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RESEARCH / ARAŞTIRMA

Reliability and Validity of Bedside Oral Exam Tool's Turkish Version: Methodological Study

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ABSTRACT

Objective: This study aims to assess the validity and reliability of the Turkish version of the Bedside Oral Exam Tool.
Material and Methods: This methodological study was conducted in the Anesthesia and Reanimation intensive care unit of a university hospital in Izmir, Turkey. Ninety patients were evaluated by three independent nurse-observers: two academic specialists in oral care and one specialist intensive care unit nurse. To assess content validity, expert opinions were collected, and the Content Validity Index was calculated. Interobserver agreement was measured using Gwet's AC1 coefficient, while internal consistency was analyzed using Cronbach's Alpha. Interobserver reliability was determined through intraclass correlation coefficients.
Results: Each assessment was completed in ≤3 minutes. The Content Validity Index for the Bedside Oral Exam subscales ranged between 0.897 and 1.000. The Kappa agreement coefficient for the Bedside Oral Exam subscales ranged from 0.937 to 1.000, indicating "perfect agreement" among observers. The overall Cronbach's Alpha value for the Bedside Oral Exam was 0.998, demonstrating very high internal consistency (ICC = 0.999).
Conclusion: The Bedside Oral Exam tool and its subscales show almost perfect inter-observer reliability, making it a valid and reliable tool for assessing oral health in intensive care patients.
Keywords: Intensive care, nursing, oral care, reliability, scale, validity.

Yatakbaşı Ağız Değerlendirme Aracı'nın Türkçe Versiyonunun Güvenirliği ve Geçerliliği: Metodolojik Çalışma

ÖZET

Amaç: Bu çalışma, Yatakbaşı Ağız Değerlendirme aracının Türkçe versiyonunun geçerliliğini ve güvenilirliğini değerlendirmeyi amaçlamaktadır.
Gereç ve Yöntem: Bu metodolojik çalışma, Türkiye, İzmir'deki bir üniversite hastanesinin Anestezi ve Reanimasyon yoğun bakım ünitesinde yürütüldü. Çalışmaya dahil edilen 90 hastanın ağız sağlığı ikisi ağız sağlığı konusunda uzman akademisyen ve biri yoğun bakım hemşiresi olmak üzere üç bağımsız gözlemci tarafından değerlendirildi. İçerik geçerliliğini değerlendirmek için uzman görüşleri toplandı ve İçerik Geçerlilik İndeksi hesaplandı. Gözlemciler arası uyum, Gwet'in AC1 katsayısı kullanılarak ölçülürken, iç tutarlılık Cronbach Alpha kullanılarak analiz edilmiştir. Gözlemciler arası güvenilirlik, sınıf içi korelasyon katsayıları aracılığıyla belirlendi.
Bulgular: Her değerlendirme ortalama üç dakikada tamamlandı. Yatakbaşı Ağız Değerlendirme aracının alt ölçekleri için İçerik Geçerlilik İndeksi 0,897 ile 1,000 arasında değişmektedir. Yatakbaşı Ağız Değerlendirme alt ölçekleri için Kappa uyum katsayısı 0,937 ile 1,000 arasında değişmekte olup gözlemciler arasında "mükemmel uyum" olduğunu göstermektedir. Yatakbaşı Ağız Değerlendirme aracı için genel Cronbach's Alpha değeri 0,998 olup çok yüksek iç tutarlılık göstermektedir (ICC = 0,999).
Sonuç: Yatakbaşı Ağız Değerlendirme aracının ve alt ölçeklerinin neredeyse mükemmel gözlemciler arası güvenilirliğe sahip olduğunu göstermektedir ve bu da onu yoğun bakım hastalarında ağız sağlığını değerlendirmek için geçerli ve güvenilir bir araç haline getirmektedir.
Anahtar Kelimeler: Yoğun bakım, hemşirelik, ağız bakımı, güvenilirlik, ölçek, geçerlilik.

1. Introduction

Many intensive care unit (ICU) patients require support from an endotracheal (ET) tube or mechanical ventilator (1). Intraoral intubation keeps the mouth continuously open, leading to dry oral mucosa and compromised oral health (2). Additionally, factors such as unconsciousness, intraoral devices (e.g., orogastric catheters and airways), multiple medications causing dry mouth, lack of oral intake, and insufficient hydration further weaken the integrity of the oral mucosa (1–4). Combined with inadequate oral hygiene, these conditions promote bacterial growth in the oropharynx, increasing the risk of secondary systemic infections, including ventilator-associated pneumonia (VAP) (5).

The care needs of critically ill patients who are unable to perform self-care activities independently are met by nurses (6). However, it has been observed that nurses who manage a wide range of care priorities often do not use evidence-based interventions in oral care (7). Although oral care is a fundamental nursing responsibility, nurses usually struggle to provide it effectively due to high workloads, inconsistencies in practice, variations in training and professional standards, and low prioritization of oral care (3, 4, 8, 9). These challenges contribute

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to gaps in oral health assessment. Research shows that 92% of ICU patients experience oral health deterioration—such as cracked lips, a pale mucosal coating on the tongue, and candidiasis—during their ICU stay (8). Evidence-based oral care practices not only enhance care quality and ensure patient safety (3), but also improve oral hygiene, reduce hospital-acquired infections, and lower VAP incidence (8). Therefore, oral care protocols should be practical, time-efficient, and research-supported (9).

Using a valid and reliable oral health assessment tool for ICU patients ensures a systematic and holistic approach to care planning and implementation. The key challenge is selecting an appropriate, high-quality tool for the specific patient population (10, 11). One of the earliest, the Oral Assessment Guide (OAG), developed by Eilers et al. (1988), was originally designed to assess oral health in patients undergoing stomatotoxic treatments. This eight-item scale, rated on a three-point system, has since been adapted for different healthcare settings (12). The Holistic and Reliable Oral Assessment Tool, developed by Dickinson et al. (2005), which nurses can use in their daily care, has eight subheadings: lips, tongue, gums, saliva, teeth, prosthesis, mucosa, and palate (13). The Beck Oral Assessment Scale was developed to evaluate the changes in the mouth of patients receiving chemotherapy and consists of seven subheadings: voice, swallowing, lips, mucosa-gingiva, tongue, teeth, and saliva. The measurement tool was later revised, and the voice and swallowing subheadings were removed (13). There are many assessments used in literature to assess oral health. However, these tools are not suitable for ICU patients, especially those who are intubated. More recently, the OAG has been updated as the Bedside Oral Exam (BOE) and tested in neuroscientific ICUs for critically ill patients (11). The BOE tool, which has photographic, numerical, and verbal criteria, allows for easy-to-use, objective, and reliable oral health assessments for intensive care patients. In addition, especially for intubated patients (11, 14, 15).

In Turkey, studies indicate that oral health assessment tools are not routinely used in clinical practice, oral examinations are rarely performed, and standardized care protocols are lacking (3, 16). In addition, oral assessment scales are not used frequently, and there is no appropriate assessment tool for intensive care patients, and especially intubated patients. This study aims to evaluate the validity and reliability of a widely used ICU oral health assessment tool in Turkey. The primary objective is to assess the validity (language and content) and reliability (internal consistency, interobserver agreement) of the Turkish version of the BOE.

1.1. Objective

This study aims to evaluate the validity and reliability of a widely used ICU oral health assessment tool in Turkey. The primary objective is to assess the validity (language and content) and reliability (internal consistency, interobserver agreement) of the Turkish version of the BOE.

2. Material and Method

2.1. Research Type and Sample of the Research

This study was designed as a methodological study. The study was conducted in the Anesthesia and Reanimation ICU of a university hospital in Izmir, Turkey, between June 2022 and January 2023. The ICU has three sections, with a total capacity of 27 beds. Nurses working in this unit receive training on oral care during their orientation; however, no standardized oral health assessment tool is currently used in the unit. The number of observers conducting the oral health assessments was set at a minimum of three, based on relevant literature recommendations and expert statistical feedback (17). The team included two observers with doctorates in oral health from the Department of Nursing Fundamentals and one ICU nurse with a master's degree. For validity and reliability studies of scales, a sample size of at least 5–10 times the number of scale items is recommended (18). Additionally, interobserver agreement should be assessed with at least 30 pairs of data (19). The BOE scale includes eight independent subscales, so a target sample size of 80 patients (10 times the number of scale items) was set, with a final total of 90 patients reached. Patients were included in the study if they: (i) were over the age of 18; and (ii) had relatives who consented to their participation**.** *Sample Exclusion Criteria:* Patients were excluded if they: (i) had head injuries preventing oral examination; (ii) were undergoing head and neck radiotherapy and/or chemotherapy; or (iii) had Sjögren's syndrome. A total of 118 patients were evaluated during the research period. Of these, eight were excluded due to lack of consent from their relatives, six had dry mouth, four were receiving chemotherapy, and ten could not be positioned appropriately for examination.

2.2. Data Collection

2.2.1. Data Collection Tools

Patient Identification Form

This form includes patients' socio-demographic and clinical information. Developed by the researchers based on a review of oral health literature, it contains nine questions covering the patient's age, gender, pre-existing systemic diseases, nutrition style, breathing method, oral care frequency, length of ICU stays, APACHE II score, and Glasgow Coma Scale score (4, 5, 8, 17–19).

Bedside Oral Exam (BOE) Tool

This tool, adapted from Eilers' Oral Assessment Guide, was used to assess ICU patients' oral health. It includes eight subscales: swallowing, lips, tongue, saliva, mucous membrane, gingiva, teeth or dentures, and odor. In the original guide, the "sound" subscale was replaced with "odor" and renamed the Modified Oral Assessment Guide (10, 12). After obtaining necessary permissions, the tool was renamed the "BOE," incorporating photos by Masumi Muramatsu to aid visual assessment (Fig. 1). Each subscale in the BOE is assessed visually, expressively, and numerically, with scores assigned as follows: "normal" (healthy) as 1 point, "mild dysfunction" as 2 points, and "severe dysfunction" as 3 points. Total scores range from 8 (excellent oral health) to 24 (poor oral health), with lower scores indicating better oral health. Based on these scores, 8-10 points indicate normal oral health, 11-14 points indicate mild dysfunction, and 15-24 points indicate severe dysfunction (10).

2.3. Implementation of the Research

2.3.1. Research Data Collection

For the purposes of language and content validity analysis of the BOE, relevant experts were consulted. Following these validations, the data collection process with patients commenced. Written informed consent was obtained from the relatives of patients who met the study inclusion criteria, after providing them with detailed information about the research. A pilot study involving 10 patients, whose data were excluded from the primary analysis, was conducted. As a result, a minor revision was made to the Patient Identification Form, and the BOE was confirmed to be comprehensible. The pilot study also proved valuable in standardizing the evaluation between observers.

On data collection days, patients were evaluated for eligibility by the primary observer. Conscious patients were informed about the study, invited to provide consent, and subsequently included; for unconscious patients, informed consent was obtained from their family members. Descriptive data for each patient included in the study were gathered by the primary observer. Oral health assessments were conducted by three observers half an hour

after the morning oral care routine. During these assessments, observers used the BOE, disposable gloves, and a light source.

The observers conducted examinations at five-minute intervals, with each examination averaging three minutes in duration. Scores determined by the observers were sealed in an envelope and handed over to an ICU nurse. Upon completion of the study, all data were compiled and transferred to the primary observer, who processed the information into a consolidated format.

2.3.2. Analysis of Research Data

The BOE was translated into Turkish by five bilingual individuals who were fluent in both English and Turkish and agreed to participate in the research. Following the creation of a unified text, a back-translation method was employed. Expert opinion was sought for content validity, and the Content Validity Index (CVI) was calculated. Descriptive statistics for categorical variables were presented as frequencies and percentages, while mean, standard deviation (SD), and range (minimum-maximum) values were provided for numerical variables. Observer agreement was assessed using Kappa analysis and the "Gwet AC1" coefficient, with results presented alongside 95% confidence intervals (CI) (23, 24). These coefficients followed Gwet's probabilistic approach, based on the Landis and Koch scale (25). The internal consistency of the BOE was evaluated using Cronbach's Alpha, with values above 0.80 considered adequate for reliability (26). The Intraclass Correlation Coefficient (ICC) was employed to assess interobserver concordance (27), where values above 0.70 indicated a good level of agreement (20). Statistical significance was set at $p<0.05$ for all analyses. Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 22.0 and R software, version 4.0.5.

2.4. Ethical Aspects of the Research

This research was conducted by the principles of the Declaration of Helsinki. This study was conducted in compliance with the ethical standards outlined in the Declaration of Helsinki, with ethical approval obtained from the Ege University Medical Research Ethics Committee (19-11.1T/1). Virginia Prendergast, its developer, granted permission for the adaptation and use of the tool in Turkish. Additionally, written authorization was obtained from the ICU where the study was conducted, and informed written consent was secured from the relatives of patients who agreed to participate.

3. Results

3.1. Sample Characteristics

The descriptive characteristics of the patients are summarized in Table 1. The mean age of the patients was 62.30 ± 18.11 years, with 62.2% being male. The average ICU stay was 31.92 ± 33.60 days. Among the patients, 41.1% had hypertension, and 32.2% had respiratory system diseases. Of the sample, 38.9% were ventilated through an oral intubation tube, 74.4% received enteral nutrition, and routine oral care was administered to all patients four times daily. The mean APACHE II score of the patients was 17.35 ± 6.90, and the mean Glasgow Coma Scale score was 9.16±3.88 (Table 1).

3.2. Validity Analysis

3.2.1. Language Validity

Following approval for the Turkish adaptation and validation study, the Bedside Oral Exam (BOE) was translated into Turkish by five independent language experts. The research team reviewed these translations and produced a unified version. This finalized translation was then back-translated into English by a bilingual linguist proficient in both Turkish and English to ensure accuracy and consistency (25).

3.2.2. Content Validity

To assess content validity, the Content Validity Index (CVI) was calculated. The translated and original versions of the BOE were presented to nine oral health experts. Each step in the BOE was rated on a scale of 1-4 (1 = not suitable, 2 = requires major revisions, 3 = minor revisions, 4 = highly appropriate). The CVI for each item in the eight independent subscales of the BOE was then calculated.

The CVI for each item was determined by dividing the number of experts who rated the item as 3 or 4 by the total number of experts. The CVI scores for the eight independent BOE subscales were as follows: "swallow" = 1.000, "lips" = 1.000, "tongue" = 0.897, "saliva" = 1.000, "mucous membrane" = 0.897, "gingiva" = 1.000, "teeth or dentures" = 0.897, and "odor" = 1.000. After validation, the BOE was tested on 10 intensive care patients (excluded from the main study) to ensure clarity and comprehension. Since the BOE operates as a rating scale (1–3 points), construct validity was not assessed.

Table 1. Socio-demographic and clinical variables of the patients

Variables	n	%
Age		
Mean±SD	62.30±18.11	
Minimum-Maximum	22-93	
Gender		
Female	34	37.8
Male	56	62.2
Day of stay in ICU		
Mean±SD	31.92±33.60	
Minimum-Maximum	2-180	
Systemic diseases*		
Hypertension	37	41.1
Diabetes Mellitus	27	30
Respiratory diseases	29	32.2
Heart diseases	17	18.9
Chronic Renal Failure	5	5.6
Breathing type		
Spontaneous	21	23.3
Oral intubation	35	38.9
Tracheostomy	34	37.8
Nutrition type		
Oral	17	18.9
Enteral	67	74.4
Parenteral	6	6.7
Oral care frequency/day		
Mean±SD	4±0.0	
Minimum-Maximum	4-4	
APACHE II score		
Mean±SD	17.35±6.90	
Glasgow Coma Scale score		
Mean±SD	9.16±3.88	

*: More than one has been selected.
%: Percentage; SD: Standard Deviation

3.3. Reliability Analysis

The mean BOE total score was 16.10 ± 3.79 (min=9, max=24) for the 1st observer, 16.07 ± 3.85 (min=9, max=24) for the 2nd observer, and 16.06 ± 3.80 (min=9, max=24) for the 3rd observer. According to the first observer's oral health examination, Cronbach's Alpha values were 0.754 for "swallow," 0.744 for "lips," 0.744 for "tongue," 0.744 for "saliva," 0.735 for "mucous membrane," 0.736 for "gingiva," 0.736 for "teeth or dentures," 0.744 for "odor," and 0.847 for the total BOE (Table 2).

3.3.1. Interobserver Reliability Analysis

Interobserver agreement was assessed using Kappa analysis and Gwet's AC1 coefficient values. Inter-observer agreement levels for the analyzed Bedside Oral Exam tool subscales were Gwet's AC1 coefficient values of 0.000. According to kappa analysis, the agreement levels between observers for each BOE subscale were as follows: "swallow" = 1.000, "lips" = 0.937,

"tongue" = 0.948, "saliva" = 0.957, "mucous membrane" = 0.956, "gingiva" = 0.989, "teeth or dentures" = 0.989, and "odor" = 1.000 (Table 2). Kappa interpretation scale, values under 0.00 were considered poor, 0.00-0.20 as slight, 0.21-0.40 as fair, 0.41-0.60 as moderate, 0.61-0.80 as substantial, and 0.81-1.00 as almost perfect agreement (23, 25).

Internal consistency for the total BOE score was analyzed using Cronbach's Alpha (0.998), and interobserver concordance was evaluated with the Intraclass Correlation Coefficient (ICC = 0.99) (Table 3). ICC provides agreement for the total scale score.

Table 2. Interobserver concordance in Bedside Oral Exam subscales

Bedside Oral Exam	Kappa Concordance efficient**	Standard error	P*	95% Confidence Interval	
Swallow	1.000	0.000		1.000	1.000
Lips	0.937	0.025	0.000	0.887	0.987
Tongue	0.948	0.022	0.000	0.903	0.993
Saliva	0.957	0.020	0.000	0.916	0.999
Mucous membrane	0.956	0.021	0.000	0.913	0.999
Gingiva	0.989	0.010	0.000	0.968	1.000
Teeth or dentures	0.989	0.010	0.000	0.967	1.000
Odor	1.000	0.000		1.000	1.000

*: Gwet's AC1 analizi
**: Benchmark scale
%: Percentage
0.8000-1.0000 ----Almost perfect

Table 3. Interobserver concordance in Bedside Oral Exam total score

Bedside Oral Exam	ICC*	p	95 % Confidence Interval	
Total score	0.999	0.000	0.999	0.999
Chronbach's Alpha		0.998		

*: Intraclass Correlation Coefficient
%: Percentage

4. Discussion

This single-center study demonstrates that the Bedside Oral Exam (BOE) is a valid and reliable tool for oral health assessment in ICU patients, with excellent interobserver agreement. The high level of agreement suggests that the BOE can be consistently used by different caregivers for the same patient, minimizing variability in scoring. A review of the literature shows that the English version of the BOE has been utilized in several studies, both in Turkey (3, 22) and globally (2, 21, 29). However, while studies on the validity and reliability of the BOE across different languages are limited, one study has examined its internal structure and validity (9).

4.1. Sample Characteristics

Research indicates that endotracheal tubes and mechanical ventilation contribute to dry mouth (xerostomia), significantly impacting oral health (1, 30, 31). In our study, approximately 70% of the sample required respiratory support (oral intubation or tracheostomy), increasing their risk of dry mouth and oral health deterioration. Similarly, Akça et al. (9) studied hemodialysis patients, who frequently experience dry mouth, while another study focused on brain-injured patients, a group at high risk for oral health deterioration.

4.2. Validity

To ensure language validity, the translation-back-translation method was used. Content validity is one of the most commonly applied methods for validating measurement tools (32). The Content Validity Index (CVI) for BOE subscales ranged from 0.89 to 1.00, confirming that experts considered the tool appropriate and comprehensive for its intended purpose. In the literature, it is desired for the CVI to be above 0.80 (33).

4.3. Reliability

The BOE demonstrated very high reliability, with a Cronbach's Alpha of 0.998 (ICC = 0.999). This high alpha coefficient suggests that the BOE is sufficiently reliable for clinical use (34). In contrast, a study examining the validity of the BOE in brain-injured patients reported a Cronbach's Alpha of 0.81, concluding that the tool was not fully valid for that population (9). Similarly, a study using the original BOE with stroke patients reported a Cronbach's Alpha of 0.69 (14). The higher reliability observed in our study may be attributed to the expertise of the two oral health specialists and the involvement of a senior ICU nurse as the third observer (14).

Given the rapid deterioration of oral health in ICU patients, interobserver agreement was prioritized over test-retest reliability. The intraclass correlation coefficient for BOE total scores was 0.999, indicating almost perfect agreement among observers. Additionally, the Kappa coefficient for all BOE subscales ranged from 0.937 to 1.000, signifying "perfect agreement." By comparison, in a study using the Oral Assessment Guide (OAG)—a non-visual version of the BOE—interobserver agreement among four nurses was reported as 0.85%, with Kendall's coefficient of concordance at 0.76 (14).

4.4. Limitation

This study has some limitations. First, only ICU patients admitted within a specific timeframe were included; however, we believe this did not significantly impact the representativeness of the sample. Second, to ensure consistency in clinical practices, the study was conducted in a single ICU.

5. Conclusion and Recommendations

This is the first study to assess the validity and reliability of the BOE in Turkey. Findings indicate that the Turkish version of the BOE is a **valid, reliable, and effective** tool for assessing the oral health of ICU patients.

6. Contribution to the Field

Each assessment was completed in ≤3 minutes. The Content Validity Index for the Bedside Oral Exam subscales ranged between 0.897 and 1.000. The Kappa agreement coefficient for the Bedside Oral Exam subscales ranged from 0.937 to 1.000, indicating "perfect agreement" among observers. The overall Cronbach's Alpha value for the Bedside Oral Exam was 0.998, demonstrating very high internal consistency (ICC = 0.999).

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Conflict of Interest

There is no conflict of interest with any person and/or institution.

Authorship Contribution

Concept: GGA, İE; Design: GGA, İE, MU; Supervision: İE, MU; Data Collection/Processing: GGA, EB, CY; Analysis/Interpretation: GGA, İE; Literature Review: GGA, EB, CY; Manuscript Writing: GGA, İE, EB; Critical Review: EB, İE, MU, CY.

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