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Reliability and validity of the Turkish version of the Chelsea critical care physical assessment tool (CPAx-TR)

Chelsea yoğun bakım fiziksel değerlendirme aracı'nın (CPAx-TR) Türkçe versiyonunun güvenirliği ve geçerliği

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ABSTRACT

Objective: Assessing physical function in Intensive Care Unit(ICU) patients is essential for clinical decision-making. The Chelsea Critical Care Physical Assessment Tool(CPAx) is a validated instrument developed to evaluate functional status. This study aimed to cross culturally adapt the CPAx into Turkish and examine its validity and reliability.

Materials and Methods: The tool was translated into Turkish using forward–backward translation and administered to 60 ICU patients. For the reliability analysis, internal consistency was evaluated using Cronbach's alpha coefficient. The construct validity of the CPAx was tested by factor analysis. The criterion validity was performed using the correlation between the CPAx and the Physical Function ICU Test (PFIT).

Results: The internal consistency of the tool was found to be high and Cronbach's alpha value was calculated as 0.960. All item-total score correlations were above 0.30. Exploratory Factor Analysis revealed that all items were grouped into a single factor. In Confirmatory Factor Analysis, the model showed good fit (CMIN/df=1.207;CFI=0.993;NFI=0.959;GFI=0.907; RMSEA=0.059). Furthermore, the correlation analysis with P-FIT revealed a strong positive relationship (r=0.892; p<0.001).

Conclusion: It has been determined that the CPAx-TR shows acceptable levels of validity and reliability in evaluating functionality in ICU patients.

Keywords: critical care, functionality, reliability, validity

ÖZ

Amaç: Yoğun bakım ünitelerinde (YBÜ), hastaların fonksiyonel durumunu değerlendirme klinik karar verme açısından kritik roldedir. Chelsea Kritik Bakım Fiziksel Değerlendirme Aracı (CPAx), YBÜ hastalarında fonksiyonel durumu değerlendirmek için geliştirilmiş, geçerliliği kanıtlanmış bir araçtır. Çalışmanın amacı; CPAx aracının Türkçeye kültürlerarası uyarlamasını yapmak ve yoğun bakım hastalarında geçerlik ve güvenirliğini değerlendirmektir.

Gereç ve Yöntem: Çeviri ve geri çeviri yöntemi ile Türkçe'ye uyarlanan araç, yoğun bakım ünitesinde yatan 60 hastaya uygulanmıştır. Güvenirlik analizi kapsamında, iç tutarlılık Cronbach's alpha katsayısı ile değerlendirilmiştir. Yapı geçerliği kapsamında faktör Analizi kullanıldı. Kriter geçerliği kapsamında ise, CPAx aracı ile Fiziksel Fonksiyon YBÜ Testi (P-FIT) arasında Pearson korelasyon analizi yapılmıştır.

Bulgular: Aracın iç tutarlılığı yüksek bulunmuş, Cronbach's alpha değeri 0,960 olarak hesaplanmıştır. Madde-toplam puan korelasyonlarının tamamı 0,30'un üzerinde çıkmıştır. Açımlayıcı faktör analizi sonucunda, tüm maddelerin tek faktörde toplandığı görülmüştür. Doğrulayıcı faktör analizinde modelin iyi uyum gösterdiği belirlenmiştir (CMIN/df=1,207; CFI=0,993; NFI=0,959; GFI=0,907; RMSEA=0,059). Ayrıca, P-FIT ile yapılan korelasyon analizinde güçlü bir pozitif ilişki bulunmuştur (r = 0.892; p <0.001).

Sonuç: CPAx-TR'nin YBÜ hastalarında işlevselliği değerlendirmede kabul edilebilir düzeyde geçerlik ve güvenirlik gösterdiği tespit edilmiştir.

Anahtar kelimeler: fonksiyonellik, güvenirlik, geçerlik, kritik bakım

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Introduction

Decreased muscle strength and neuromuscular disorders, functional impairments, organ and system dysfunctions because of prolonged mechanical ventilation (MV), immobilization, and inactivity are severe problems among patients treated in the Intensive Care Unit (ICU) and may be followed by adverse effects including Post Intensive Care syndrome (PICS) and mortality (1,2). Studies have shown that after admission to the ICU, muscle atrophy is rapid and reaches 17.7% in the lower extremities and 13.2-16.9% in the upper extremities within the first 10 days (3,4). Prolonged ICU stay increases the risk of Intensive Care Unit-Acquired Weakness (ICU-AW), characterized by symmetrical and systemic atrophy of limb and respiratory muscles (5). However, immobilization also affects the cardiac system and studies has been reported that prolonged supine position causes dysregulation of blood volume in the peripheral circulation and a 20% decrease in cardiac workload (6). Muscle atrophy process that develops in the ICU can also lead to the chronic physical and psychological problems after discharge. Patients with an ICU stays exceeding 72 hours have been shown to have poor ambulation performance with cardiopulmonary dysfunction, muscle weakness and malnutrition after ICU discharge (7). A study shown that reduced walking speed, difficulties with stair climbing, and challenges in performing independent activities such as dressing in discharged ICU patients (8).

The evaluation of physical function status in the ICU is crucial for identifying patients' functional impairments, determining individualized treatment plans, and monitoring the effectiveness of the applied interventions (9). Performing adequate and timely measurements, along with implementing early rehabilitation as appropriate, can contribute to increased success rates in ventilator weaning, reduce lengths of stay in both the ICU and hospital, facilitate earlier discharge, and enhance the quality of life during and post-ICU admission (10,11). Assessing the physical functional status and of ICU patients can be difficult due to cognitive dysfunction, existing cognitive impairment, coma, oversedation/analgesia and nutrient disorders (12,13). In this context, the existing scales used should provide the specificity required by ICU conditions. Several tools have been developed and are clinically utilized to evaluate physical function and activity in critically ill ICU patients, including the Functional Independence Measure (14), PFIT (15), Barthel Index (16), Modified Rankin Scale (17), Functional Status Score for the ICU (11), Karnofsky Performance Status Scale (11), 4P Score (18), Glasgow Coma Scale(GCS) (19), Disability Rating Scale (17), and Chelsea Critical Care Physical Assessment(CPAx) (20).

The CPAx tool has been designed specifically to evaluate physical functions in ICU patients (20,21). The CPAx is comprised of ten domains: respiratory, cough, moving within the bed, supine to sitting on the edge of bed, dynamic sitting, standing balance, sit to stand, transferring from bed to chair, stepping, and grip strength. In contrast to other questionnaires assessing ICU patients, this tool additionally evaluates the respiratory status and grip strength domains. Grip strength is an indicator of the strength of the peripheral muscles (22). In addition, the fact that most ICU patients receive ventilatory support may leads to the catabolism process in diaphragm muscle, thereby increasing immobilization (23). Therefore, evaluating these parameters in ICU patients is essential, as it offers a more comprehensive understanding.

Chelsea Critical Care Physical Assessment Tool, initially developed in the UK, also has Swedish, Norwegian, German, Danish, South African and Chinese versions available (20,21,24-30). However, this tool remains untested in a Turkish ICU patient and has yet to be used in an ICU. The aim of the study is to evaluate the reliability and validity of the Turkish version of the CPAx in ICU patients.

Material Method

This is a methodological study with a prospective, single-arm design. This study aimed to evaluate the validity and reliability of the Chelsea Critical Care Physical Assessment (CPAx) tools. After the cross-cultural adaptation and translation process, the reliability and validity of the Turkish version of the tool were investigated. Prior to the study, contact was made via email with Evelyn Corner, and permission was granted to adapt the tool.

Cross-cultural adaptation and translation process

We employed a cross-cultural adaptation approach in the translation process, following the guidelines outlined by the International Test Commission and World Health Organization (WHO). to ensure cultural relevance and accuracy (31,32). In the first step, The CPAx was independently translated from English to Turkish by two bilingual Turkish translators without prior knowledge, each translating separately from the other (33). Subsequently, three physiotherapists and an ICU consultant reviewed and compared the translations to identify and resolve any inconsistencies, leading to the creation of a draft Turkish version. Then, Two bilingual translator, were unaware of the purpose of translation, retranslated the edited Turkish version into English. As a final step, the original tool was compared with the back-translated English version, and adjustments were made as needed. Afterward, the revised version reviewed and approved by a professional translator.

Participants

Data were collected from Jan 2021 to Jan 2022 in the Istinye University Hospital, General Medical ICU. To determine a sample size in scale development or adaptation studies, it is generally advised to include 5 to 10 participants per item (34). Therefore, 60 patients were included in the study. Inclusion criteria for the study were individuals admitted to the ICU with critical illnesses, aged over 18 ages, Glasgow Coma Scale (GCS) total score greater than 11 point and ICU stay longer than 48 hours. Exclusion criteria included the presence of unstable fractures, limb deformities or dysfunctions, Myasthenia Gravis or neuromuscular dysfunction, and a diagnosis of COVID-19.

Ethical considerations

Ethical approval was received from the Ethics Committee of Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital (2021-70). Written informed consent was obtained from participants or their first-degree relatives. The study is registered at Clinicaltrials.gov (NCT04811638).

Data collection

Patient data, including medical histories, diagnosis, age, sex, use of the cigarette and alcohol, and GCS (19), RASS (35) and APACHE II (36) scores were recorded.

Physical Function ICU Test (PFIT)

Physical Function ICU Test is a tool introduced by Skinner et al. in 2009 to assess endurance, strength, and functional levels in ICU patients (15). The Turkish reliability of the test was adapted on major abdominal surgery by Avcı et al. in 2019 (37). The test includes sit-to-stand, cadence, muscle strength of bilateral shoulder flexion, and bilateral knee extension subitems. Knee flexion and shoulder extension strength are assessed using the Oxford grading (0-5) system. Each section is scored between 0 and 3, and a total score is calculated. The original scale's internal consistency coefficient ranges from 0.996 to 1 (15,38).

Chelsea Critical Care Physical Assessment (CPAx) tool

Developed by Corner et al. in 2013, the tool based on a 6-point Guttman Scale (20,21). It is a tool that combines visual and numerical elements and assessing ten physical function parameters, ranging from total dependence to independence. It evaluates not only physical function and mobility but also respiratory function and cough ability, and grip strength. A total score between 0 and 50 can be

calculated, where 0 indicates total dependence and 50 represents complete independence (20,21).

Data analysis

Statistical analyses were performed using IBM SPSS statistics version 22 and IBM SPSS AMOS version 25. The normal distribution of the continuous variables was tested using the Shapiro-Wilk test. Internal consistency was measured using Cronbach's alpha statistical test. In the Cronbach α test, the acceptable level of high-reliability of the tool was determined to be greater than 0.80, and in addition, the item-total correlation values were required to be greater than 0.30 (39,40). Correlations between the P-FIT scores were measured using the Spearman rank (p) correlation coefficient (41). In confirmatory factor analysis (CFA), the fit indexes and their cut-off values for appropriate fit were given as Table 1 (42). In the exploratory factor analysis, a factor loading greater than 0.45 and a variance explanation rate exceeding 50% were required as criteria. The Type I error rate in our analysis was set at 5%.

Results

The clinical and demographic status of the patients in this study are presented in Table 2. The study included sixty critically ill patients admitted to the ICU, with a mean age of 68.30 ± 12.06 years; 38 (63.3%) were male and 22 (36.7%) females. The mean value of the APACHE II score was 21.52 ± 7.21. The mean GCS score was 11.88 ± 3.50 and the mean RASS score was -0.23 ± 1.22. The average duration of ICU stay

Table 1. The range of acceptable fit indexes

	Good Fit	Acceptable Fit
CMIN/DF	0< CMIN/DF ≤2	0≤ CMIN/DF ≤3
CFI	0.97≤CFI≤1.00	0.95≤NNFI≤0.97
NFI	0.95≤NFI≤1.00	0.90≤NFI≤0.95
GFI	0.95≤GFI≤1.00	0.90≤GFI≤0.95
RMSEA	0≤RMSEA≤0.05	0.05≤RMSEA≤0.10

CMIN/DF, Chi-square statistic divided by degrees of freedom; CFI, Comparative Fit Index; NFI, Normed Fit Index; GFI, Goodness-of-Fit Index; RMSEA, Root Mean Square Error of Approximation.

Table 2. Patients' demographic and clinical characteristics

	n (%)	
Sex		
Male	38 (63.3)	
Female	22 (36.7)	
Diagnosis		
Pneumonia	9 (15)	
COPD	16 (26.7)	
Urosepsis	2 (3.3)	
Respiratory failure	12 (20)	
Hyperkalemia	1 (1.7)	
Subdural Hematoma	2 (3.3)	
Pulmonery Edema	5 (8.3)	
Intracranial Hematoma	5 (8.3)	
Gastrointestinal Perforation	1 (1.7)	
Liver Failure	2 (3.3)	
Lung Resection	1 (1.7)	
Deterioration of General Condition	1 (1.7)	
Pleural Effusion	3 (5)	
Medical History		
Present	50 (83.3)	
Absent	10 (16.7)	
Family History		
Present	49 (81.7)	
Absent	11 (18.3)	
Surgical History		
Present	36 (60)	
Absent	24 (40)	
Smoking status		
Current Smoker	17 (28.3)	
Non-smoker	28 (46.7)	
Former Smoker	15 (25)	
Ventilatory Support Type		
Invasive	23 (38.3)	
Non-invasive	37 (61.7)	
Discharge status		
Discharge	36 (60)	
Transfer to another unit	9 (15)	
Exitus	15 (25)	
	x̄±SD	**Med (min/max)**
Age (years)	68.30±12.06	71 (32/84)
APACHE II (admission)	21.52±7.21	21 (5/38)
GCS	11.88±3.50	13 (3/15)
RASS	-0.23±1.22	0(-5/1)
ICU Admission (day)	7.68±4.96	6.5 (2-22)

COPD, Chronic Obstructive Pulmonary Disease; APACHE II, Acute Physiology And Chronic Health Evaluation II; GCS, Glasgow Coma Scale; RASS, Richmond Agitation-Sedation Scale; ICU,Intensice Care Unit
n, Sample size; %, Percentage; x̄, Mean; SD, Standard Deviation; Med, Median; Min, Minimum; Max, Maximum

was 7.68 ± 4.96 days. Among the primary diagnoses, COPD was the most common, followed by pneumonia. Additionally, 50 participants had a history of chronic disease, and 49 had a family history of chronic illness. A total of 36 participants had a history of surgical procedures. Upon ICU discharge, 36 (60%) patients were discharged home, 9 (15%) were transferred to other units, and 15 (25%) exitus.

The item-total correlation for all sub-items was above 0.30. The Cronbach's alpha was found to be 0.960 and it was determined that CPAx-TR has internal consistency (Table 3).

The results of the factor analysis for construct validity showed that all factor loadings were above 0.800. The tool, consisting of 9 items, was grouped into a single factor, explaining 76.973% of the total variance (Table 4).

To examine multiple fit indices for the confirmatory factor analysis of CPAx. The CMIN/DF value was 1.207, the GFI was 0,907, the NFI was 0.959, and the RMSEA was 0.059 (Table 5).

To assess criterion validity, the correlation coefficient between scales CPAx and PFIT was examined to determine their relationship. A statistically significant, strong positive correlation was identified between CPAx and PFIT ($r = 0.892$, $p < 0.001$) (Table 6).

Discussion

This is the first study to conduct a translation and cross-cultural adaptation of the CPAx into Turkish version and to examine its reliability and validity. The CPAx was translated and cross-culturally adapted from the English into the Turkish ICU patients. Our findings demonstrate that the CPAx-TR has high reliability and validity for ICU population and that

Table 3. Reliability of the Turkish CPAX

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
Respiratory	0.757	0.959	0.960
Cough	0.802	0.957	
Moving Within The Bed	0.823	0.956	
Supine to Sitting on the Edge of Bed	0.843	0.955	
Dynamic Sitting	0.844	0.955	
Standing Balance	0.901	0.953	
Sit to Stand	0.899	0.953	
Transferring from Bed to Chair	0.879	0.953	
Stepping	0.819	0.956	

Table 4. The exploratory factor analysis results: eigenvalues of factors, factor loadings and variance amounts explained by the factors

Component		Initial Eigenvalues				Extraction Sums of Squared Loadings		
Item	Factor loading	Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	0.800	1	6.928	76.973	76.973	6.928	76.973	76.973
2	0.836	2	0.753	8.364	85.337			
3	0.858	3	0.470	5.226	90.563			
4	0.878	4	0.241	2.679	93.242			
5	0.880	5	0.218	2.426	95.668			
6	0.928	6	0.139	1.550	97.218			
7	0.928	7	0.100	1.114	98.332			
8	0.916	8	0.085	0.945	99.277			
9	0.864	9	0.065	0.723	100.000			

Table 5. The values of fit indexes of confirmatory factor analysis

Fit Indexes	Value	Status
CMIN/DF	1.207	Good Fit
CFI	0.993	Good Fit
NFI	0.959	Good Fit
GFI	0.907	Acceptable Fit
RMSEA	0.059	Acceptable Fit

CMIN/DF , Chi-square statistic divided by degrees of freedom; CFI, Comparative Fit Index; NFI, Normed Fit Index; GFI, Goodness-of-Fit Index ; RMSEA, Root Mean Square Error of Approximation.

Table 6. Criterion validity results of CPAx

		PFIT
CPAx	r	0.892
	p	**<0.001****

r, correlation coefficient; **p <0.001

statistically significant correlations of strong were present between CPAx-TR and P-FIT.

In the original CPAx version, the Cronbach's alpha value was determined to be 0.798, and the intraclass correlation coefficient (ICC) of 0.988 within a 95% confidence interval (20,21). Similarly, in the cultural adaptation and test-retest studies of the Swedish version, the ICC was 0.970, with Kappa values were observed to range between 0.88 to 0.98 (27). In the study of the Norwegian version, the ICC was reported as 0.990 within a 95% confidence interval (28). For the Chinese version, the Cronbach's alpha was found to be 0.930, with test-retest reliability of 0.902 and Kappa values ranging from 0.839 to 0.845 (30). In the German version, the Cronbach's alpha was above 0.7, and the ICC was greater than 0.8 (25,26). For the Danish version the ICC was 0.996 within a 95% confidence interval, with Kappa values ranging from 0.914 to 0.995 (24). In our study, in which we evaluated the Turkish version of the tool, the Cronbach's alpha was determined to be 0.960. Our findings are consistent with previous validation studies, indicating that the CPAx-TR scale demonstrates high homogeneity and internal consistency.

As a result of the factor analysis applied for CPAx-TR, the number of items in the tool decreased from 10 to 9. These 9 items were grouped into a single factor. For CPAx-TR, the explained total variance was 76,973%. According to these results, it was observed that the items grouped under a single factor were sufficient to explain physical function (43,44). In addition, the lowest factor loading of all items was 0.800, which is above the acceptable level of 0.45 (43,44). For the construct validity of a scale to be appropriate, ' the fit indices' examined in CFA should meet the acceptable level (45,46). According to the results, the CMIN/df value was found to be 1.207, with CFI = 0.993, NFI = 0.959, GFI = 0.907, and RMSEA = 0.059. Among these values, CMIN/df, CFI, and NFI indicate a good fit, while GFI and RMSEA show an acceptable fit (42). In conclusion, the CPAx-TR showed good construct validity.

Regarding criterion validity, in the original version developed, a moderate to strong positive correlation was found between the CPAx score and the MRC score ($p<0.001$), GCS score ($p<0.001$), sedation score ($p<0.001$), peak cough flow ($p=0.006$), and AusTOM score ($p<0.001$) (20). In Chinese version, correlation between MRC score and CPAx-Chi coefficient was 0.60 ($p<0.001$) for researcher A and 0.65 ($p<0.001$) for researcher B in the assessment of ICU-AW (30). Furthermore, the Chinese version demonstrated strong content validity. The item-level content validity index (I-CVI) ranged from 0.889 to 1, and the scale-level content validity index (S-CVI) was calculated as 0.955 (30). In our study, a strong positive correlation was found between the CPAx-TR score and the P-FIT score ($p<0.001$), suggesting that the tool reliably assessment of physical function status in ICU.

The Turkish adaptation of the CPAx offers a robust and objective means of assessing functional status in ICU settings. It holds significant potential for both clinical practice and research, particularly in enabling ICU professionals to monitor patient recovery and inform treatment strategies.

This study has several limitations. The most significant limitation is that it is a single-center study. Due to practical constraints, follow-up tools could not apply

to patients, which made a test-retest reliability analysis impossible. In future studies, conducting the inter-rater and test-retest reliability analysis is recommended. Additionally, the 'absence to grip strength protocol' limitation observed in the original version is also applicable to our study. Thirdly, the 'CPAx does not account such as exercise tolerance or walking distance' limitation noted in the German version is also apply to CPAx-TR.

Conclusion

In summary, the findings of this study suggest that the CPAx-TR is a reliable and valid tool for assessing the physical functions and activities of patients with critical illness in the ICU. The CPAx-TR can be regarded as a valuable measurement tool for healthcare professionals in the ICU to evaluate physical and respiratory function and to plan and establish goals for early rehabilitation and treatment within a multidisciplinary team. Future studies should focus on exploring the minimum clinically important change as well as the predictive validity and reliability of the CPAx tool should be investigated in more intensive care units and units with critically ill patients in Turkey.

Ethical approval

This study has been approved by the Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital Clinical Research Ethics Committee (approval date: January 14, 2021, number: 2021,70). Written informed consent was obtained from the participants.

Author contribution

Study conception and design: MBU, EP, GK; data collection of data: MBU, GK, HP; analysis and interpretation of results: MBU, EP, KNB; draft manuscript preparation: MBU, EP, GK; critical revision of the manuscript : MBU, EP, GK. The authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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