutritive phase. To construct this overall score, we used 2 approaches: a factorial standardized score and a clinical simple score. For all calculations we took the final 16 EFODEA items as reference. The clinical simple score corresponded to the simple sum of the items.

The weighted CFA score consisted of the standardized predictions obtained from the factor loadings and correlations of the confirmatory model. The score has  $\bar{X} = 0$  y  $\sigma^2 = 1$ .

The clinical score was later built as follows:

$$EFODEA_{sum} = OTI + NOF + ASC + CBI + VQ + AOS + OSDs + OMDs + FA + ICR + SS + IASSS + ASR + AHE + WV + WCA$$

Based on these estimates and their differences, we then normalized to a percentage of EFODEA achievement as follows:

$$EFODEA = \frac{(EFODEA_{sum} - \min(EFODEA_{sum}))}{(\max(EFODEA_{sum}) - \min(EFODEA_{sum}))} * 100$$

Finally, we will have a value with a minimum of 0 and a maximum of 100 in the EFODEA achievement. One example appears hereinafter:

$$X = OTI + NOF + ASC + CBI + VQ + AOS + OSDs + OMDs + FA + ICR + SS + IASSS + ASR + AHE + WV + WCA - 0 = (\text{sum of indicator}) / 16 * 100 = \% \text{ of EFODEA achievement}$$

Example:

$$X = 6 - 0 / 16 - 0 = 6 / 16 = 0,375 * 100 = 37,5\% \text{ of EFODEA achievement}$$

Percentage = 0 a 100%

- Under 20%=suggested to perform nutritional swallowing assessment
- Greater than or equal to 21%=suggested not to perform nutritional swallowing assessment, stop your assessment and record your findings).

After these analyses we compared these two scores, obtaining a correlation of 0.95 for the full sample, and 0.94 for the sample considering only patient data (Appendix 14) (Figure 1, 2. Table 2, 3, 4, 5).

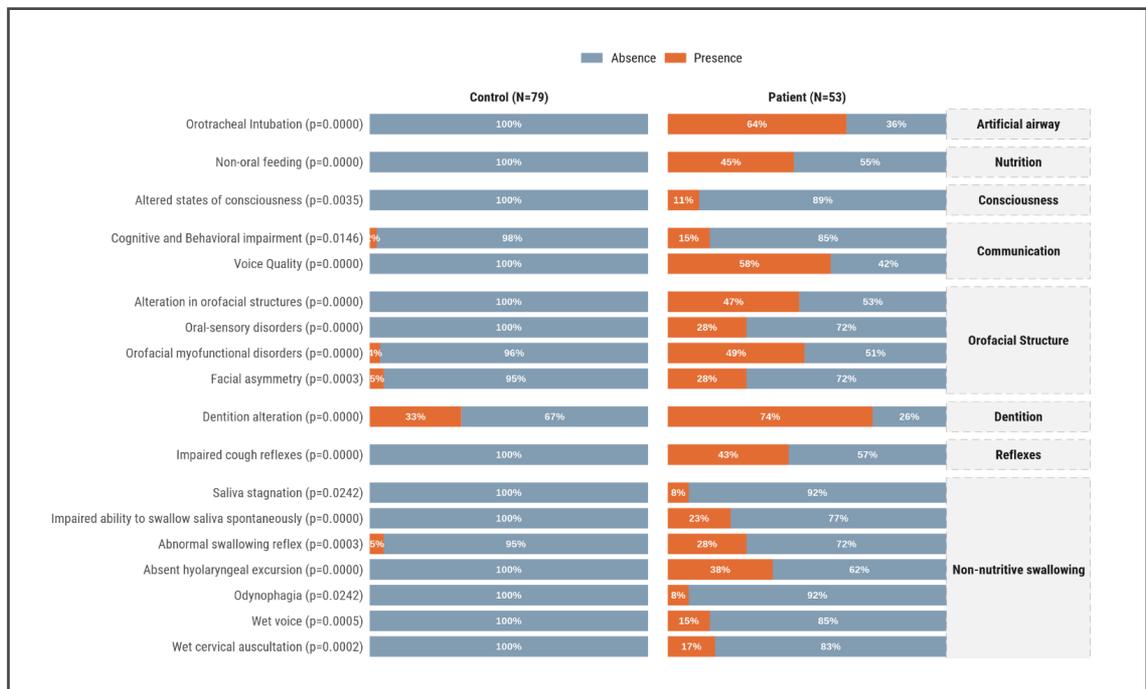


Figure 1: Differences between EFODEA characteristics for patients and controls. Note: P-values were obtained according to Fisher's exact test to compare the prevalence of each EFODEA characteristic between patients and controls.



**Table 3.** Cronbach's alpha for EFODEA items.

	<b>Full Sample (n=132; Items=18)</b>		<b>Patient group (n=53; Items=18)</b>	
<b>Global Cronbach's <math>\alpha</math></b>	0.911		0.868	
<b>Reliability if an item is dropped</b>	<b>Cronbach's <math>\alpha</math></b>	<b>SE</b>	<b>Cronbach's <math>\alpha</math></b>	<b>SE</b>
Orotracheal Intubation (OTI)	0.908	0.011	0.876	0.023
Non-oral feeding (NOF)	0.904	0.011	0.863	0.026
Altered states of consciousness (ASC)	0.910	0.011	0.863	0.026
Cognitive and Behavioral impairment (CBI)	0.909	0.011	0.861	0.026
Vocal Quality (VQ)	0.902	0.011	0.861	0.026
Alteration in orofacial structures (AOS)	0.898	0.012	0.848	0.029
Oral-sensory disorders (OSDs)	0.905	0.011	0.858	0.026
Orofacial myofunctional disorders (OMDs)	0.903	0.011	0.856	0.027
Facial asymmetry (FA)	0.907	0.011	0.858	0.027
Dentition alteration (DA)	0.917	0.009	0.873	0.024
Impaired cough reflexes (ICR)	0.900	0.012	0.852	0.028
Saliva Stagnation (SS)	0.911	0.010	0.866	0.025
Impaired ability to swallow saliva spontaneously (IASSS)	0.905	0.011	0.856	0.027
Abnormal swallowing reflex (ASR)	0.905	0.011	0.853	0.028
Absent hyolaryngeal excursion (AHE)	0.901	0.011	0.852	0.028
Odynophagia (ODI)	0.915	0.010	0.875	0.024
Wet voice (WV)	0.909	0.011	0.864	0.025
Wet cervical auscultation (WCA)	0.906	0.011	0.858	0.027

Note: The highlighted values in bold represent higher Global Cronbach's  $\alpha$ . OTI = Orotracheal Intubation; NOF = Non-oral feeding; ASC = Altered states of consciousness; CBI = Cognitive and Behavioral impairment; VQ = Voice Quality; AOS = Alteration in orofacial structures; OSDs = Oral-sensory disorders; OMDs = Orofacial myofunctional disorders; FA = Facial asymmetry; DA = Dentition alteration; ICR=Impaired cough reflexes; SS = Saliva stagnation; IASSS = Impaired ability to swallow saliva spontaneously; ASR = Abnormal swallowing reflex; AHE = Absent hyolaryngeal excursion; ODI = Odynophagia; WV = Wet voice; WCA = Wet cervical auscultation.

**Table 4.** Confirmatory factor analysis EFODEA items' fit.

	Full Sample (n=132; Items=18)					Patient group (n=53; Items=18)				
	X <sup>2</sup>	CFI	TLI	RMSEA	SRMR	X <sup>2</sup>	CFI	TLI	RMSEA	SRMR
EFODEA 18	126.1 <sup>+</sup>	1.000	1.001	0.000	0.123	133.3 <sup>+</sup>	1.000	1.001	0.000	0.179
EFODEA 16	95.31 <sup>+</sup>	1.000	1.001	0.000	0.110	97.90 <sup>+</sup>	1.000	1.003	0.000	0.165
EFODEA 15	86.18 <sup>+</sup>	1.000	1.000	0.000	0.100	88.14 <sup>+</sup>	1.000	1.001	0.000	0.157

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01; + non-significant result. Weighted least squares mean and variance adjusted (WLSMV= estimator. Reference values: No-significant ; CFI>=0.95; TLI>0.95; RMSEA<0.05; SRMR<0.05.

**Table 5.** Descriptive statistics score EFODEA index (16 Selected items\*).

	Mean	SD	Min	P05	P25	P50	P75	P95	Max
<b>Full Sample (n=132)</b>									
Normalized score	0.156	0.261	0.000	0.000	0.000	0.000	0.214	0.746	1.000
Weighted score (CFA)	0.133	0.539	-0.271	-0.271	-0.271	-0.271	0.573	1.171	1.583
<b>Patient group (n=53)</b>									
Normalized score	0.371	0.301	0.000	0.000	0.143	0.286	0.643	0.957	1.000
Weighted score (CFA)	0.633	0.500	-0.271	-0.271	0.378	0.676	0.932	1.456	1.583
<b>Control group (n=79)</b>									
Normalized score	0.012	0.035	0.000	0.000	0.000	0.000	0.000	0.079	0.143
Weighted score (CFA)	-0.203	0.193	-0.271	-0.271	-0.271	-0.271	-0.271	0.341	0.424

Note: The sum score sums each of the indicator values. This generates an indicator with a minimum of 0 and a maximum of 16 (theoretical). The normalized score adjusts the sum score to have a minimum value of 0 and a maximum of 1. This allows us to interpret it as a diagnostic % for the EFODEA. Selected items: OTI = Orotracheal Intubation; NOF = Non-oral feeding; ASC = Altered states of consciousness; CBI = Cognitive and Behavioral impairment; VQ = Voice Quality; AOS = Alteration in orofacial structures; OSDs = Oral-sensory disorders; OMDs = Orofacial myofunctional disorders; FA = Facial asymmetry; ICR = Impaired cough reflexes; SS = Saliva stagnation; IASSS = Impaired ability to swallow saliva spontaneously; ASR= Abnormal swallowing reflex; AHE = Absent hyolaryngeal excursion; WV = Wet voice; WCA = Wet cervical auscultation.

## Discussion

We developed a valid and reliable CSE tool focused on the non-nutritive phase of swallowing in hospitalized adults, implementing a simplified scoring system for SLTs to assess oropharyngeal dysphagia. Based on existing tools and expert consensus, 18 initial items were selected. Unlike screening tools, EFODEA includes components requiring specialist administration<sup>38</sup>. We assessed its reliability and validity to establish a comprehensive clinical score.

Internal consistency analysis of EFODEA identified three items—alterations in DA, SS, and ODI—as non-contributory. However, SS was retained in the final version due to its validity within the patient sample. This decision aligns with Mortensen et al. (2015)<sup>39</sup> and Persson et al. (2018)<sup>40</sup>, who highlight the relevance of factors such as xerostomia, age, and pharmacological effects in dysphagia assessment. Both studies support saliva accumulation as a valid and reliable indicator of aspiration risk, confirmed by instrumental evaluations<sup>39,40</sup>.

Construct validity analysis in the patient sample indicated that OTI and WV were not essential to the CSE. However, both items were retained based on their relevance across the full sample and supporting literature. Kwok et al. (2013)<sup>41</sup> showed that each additional day of OTI increases the risk of post-extubation dysphagia, validating its inclusion. WV is widely recognized as a key indicator in dysphagia assessment; Sampaio et al. (2014)<sup>42</sup> emphasized its role in identifying risks of penetration/aspiration and predicting performance in the nutritive phase.

For SLTs, prioritizing CSE dimensions under time constraints is challenging. In developing the EFODEA short set, CFA helped identify efficient items, confirming that dentition (DA) and odynophagia (ODI) could be excluded—consistent with internal consistency results. Drancourt et al. (2022)<sup>43</sup> found mixed evidence on dentition and OD, with most studies being cross-sectional. While Mituuti et al. (2015)<sup>44</sup> reported an association post-stroke, others (Wang et al., 2012; Brochier et al., 2018)<sup>45,46</sup> found no link with dental status. As dentition mainly affects the nutritive phase, its

relevance in non-nutritive assessment is limited. Similarly, odynophagia, though relevant in head and neck pathology, was excluded due to our sample criteria.

Three models were tested to finalize EFODEA: one with 15 items (excluding DA, SS, and ODI), one with 16 items (excluding DA and ODI), and one with all 18 items. The final model retained 16 items: OTI, NOF, ASC, CBI, VQ, AOS, OSDs, OMDs, FA, ICR, SS, IASSS, ASR, AHE, WV, and WCA—reflecting SLT priorities in CSE. Vogels et al. (2015)<sup>20</sup> found that SLTs value medical history, patient participation, posture, lip seal, dentition, cough reflex, and tongue movement. Less than 50% of the surveyed SLTs reported that they do not systematically evaluate the nutritional status, hydration, clinical interviews with the patient and family, and the presence of speech and language disorders. Coyle (2015)<sup>47</sup> emphasized that CSE should cover general health, orofacial and sensorimotor function, speech-language abilities, cognition, and the nutritive phase.

The outcomes of our inter-rater analysis disclosed a predominant concordance among evaluators for the majority of EFODEA items, characterized by high to substantial agreement. However, six specific items—OMDs, DA, ICR, AHE, ODI, and WV—manifested moderate concordance. The potential contributing factors to this moderate agreement were explored. OMDs and WV exhibited decreased concordance which might be associated with patient evaluations' temporal dimension. Within the hospital context, it is expected to observe variations in measurements when assessments occurred during the early morning or following physiotherapist visits. The temporal factor thus emerged as a plausible source of variability in the agreement levels for these particular items. For ODI, the variability in agreement was attributed to its inherent dependence on patient-specific criteria. Despite achieving only moderate agreement for this item, it was acknowledged that subjective factors might introduce bias into the assessment process. In the case of ICR, a proposal was made for future iterations of EFODEA to incorporate a more standardized or objective method for eliciting the cough reflex, such as

employing a device using handheld peak flow meters to measure voluntary cough airflow or using handheld nebulizers to assess reflex cough sensitivity<sup>48</sup>. In summary, the findings underscore the robustness of inter-rater agreement for the majority of EFODEA items, while highlighting nuanced challenges associated with temporal considerations and subjectivity. The suggested refinement in methodology, particularly regarding the standardization of cough reflex induction in future iterations, reflects a conscientious endeavor to bolster the objectivity and overall utility of the tool in clinical settings. Furthermore, as with any standardized assessment protocol, it is recommended that the EFODEA tool be implemented in strict accordance with the guidelines provided in the user manual. Evaluations should be conducted at consistent time intervals to ensure reliability. Although temporal consistency was maintained throughout our study, we strongly recommend that evaluators undergo training using the EFODEA manual to minimize inter-rater variability and enhance the accuracy of assessments.

Compared to existing CSE tool in English, EFODEA provides a clinical score performed comparably to the weighted CFA score, offering a simpler and more interpretable tool for clinicians. This makes EFODEA especially valuable in low- and middle-income settings, where access to objective assessments is limited. Although EFODEA offers a more detailed assessment than existing screening tools, it remains an observational protocol and cannot detect physiological abnormalities in the pharynx or larynx, nor visualize airway protection or bolus transit<sup>47</sup>. This initial phase represents a step toward a comprehensive CSE covering both non-nutritive and nutritive phases. Assessing sensitivity and specificity was beyond this study's scope; instead, we focused on systematizing key clinical features. Given the limited availability and high cost of VFS and FEES, CSE remains essential for early dysphagia assessment in hospitalized patients. Instrumental evaluation is recommended when it can inform therapeutic decisions by identifying pharyngeal phase pathophysiology not captured by CSE. In cases where such tools are inaccessible or pose risks, CSE may be used

independently<sup>47</sup>. Another limitation was the absence of objective cough reflex measurement and the relatively small sample size. Future research efforts should aim to include a larger and more diverse population, ideally through multicenter studies. Additionally, expanding the methodology to incorporate objective assessment tools such as VFS and FEES would further strengthen the validity and clinical applicability of the findings. Future work will apply EFODEA to patients undergoing nutritive swallowing evaluation and assess its diagnostic accuracy against gold standards (VFS and FEES)<sup>26,27</sup>.

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### Declaration of interest statement

The authors have no conflicts of interest to disclose.

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