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Turkish validity and reliability of Burnout Syndrome Assessment Scale for nurses working in intensive care units

Yağmur Dağ[1], Gülsün Özdemir Aydın[2] and Nuray Turan[2*]

Abstract

Aims This study aimed to translate the Burnout Syndrome Assessment Scale (BOSAS) for Nurses Working in Intensive Care Units into Turkish validity and reliability.

Methods The questionnaire was planned to be of a methodological type and translation-back translation methods were used to translate it into Turkish. The content validity was established by submitting it to a panel of 12 faculty members with expertise in nursing. The Burnout Syndrome Assessment Scale (BOSAS) for Nurses Working in Intensive Care Units, the Maslach Burnout Inventory (MBI), and the Nurse Information Form were applied to 200 nurses. Internal consistency analyses were conducted using Cronbach's alpha coefficients and item analysis. Confirmatory factor analysis was employed to evaluate the construct validity. To ascertain the scale's stability over time, a test-retest method was implemented, involving the administration of a questionnaire to 150 intensive care nurses at two-week intervals. The MBI facilitated the assessment of the level of agreement between parallel forms, and intraclass correlations were computed.

Results Following confirming language equivalence for the scale, the content validity index was subsequently computed. The items' content validity indices (CVIs) ranged between 0.833 and 1.000 and were higher than the generally accepted standard level. Nevertheless, since most of the items related to the scale were explained over a single dimension, the factor analysis application was carried out over a single dimension. The MBI was used to assess the interreliability of the Burnout Syndrome Assessment (BOSAS) Scale for Nurses Working in Intensive Care Units in parallel forms. The scale's internal consistency coefficient demonstrated a high-reliability level, achieving a value of 0.95. The intraclass correlation coefficients (ICCs) obtained for each subdimension and overall questionnaire were high.

Conclusion The Turkish adaptation of this scale is a valid and reliable tool for evaluating and identifying burnout among nurses in intensive care settings.

Keywords Burnout assessment, Intensive care, Validity, Reliability, Turkish nurses

*Correspondence:
Nuray Turan
nkaraman@istanbul.edu.tr
[1]Institute of Graduate Studies in Health Sciences, Department of Fundamentals of Nursing, Istanbul University, Bozdoğan Kemeri Cd. No: 4 Vezneciler Hamamı Sk. Vezneciler, Fatih, Istanbul 34126, Türkiye
[2]Faculty of Nursing, Department of Fundamentals of Nursing, Istanbul University, Süleymaniye Mh. Bozdoğan Kemer Cd. Prof. Dr. Cahit Orhan Tütengil Sk. No: 1, Fatih, Istanbul 34116, Türkiye

Introduction

Burnout syndrome in nursing refers to the difficulty in fulfilling the profession's requirements and the inability to cope adequately with professional challenges due to prolonged exposure to stress [1]. It is frequently encountered in the nursing profession [2]. Burnout syndrome is generally associated with both external and internal factors and occurs in a state of continuous unresolved stress [3].

Although many factors cause burnout syndrome, there are many different causes of burnout, especially in intensive care nurses. The main reasons are high workload, long shift work, difficulties in human relations, maintaining care for dying patients, institutional sanctions, conflicts within the team, and health policies [4, 5]. Studies have revealed that nurses experience burnout syndrome primarily in intensive care units, emergency units, and oncology clinics, with intensive care nurses working in demanding workloads being more prone to burnout syndrome than nurses in other fields [2, 4–10]. In addition to factors such as the physical environment (light, sound, noise, humidity, etc.), stress, insomnia, and fatigue [6], the fact that patients have a low probability of recovery and are usually in the terminal period despite all care and treatment practices in the intensive care unit, which is one of these areas, emotionally strains nurses and increases the risk of burnout syndrome.

Although various factors contribute to burnout syndrome, diagnosing it in intensive care nurses and initiating appropriate interventions are critical for the well-being of nurses, patients, and healthcare institutions. Early identification and management of burnout can enhance nurses' productivity and overall health. While numerous tools exist to measure burnout, there is a need for a tool that not only evaluates the antecedents of burnout but also highlights its physical and psychological consequences, offering a broader perspective tailored to intensive care nursing [11]. This study aims to assess the validity and reliability of the Turkish Burnout Syndrome Assessment Scale for Nurses working in Intensive Care Units, originally developed in English by Choudhary et al. in 2022.

Materials and methods

Study design and participants

The population of the methodological study consisted of nurses working in the intensive care units of a university-affiliated training and research hospital and two private hospitals in Istanbul (N=265). The sample size of this study was determined according to the following principle: In scale validity and reliability studies, the sample size should be at least 5–10 times that of each scale item or in the range of 200–300 [12, 13]. Since BOSAS for nurses working in intensive care units consists of 20 items, the sample size was between 200 nurses.

Analyses were performed on the data collected by 200 nurses. The test-retest test to determine the invariance of the scale over time was performed with 150 nurses independently of the sample. The inclusion criteria were that the nurses were actively working in the intensive care unit, had at least one year of professional experience, and volunteered to participate in the study.

Measurements

Nurse information form

The form, which was created in accordance with the literature [2, 4, 6, 11], included questions about the nurses' individual characteristics, including age, gender, marital status, education level, length of experience, and the unit in which they worked.

The burnout syndrome assessment scale (BOSAS) for nurses working in intensive care units Development and validation was developed by Choudhary et al. in 2022 [2]. The scale consists of 20 questions to diagnose burnout syndrome in nurses working in intensive care units. The scale is a 5-point Likert-type scale with values ranging from 0 (never) to 4 (always); the lowest score obtained from the scale is 0, and the highest score is 80. In the scoring scale, a score ranging from 20 and below indicates no burnout, a score ranging from 21 to 40 indicates mild burnout, a score ranging from 41 to 60 indicates moderate burnout, and a score ranging from 61 to 80 indicates severe burnout. The higher the score obtained from the scale, the greater the burnout level of the nurses. The original Cronbach's alpha reliability coefficient was 0.94 [2], and the cronbach's alpha reliability coefficient was 0.95 in this study.

Maslach burnout inventory (MBI)

This scale was developed by Maslach in 1981, and its Turkish validity and reliability were assessed by Ergin [14]. The scale contains 22 total items and covers three dimensions: emotional exhaustion, depersonalization, and lack of personal success. Emotional exhaustion assesses situations in which a person feels depleted of emotional energy; depersonalization assesses the level of depersonalization or emotional cooling toward work and people at work; and lack of personal success assesses the individual's sense of success at work and interaction with work. An increase in the scores of emotional exhaustion and depersonalization indicates a high level of burnout. In contrast, an increase in the score of lack of personal success indicates a low level of burnout [15]. The scale is based on a 5-point Likert-type scale, and the scores are evaluated between 1 and 5. In Ergin's (1992) Turkish adaptation study, cronbach's alpha reliability coefficients

of the three dimensions were 0.83 for emotional exhaustion, 0.71 for depersonalization, and 0.72 for lack of personal success [14]. In this study, the Cronbach's alpha reliability coefficient was 0.95.

Translation of the Burnout Syndrome Assessment Scale (BOSAS) for nurses working in Intensive Care Units—Turkish

The five-step model proposed by Choudhary et al. was employed to translate the BOSAS for nurses working in intensive care units into Turkish. This process involved (1) an initial translation from the source language to the target language, (2) an assessment of the initial translation, (3) a back-translation to the source language, (4) an evaluation of the equivalence between the back-translation and the original scale, and (5) a final review conducted by experts. A linguist and a professional translator translated. Following the necessary adjustments by the researchers, the scale was subsequently back-translated into English by an academic proficient in Turkish and English, along with another professional translator.

Data collection procedure

Data were collected from nurses working in the intensive care units of three hospitals between March 15, 2023, and March 15, 2024. Before data collection, the content validity of the Burnout Syndrome Assessment Scale (BOSAS) for nurses was evaluated using the Davis technique. An expert opinion form was shared with 12 faculty members who are specialists in the field to assess the scale's content validity. The form included the original version of the scale, its Turkish translation, subdimensions, and scoring method, and was sent to the experts via email.

According to the Davis technique, the experts were asked to evaluate each item on a 1–4 scale. Based on their evaluations, the content validity index (CVI) for the scale items ranged from 0.833 to 1.000, indicating agreement on the clarity and appropriateness of the items. After confirming content validity and achieving language equivalence, a pilot study was conducted with intensive care nurses. Data from the pilot study were not included in the final analysis, and the BOSAS was subsequently utilized for the main study.

During the primary data collection phase, the researchers distributed the instruments to intensive care nurses who met the inclusion criteria and voluntarily agreed to participate. This was done during their working hours without disrupting patient care and treatment. Completing the forms took approximately 15 min. The researchers then collected the completed forms from the nurses. For the test-retest reliability phase, participating nurses were asked to create a pseudonym to ensure anonymity and enable matching of the first and second submissions. In line with the literature recommending a 15–30 day interval for test-retest reliability, the data collection forms were re-administered two weeks after the initial submission to 150 nurses. The two data sets were matched using the pseudonyms provided by the participants.

Data analysis

The IBM SPSS Statistics 26 and LISREL 8.7 (IBM SPSS, Turkey) statistical package programs were used for statistical analysis. The frequency distribution (number, percentage) for categorical variables and descriptive statistics (mean, standard deviation) for numerical variables were used to evaluate the research data. Univariate normality tests (Shapiro–Wilk) and multivariate normality tests (Henze Zirkler) were used to test the normality of the scale expressions. This study tested the scale's validity via confirmatory factor analysis (CFA), test-retest, intraclass correlation coefficient, and mean-variance methods. The scale's reliability was tested with Cronbach's alpha and combined reliability analyses. The relationships between variables were analyzed via Spearman's (rho) correlation analysis, and the results were evaluated at the 95% confidence interval and $p<0.05$ significance level [17].

Ethical considerations

To determine the validity and reliability of the BOSAS for nurses working in intensive care units in Turkey, written permission was acquired from Mahima Choudhary via email. The study was sanctioned by the Ethics Committee of Istanbul University, under the Social Sciences and Humanities Research Ethics Committee (Date: 28.02.2023, Number: 16579483), and institutional approval was obtained before the initiation of the research. Before the data collection instruments were implemented, participants were briefed on the objectives and extent of the research. Individuals who consented to participate were incorporated into the sample and requested to complete the informed consent form.

Results

Comparison of Burnout Syndrome Assessment Scale scores by general characteristics of intensive care nurses

The findings regarding the burnout syndrome assessment scale for nurses working in intensive care units indicate that there is no statistically significant difference in Burnout Syndrome Assessment Scale scores based on gender, education level, type of intensive care unit, working style, overwork status, reason for overwork, or income status ($p>0.05$). However, a statistically significant difference was observed in burnout syndrome scores according to the dependents of the nurses ($p<0.05$). Pairwise comparisons using the Tukey method revealed that nurses with "Other" dependent groups had significantly higher Burnout Syndrome Assessment Scale scores (2.5 ± 0.7)

compared to those whose dependents were "mother and/or father" (1.8±0.8). These results suggest that the type of dependents may influence the level of burnout experienced by intensive care nurses.

Psychometric measurements

Construct validity (factor analysis)

Confirmatory factor analysis (CFA) was used to evaluate the construct validity of the BOSAS for nurses working in intensive care units [18, 19].

Confirmatory factor analysis results for the BOSAS for nurses working in intensive care units items in Table 3 and discriminant validity, combined reliability analyses, and Cronbach's alpha results for the scale items are also given. The items on the scale were not normally distributed according to the results of the Henze–Zirkler multiple normality test ($p<0.001$). Therefore, regression coefficients were calculated via the robust maximum likelihood method as the estimation method in confirmatory factor analysis (CFA). In the original structure of the scale, the scale has a single-factor structure. According to the results of this study, although the scale had a three-factor structure, the scale was handled as one-dimensional because the original scale had a single-factor structure (Table 1).

The standardized coefficient values of the BOSAS for nurses working in intensive care units were between 0.62 and 0.88, indicating that all the items were significant ($p<0.01$). In addition, since the average variance extracted (AVE) (0.558) was greater than 0.50, it was determined that the model provided sufficient convergent validity. According to the reliability analysis of the scale, since the composite reliability (CR) value (0.961) was greater than 0.70 and Cronbach's alpha (0.951) was greater than 0.80, the consistency of the responses given to the BOSAS for nurses working in intensive care units was generally high (Table 3).

Table 1 Comparison of Burnout Syndrome Assessment Scale scores according to general characteristics of nurses working in intensive care units

General Characteristics of Nurses		**Mean ± SD (Median)**	**Min.–Max.**		
Age (years)		27.66 ± 5.02	26 (22–48)		
Working time (years)		5.74 ± 5.24	4 (1–26)		
Working time in intensive care (years)		3.49 ± 3.73	3 (0.20–33)		
Working hours per week		48.99 ± 8.40	48 (40–80)		
		n	**%**	**t/F**	**p**
Gender	Women	143	71.50	0.376[a]	0.708
	Men	57	28.50		
Education status	High school	43	21.50	0.841[b]	0.473
	Associate degree	20	10.00		
	Bachelor's degree	126	63.00		
	Master's degree	11	5.50		
Type of intensive care unit	General intensive care	87	43.50	1.597[b]	0.177
	Coronary intensive care	39	19.50		
	CVC intensive care	43	21.50		
	Pediatric intensive care	17	8.50		
	Neonatal intensive care	14	7.00		
Way of working in the intensive care unit	Continuous daytime	21	10.50	2.116[b]	0.100
	Shift	157	78.50		
	24 h	20	10.00		
	Other	2	1.00		
Overtime situation	Yes	186	93.00	1.752[a]	0.081
	No	14	7.00		
Reason for overwork	At my request	44	22.00	1.954[b]	0.145
	By management decision	138	69.00		
	Other	18	9.00		
Income status	Income covers expenses	59	29.50	-1.390[a]	0.166
	Income does not cover expenses	141	70.50		
Dependents	No, no one	92	46.00	3.014[b]	0.031*
	My mother and/or father	58	29.00		
	My child/children	34	17.00		
	Others	16	8.00		

**$p<0.01$. *$p<0.05$; a: Independent t-test, b: One-Way ANOVA test

Table 2 Results of the item analysis

Items	Mean ± SD	Median (Min.-Max.)	Anti-Image Correlation	Item-Total Correlation	Cronbach Alpha When Item Deleted Alpha
Item 1	2.97 ± 0.92	3 (0–4)	0.945	0.651	0.949
Item 2	2.26 ± 1.16	2 (0–4)	0.933	0.630	0.949
Item 3	1.89 ± 1.28	2 (0–4)	0.949	0.594	0.950
Item 4	1.85 ± 1.21	2 (0–4)	0.944	0.601	0.950
Item 5	2.06 ± 1.22	2 (0–4)	0.962	0.747	0.948
Item 6	2.02 ± 1.26	2 (0–4)	0.948	0.777	0.947
Item 7	2.82 ± 1.07	3 (0–4)	0.927	0.631	0.949
Item 8	2.38 ± 1.28	3 (0–4)	0.941	0.716	0.948
Item 9	1.99 ± 1.32	2 (0–4)	0.941	0.689	0.949
Item 10	2.35 ± 1.20	2 (0–4)	0.959	0.657	0.949
Item 11	2.26 ± 1.26	2 (0–4)	0.938	0.797	0.947
Item 12	2.51 ± 1.13	3 (0–4)	0.923	0.781	0.947
Item 13	2.52 ± 1.15	3 (0–4)	0.929	0.772	0.947
Item 14	1.53 ± 1.35	1 (0–4)	0.964	0.707	0.948
Item 15	1.03 ± 1.25	1 (0–4)	0.885	0.572	0.950
Item 16	1.80 ± 1.26	2 (0–4)	0.969	0.677	0.949
Item 17	1.50 ± 1.26	1 (0–4)	0.960	0.739	0.948
Item 18	1.80 ± 1.41	2 (0–4)	0.932	0.662	0.949
Item 19	1.91 ± 1.30	2 (0–4)	0.929	0.741	0.948
Item 20	0.87 ± 1.23	0 (0–4)	0.889	0.586	0.950

Table 3 Goodness-of-fit indices obtained for the confirmatory factor analysis

Fit Criteria	Good Fit *	Acceptable Fit **	Model
χ^2/df	$0 \leq \chi^2/df \leq 2$	$2 \leq \chi^2/df \leq 5$	2.23**
CFI (comparative fit index)	$0.97 \leq CFI \leq 1$	$0.95 \leq CFI \leq 0.97$	0.98*
NNFI (nonnormed fit index)	$0.97 \leq NNFI \leq 1$	$0.95 \leq NNFI \leq 0.97$	0.98*
NFI (normed fit index)	$0.95 \leq NFI \leq 1$	$0.90 \leq NFI \leq 0.95$	0.97*
SRMR (Standardized root mean square error)	$0 \leq SRMR \leq 0.05$	$0.05 \leq SRMR \leq 0.08$	0.067**
RMSEA (root mean square error of approximation)	$0 \leq RMSEA \leq 0.05$	$0.05 \leq RMSEA \leq 0.08$	0.079**

χ2: chi-square fit test df: degree of freedom $^{**}p < 0.01$

For confirmatory factor analysis, the normalized chi-square test (NC), comparative fit index (CFI), normalized fit index (NFI), nonnormed fit index (NNFI), standardized root mean square error (SRMR), and root mean square error of approximation (RMSEA) were examined as fit indices. As shown in Table 3, the CFA value [20], which indicates a good fit of 0.95 and above, was 0.98, indicating that the scale items had a good fit. Another fit index is the root mean square error of approximation (RMSEA). The acceptable fit ratio of the RMSEA is not below 0.08. A perfect fit is required if it is above 0.05. According to the study results, the RMSEA value of 0.079 indicates that the scale items are compatible.

According to the confirmatory factor analysis (CFA) model test results of the BOSAS for nurses working in intensive care units in Table 3, the fit index values of the model were as follows: chi-square/df (cmin/df) = 2.23, CFI = 0.98, NNFI = 0.98, NFI = 0.97, SRMR = 0.067, RMSEA = 0.079 (Table 2). According to Table 3, these results show that there is a good fit, thus indicating that the CFA model is valid [20–22]. The CFA model path diagram for the BOSAS for nurses working in intensive care units is shown in Fig. 1.

Item analysis and internal consistency An item analysis was conducted to assess the reliability of the Burnout Syndrome Assessment Scale designed explicitly for nurses in Intensive Care Units. This analysis aimed to identify and eliminate items that exhibited low correlation with the overall scale. The findings indicated that no items had a correlation value with the item-total score below 0.30 (Table 2). Consequently, no items were removed from the scale. The correlation values for the 20 adapted items ranged from $r = 0.572$ to $r = 0.797$. Furthermore, cronbach's alpha for the adapted scale was calculated, revealing an overall internal consistency coefficient of 0.951 (Table 2).

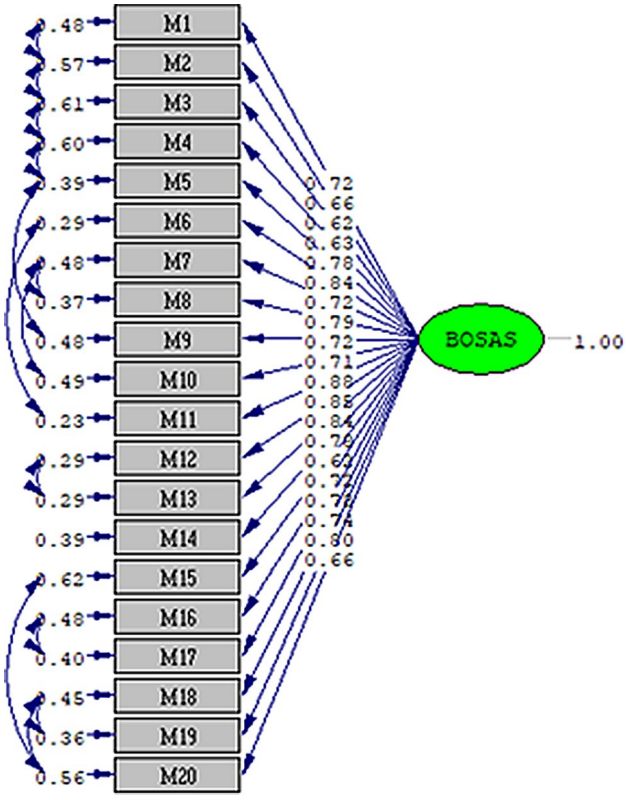

Fig. 1 Premodification path diagram and factor loadings (Standardized Estimates)

Stability

Retest reliability of the scale

It is advised in the literature that test-retest methodologies should be implemented with 25% of the primary sample [16]. Table 4 shows the test-retest results for 150 participants. The BOSAS's intraclass correlation coefficient (ICC) for nurses working in intensive care units between times 1 and 2 was high (ICC=0.985; 95% CI: 0.972–0.985). Cronbach's alpha values were also analyzed for internal consistency. The Cronbach's alpha values for times 1 and 2 were 0.956 and 0.957, respectively. These high values indicated that the reliability of the scale was high. In this case, the validity and reliability of the scale were ensured via the test-retest method.

Parallel-form reliability

The relationships among the BOSAS for nurses working in intensive care units, the Maslach Burnout Inventory, and its subdimensions were analyzed via correlation analysis. A statistically significant relationship was found between all the subdimensions (Table 5).

Discussion

Burnout syndrome in intensive care nurses is a condition in which nurses experience symptoms such as fatigue, emotional exhaustion, and work-related insensitivity due to long working hours, constant stress, and some difficulties inherent in intensive care. In Turkey, no strong measurement tool is used to diagnose burnout syndrome in intensive care nurses (1,11,23). This research involved adapting the BOSAS for nurses working in intensive care units into the Turkish language, along with comprehensive validity and reliability assessments.

This study found that nurses with childcare responsibilities experienced significantly higher burnout levels than those without ($p<0.05$). This result aligns with findings from similar studies in the literature [23]. For instance, Rizo-Baeza et al. [24] highlighted that high burnout levels are closely linked to personal factors, such as being single and the challenges of balancing childcare responsibilities. Similarly, Verdon et al. [25] reported a statistically significant relationship between burnout and individuals with childcare obligations. These consistent findings suggest that family care responsibilities increase the risk of burnout among nurses by exacerbating the challenges they face in the workplace. In conjunction with nurses' workload, the type of dependents emerges as a critical factor influencing burnout levels. Family care obligations may intensify workplace stress, ultimately contributing to burnout. To address this issue, healthcare organizations should prioritize policies that support nurses in achieving a healthy work-life balance. Initiatives such as flexible working hours and tailored support programs for nurses with caregiving responsibilities could significantly mitigate burnout and foster well-being [26].

The concept of validity is an important method that shows at what level the measurement tool is to be used in evaluating any subject measures that subject. Validity is a criterion that reflects how accurate and meaningful a measurement tool is [27, 28]. Language adaptation is one of the first and most important steps in adapting a scale from a different culture. Since the scales are developed in the language and culture of that society, they need to be adapted to the Turkish language and culture [28, 29]. Therefore, in adapting the BOSAS for nurses working in intensive care units into Turkish, language validity was first ensured, and then content validity was assessed.

The first step in ensuring validity is to obtain an expert opinion. Thus, the adequacy of the questions about the situation to be measured is evaluated. This method uses the content validity index (CVI). For this purpose, the scale was first translated into Turkish and submitted to expert opinion [30]. As a result of the content validity assessment of the scale, the CVI for the items ranged between 0.833 and 1.000. This finding showed that this scale was suitable for Turkish individuals regarding language and content validity when the accepted CVI was considered. The item-total score correlation measures the relationship between the scores of a particular item in a measurement tool and the overall total scores and

Table 4 Retest reliability of the scale

		Test		Retest		ICC 95% Confidence Interval			
Items	***n***	**Mean ± SD**		**Mean ± SD**		**Lower Limit**	**Upper Limit**	**ICC**	***p***
Item 1	150	2.95 ± 0.94		2.99 ± 0.94		0.960	0.979	0.971	0.000**
Item 2	150	2.34 ± 1.11		2.42 ± 1.13		0.916	0.955	0.939	0.000**
Item 3	150	1.96 ± 1.31		2.09 ± 1.30		0.896	0.944	0.924	0.000**
Item 4	150	1.97 ± 1.17		2.05 ± 1.22		0.926	0.961	0.946	0.000**
Item 5	150	2.11 ± 1.25		2.14 ± 1.21		0.934	0.965	0.951	0.000**
Item 6	150	2.01 ± 1.26		2.06 ± 1.31		0.935	0.965	0.952	0.000**
Item 7	150	2.78 ± 1.09		2.80 ± 1.09		0.920	0.957	0.941	0.000**
Item 8	150	2.35 ± 1.30		2.37 ± 1.31		0.952	0.975	0.965	0.000**
Item 9	150	2.01 ± 1.33		2.02 ± 1.30		0.929	0.962	0.948	0.000**
Item 10	150	2.36 ± 1.18		2.35 ± 1.18		0.944	0.970	0.959	0.000**
Item 11	150	2.25 ± 1.27		2.31 ± 1.27		0.911	0.953	0.935	0.000**
Item 12	150	2.49 ± 1.16		2.50 ± 1.19		0.937	0.966	0.954	0.000**
Item 13	150	2.51 ± 1.18		2.51 ± 1.20		0.876	0.933	0.908	0.000**
Item 14	150	1.55 ± 1.35		1.62 ± 1.32		0.915	0.955	0.938	0.000**
Item 15	150	1.09 ± 1.26		1.15 ± 1.27		0.888	0.940	0.917	0.000**
Item 16	150	1.83 ± 1.28		1.85 ± 1.27		0.933	0.964	0.951	0.000**
Item 17	150	1.56 ± 1.31		1.59 ± 1.31		0.907	0.950	0.932	0.000**
Item 18	150	1.81 ± 1.40		1.85 ± 1.38		0.955	0.976	0.968	0.000**
Item 19	150	1.91 ± 1.27		1.91 ± 1.27		0.935	0.965	0.952	0.000**
Item 20	150	0.92 ± 1.24		1.03 ± 1.42		0.748	0.859	0.811	0.000**
		Test		**Retest**					
		Mean ± SD	**Cronbach Alpha**	**Mean ± SD**	**Cronbach Alpha**	**Lower Limit**	**Upper Limit**	**ICC**	***p***
Burnout Syndrome Assessment Scale for Nurses Working in Intensive Care Units	150	2.03 ± 0.91	0.956	2.08 ± 0.93	0.957	0.972	0.985	0.980	0.000**

**$p < 0.01$. *$p < 0.05$; ICC: Intraclass correlation coefficient (ICC) **$p < 0.01$

provides information about the reliability of each item on the scale [31].

Confirmatory factor analysis (CFA) examines whether the previously proposed and used structure is confirmed with the data available to the researcher. The purpose of this analysis is to test the factor structure of the variable. Conducting a confirmatory factor analysis to adapt a scale prepared in a different language to Turkish is sufficient. In evaluating the construct validity of a scale, the goodness of fit statistics results obtained from confirmatory factor analysis (CFA) are essential for the scale's validity [18]. The goodness of fit results are used to evaluate the level of representation or fit of the theoretical model to the data [32]. Confirmatory factor analysis (CFA) was applied to test the construct validity of the BOSAS for nurses working in intensive care units and to evaluate the fit between factors. The original structure of the scale has a single-factor structure. According to the results of this study, although the scale had a three-factor structure, the scale was handled as one-dimensional because the original scale had a single-factor structure. The rate of explaining the total variance of the single-factor structure was 50.174%. The single factor significantly explains the total variance and the variance related to the scale. In addition, the eigenvalue obtained from the factor analysis results must be above 1. According to the research results, the eigenvalue of a single factor was above 1. In this case, validity was achieved through a single factor. In this context, the normalized chi-square test (NC), comparative fit index (CFI), normalized fit index (NFI), nonnormed fit index (NNFI), standardized root mean square error (SRMR), and root mean square error of approximation (RMSEA) were examined as fit indices for confirmatory factor analysis (CFA). A CFI value of 0.95 and above indicates a very good fit [20], and a CFI value of 0.98 indicates that the fit of the scale items is good. Another fit index is the root mean square error of approximation (RMSEA). The acceptable fit ratio of the RMSEA is not below 0.08. A perfect fit is required if it is above 0.05. According to the study results, the RMSEA value of 0.079 indicates that the scale items are compatible.

Cronbach's alpha, used to assess the reliability of the measurement tool, was used to analyze the internal consistency of the items. This method is based on the

Table 5 Retest reliability of the scaleBurnout Syndrome Assessment Scale for nurses Working in Intensive Care Units and Maslach Burnout Inventory (MBI) Cronbach's alpha and correlation

	n	Mean ± SD	Median (Min.-Max.)	Spearman's rho	Emotional Exhaustion	Depersonalization	Lack of Personal Success	Maslach Burnout Scale	Burnout Syndrome Assessment Scale for Nurses Working in Intensive Care Units
Emotional Exhaustion	200	3.40 ± 0.68	3.55	r	0.873				
			(1.22-5.00)	p					
Depersonalization	200	2.48 ± 1.00	2.4	r	0.597	0.811			
			(1.00–5.00)	p	0.000**				
Lack of Personal Success	200	3.85 ± 0.64	3.87	r	-0.184	-0.231	0.757		
			(1.63-5.00)	p	0.009**	0.001**			
Maslach Burnout Scale	200	3.36 ± 0.53	3.31	r	0.859	0.724	0.161	0.81	
			(1.95 -5.00)	p	0.000**	0.000**	0.023*		
Burnout Syndrome Assessment Scale for Nurses Working in Intensive Care Units	200	2.01 ± 0.88	2.05	r	0.742	0.508	-0.237	0.605	0.951
			(0.00–4.00)	p	0.000**	0.000**	0.001**	0.000**	

Pearson correlation analysis $^{**}p<0.01$ $^{*}p<0.05$

weighted standard deviation mean change found by evaluating the ratio of the sum of the variances of the items in the measurement tool to the overall variance. This value is considered a coefficient that measures the similarity and closeness of the questions in the measurement tool. In the process of evaluating the resulting coefficient, values below 0.40 indicate that the scale is not reliable, values in the range of 0.40–0.60 indicate low reliability, values in the range of 0.60–0.80 indicate medium reliability, and values in the range of 0.80-1.00 indicate high reliability [33]. A value of 0.70 and above for scale reliability is generally an acceptable level of internal consistency [34]. In the study in which the original scale was developed, the Cronbach's alpha reliability coefficient was reported to be 0.94 [2]. In this study, the Cronbach's alpha reliability coefficient of the scale was 0.95. Therefore, the reliability level of this scale is quite high.

Item analysis was performed to determine the reliability of the items in the BOSAS for nurses working in intensive care units and to identify and remove items with low correlation in the scale. The results of the analysis revealed that there was no item-total score correlation value of 0.30 or less. Therefore, no items were removed from the scale.

Reliability refers to the ability of a measurement tool to produce similar results when repeated under the same conditions and on the same samples. In other words, the reliability of a measurement tool ensures that similar or consistent results are obtained when the same person or group repeats the same test. One frequently used analysis to assess a scale's consistency over time is the test-retest method [35]. This study used the test-retest method to apply the scale to 150 intensive care nurses at 2-week intervals, and the intraclass correlation coefficient (ICC) was calculated. The intraclass correlation coefficient (ICC) measures the relationship between measurements. The intraclass correlation coefficient (ICC) can vary between 0 and 1. When this coefficient approaches 1, the level of reliability increases. The correlation coefficient also determines the level of similarity of measurements between two raters [36]. The intraclass correlation coefficient (ICC) obtained for each subdimension of the scale and the overall scale is high. This finding indicates that the scale measures the same situation at different times, is consistent, and is therefore reliable.

Limitations of the study

This study is limited by its focus on the intensive care units of the designated hospitals. The BOSAS for nurses working in intensive care units, adapted into Turkish, is intended as a self-assessment tool for nurses. It should be acknowledged that there may be a divergence between the burnout levels that nurses assess for themselves and their actual burnout levels.

Conclusions and recommendations

This study demonstrated that the Turkish adaptation of the BOSAS for nurses working in intensive care units is a valid and reliable measurement tool. The scale's language adaptation and content validity were confirmed through expert opinions, with content validity indices (CVIs) found to be above acceptable levels. The confirmatory factor analysis (CFA) results, which assessed construct validity, validated the single-factor structure of the scale, and the goodness-of-fit indices indicated that this structure is suitable for Turkish nurses. Additionally, the scale's overall internal consistency coefficient (Cronbach's alpha) was very high, and the test-retest results revealed that the scale is consistent and reliable over time.

The Turkish-adapted version of this scale can effectively assess burnout levels in intensive care nurses and develop early intervention strategies. This scale should be regularly implemented in healthcare institutions to enable nurses to recognize burnout symptoms early and activate necessary support mechanisms. Furthermore, the scale should be applied in different healthcare settings and among various nurse groups to test its validity and reliability in a broader population.

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Author contributions
Nuray Turan, Yağmur Dağ, Gülsün Özdemir Aydın: Methodology; Yağmur Dağ: Data collection; Yağmur Dağ, Nuray Turan: Formal analysis; Nuray Turan, Gülsün Özdemir Aydın: Conceptualization; Nuray Turan, Gülsün Özdemir Aydın: Supervision; Nuray Turan, Gülsün Özdemir Aydın: The stages of writing, reviewing, and editing are now concluded. All authors have affirmed their responsibility for every aspect of the work and have given their final consent for the version set to be published.

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Data availability
The datasets generated and/or analyzed during the current study are not publicly available due to ethical considerations and confidentiality agreements but are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The study was approved by the Ethics Committee of Istanbul University, Social Sciences, and Humanities Research Ethics Committee (Date: 28.02.2023, Number: 1657948), and institutional permission was obtained before starting the study. Before the data collection instruments were implemented, participants were briefed on the objectives and extent of the research. Individuals who consented to participate were incorporated into the sample and requested to complete the informed consent form.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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