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ORIGINAL ARTICLE

Turkish translation, cross-cultural adaptation, and assessment of psychometric properties of the Functional Status Score for the Intensive Care Unit

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ABSTRACT

Purpose: To translate and cross-culturally adapt the Functional Status Score for the Intensive Care Unit instrument to Turkish and investigate its psychometric properties.

Methods: An expert committee supervised forward and backward translation. Thirteen participants reviewed the pre-final version of Turkish Functional Status Score for the Intensive Care Unit instrument providing minor revisions to improve its readability. Two physiotherapists assessed patients ($N = 50$) from a coronary intensive care unit using the Turkish Functional Status Score for the Intensive Care Unit instrument.

Results: Internal consistency was excellent (Cronbach's $\alpha = 0.949$). Inter-rater reliability and intra-rater reliability were excellent for each of five functional tasks and total scores (intra-class correlation coefficient = 0.955–0.996). The Turkish Functional Status Score for the Intensive Care Unit score had moderate to high correlations with other functional measures as follows: Perme Intensive Care Unit Mobility Score (Spearman's $r = 0.92$), Katz Activities of Daily Living ($r = 0.80$), handgrip strength ($r =$ 0.76–0.77), and knee extension strength ($r = 0.70$–0.71).

Conclusion: The Functional Status Score for the Intensive Care Unit instrument was translated and culturally adapted to Turkish and demonstrated strong psychometric properties, including internal consistency, intra-rater and inter-rater reliability, construct validity, and floor and ceiling effects.

➤ IMPLICATIONS FOR REHABILITATION

- Rehabilitation professionals strive to assess and document patient status using validated and reliable outcome measures as part of good clinical practice.
- Longitudinal evaluation of physical function in the intensive care units is important.
- The Functional Status Score for the Intensive Care Unit is a validated and reliable physical functioning measurement instrument suitable for the intensive care units.
- The Functional Status Score for the Intensive Care Unit was translated and culturally adapted to Turkish, and demonstrated strong psychometric properties, including internal consistency, intra-rater reliability, inter-rater reliability, construct validity, and floor and ceiling effects.

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Functional status; intensive care unit; reliability; validity; Turkish

Introduction

Chronic critical illness is associated with mechanical ventilation dependence, organ failure, infections, multiple comorbidities, nutritional and rehabilitation needs, and other intensive care treatments [1,2].

Although physical dysfunction after intensive care unit (ICU) admission is common, there is lack of information about understanding subgroups of patients at highest risk for dysfunctions and greatest benefit from rehabilitation interventions. Measurement of early and longitudinal physical function in ICU is important to identify patients with poor physical outcomes, monitor intervention efficacy, and inform recovery trajectories [3–5].

Physiotherapists strive to assess and document patient status using validated and reliable outcome measures as part of good clinical practice [4]. Despite growing evidence supporting the role of physiotherapists in the ICU, there is a need for greater evidence regarding how to measure and report physical functional status, and associated changes over time [3,5].

There are several available functional status outcome measures, such as the Physical Function in Intensive care Test scored

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Supplemental data for this article can be accessed here.

Table 1. Professional backgrounds of the participants in the pre-final test.

Number	Profession	Degree	Expertise area	Working time
3	Physiotherapist	PhD	Cardiopulmonary rehabilitation	>15 years
2	Physiotherapist	PhD	Cardiopulmonary rehabilitation	>5 years
1	Physiotherapist	PhD	Neurological rehabilitation	>5 years
5	Physiotherapist	MSc	Different areas including intensive care units	>2 years
2	Intern physiotherapist	Student	Clinical placement in intensive care unit	Senior (at 4th year)

(PFIT-s), Chelsea Critical Care Physical Assessment Tool (CPAx), Perme Mobility scale, Surgical intensive care unit Optimal Mobilization Score (SOMS), and ICU Mobility Scale [3]. However, many of these instruments have not been translated and cross-culturally adapted into other languages. A recent international study investigated psychometric properties of the Functional Status Score for the Intensive Care Unit (FSS-ICU) in 819 ICU patients, demonstrating good internal consistency, validity and responsiveness [6]. The FSS-ICU has increasing use in international studies and was previously translated into Brazilian Portuguese demonstrating good inter-rater reliability [7]. However, the FSS-ICU does not have a Turkish translation and cultural adaptation with assessment of psychometric properties. Therefore, this study aimed to translate and culturally adapt the FSS-ICU into Turkish and investigate the psychometric properties of this adapted version.

Methods

Participants

Awake patients aged above 18 years old admitted to a coronary ICU of a university hospital (Dokuz Eylül University, Izmir, Turkey) were recruited to this methodological study from June to August 2018. Patients' awakening and comprehension were evaluated based on their responses to the following five orders: (1) Open (close) your eyes, (2) Look at me, (3) Open your mouth and put out your tongue, (4) Nod your head, and (5) Raise your eyebrows when I have counted up to 5 [8]. Patients who responded to at least three of these orders were included in the study. Patients with a baseline physical or cognitive impairment or hemodynamic instability in the ICU that would prevent exercise were excluded. The patients were receiving routine medical and rehabilitation care.

Although there is no internationally accepted consensus about the minimum required sample size for validation studies, 2–20 participants per item are generally recommended [9]. In this study, *a priori* sample size was determined as 50 patients, 10 participants per item within the FSS-ICU.

Ethical approval according to the Helsinki Declaration was obtained from the Noninvasive Research Ethics Board of Dokuz Eylül University. Verbal and written explanations were provided to patients about the study, and all the patients provided written informed consent.

Translation and cross-cultural adaptation process

Permission for the Turkish cross-cultural translation was obtained from Dr. Dale Needham who was the senior and corresponding author of the original version of the FSS-ICU on behalf of all developer authors [10]. Translation and cross-cultural adaptation of the FSS-ICU into Turkish was conducted following published guidelines [11].

Forward translation

Two translators who were bilingual and having Turkish as their mother tongue independently performed the forward translation from English to Turkish. One of these two translators was familiar with medical terms. In the following step, the Expert Committee (described below) compared and analyzed the independently translated versions. Thereafter, the Expert Committee produced the final forward translated version by consensus, discussing the disagreements between the two versions.

Backward translation

Two independent translators who were fluent in Turkish, and native English speakers performed back translation of the FSS-ICU from Turkish to English. This step aimed to ensure that the Turkish (forward) translated version reflects the same content as the original FSS-ICU. The English version was reviewed by Dr. Dale Needham and a physical therapist experienced in using the English version of FSS-ICU (SH), and comments from them were used by the Expert Committee to improve the Turkish forward translation version.

Expert committee review

The expert committee consolidated all the versions of the questionnaire and developed the pre-final version of the FSS-ICU for field-testing. The Expert Committee comprised health professionals (four physiotherapists and two medical doctors), one primary school teacher, one Turkish language teacher, and the translators (two forward and two back translators).

Test of the pre-final version

Thirteen persons were tested using the pre-final translated version. The professional backgrounds of the participants are presented in Table 1. These participants were interviewed with regard to the wording, terminology, instructions and clarity of the response options. The participants read the questions and verbally evaluated the items in terms of their comprehensibility. They were invited to recommend items for deletion or modification.

Final version

The reports from the previous step were used by the expert committee to develop the final version. Minor revisions were offered by the participants in the pre-final version stage. Only some changes about word orders in a few sentences were conducted to make the readability much easier.

Procedure

The FSS-ICU assessments were performed at the 3rd day during the ICU stay. To assess the inter-rater reliability, two physiotherapists evaluated the same patient using the FSS-ICU, on the same day. The physiotherapists had more than 5 years of experience in cardiopulmonary rehabilitation, including ICU experience. The same physiotherapist conducted all tests following standard testing guidelines for each test. In addition, the physiotherapists received additional training about the testing protocol of FSS-ICU to ensure that both had similar skills for performing the FSS-ICU. If the patient could perform the task without assistance, then the task was only performed one time and both physiotherapists scored the patient simultaneously. However, if the patient required assistance to perform the task, then the task was performed twice, following a rest period, in order for both physiotherapists to physically assess the assistance level required by the patient to perform the task. In this situation, the physiotherapists alternated their roles as first vs. second assessor with each patient. If the patient required assistance of both physiotherapists to perform a task then the task was only performed once and simultaneously scored by the physiotherapists. In all cases, the two physiotherapists were blinded to each other's scores. To examine the intra-rater reliability, one of two physiotherapists scored the same patient after an hour later on the same day if the patient's clinical status was unchanged (i.e., there was no worsening, invasive intervention, etc. over the prior hour). To assess concurrent validity, handgrip dynamometry, and knee extension strength, Perme ICU mobility score [12], and Katz activities of daily living score [13] were assessed, as described below on the same day. Additionally, to assess divergent validity the following variables were recorded: heart rate, systolic and diastolic blood pressure. Patient characteristics (i.e., age, gender, and body mass index) were also recorded. Floor and ceiling effects of the FSS-ICU were calculated. Depending on the patient's functional capacity, 40–100 min took to administer all tests in the baseline assessment, including time for a rest interval between the tests to allow the patient's hemodynamic responses to return to their initial value before each test.

Outcome measures

Physiological parameters and demographic characteristics

The physiological parameters including heart rate (beats/min), systolic and diastolic blood pressure (mmHg) were obtained from the ICU monitor just before starting the assessments. The demographic characteristics were collected from the latest medical records of the patients.

Functional Status Score for the Intensive Care Unit

The FSS-ICU assesses five functional tasks: rolling, supine to sit transfer, sit to stand transfer, sitting on the edge of bed, and walking (or using a wheelchair) [10]. The items are generally scored using an eight-point ordinal scale including scores (0) Unable to attempt or complete task due to weakness, (1) Complete dependence, (2) Maximal assistance (patient performing $\leq$25% of work), (3) Moderate assistance (patient performing 26–74% of work), (4) Minimal assistance (patient performing $\geq$75% of work), (5) Supervision only, (6) Modified independence, and (7) Complete independence. The FSS-ICU – total score is the sum score of all five items ranging 0–35. The higher scores indicate better functional status.

Perme intensive care unit mobility score

The Perme ICU mobility score measures a patient's mobility status. It is a valid and reliable mobility status measure to be used in the ICU setting [12]. It has 15 items grouped in seven categories including mental status, potential mobility barriers, functional strength, bed mobility, transfers, gait, and endurance. The total score ranges from 0 to 32, which a high score indicates better mobility status and more independence.

Katz activities of daily living score

The Katz score is an outcome measure via patients' ability to perform activities of daily living independently [13]. It has six items including bathing, dressing, toileting, transferring, continence, and feeding. All items are scored as 1 (independence) and 0 (dependence). The total score ranges from 0 to 6. A higher score indicates higher patient independence. The Turkish version of Katz activities of daily living score was found as valid and reliable [14].

Peripheral muscle strength assessments

Knee extension and handgrip strength were assessed using a digital dynamometer Manual Muscle Tester (Lafayette Instrument Company, Lafayette, IN), and a Jamar® hand dynamometer (Patterson Medical, Warrenville, IL), respectively. Peripheral muscle strength assessments were conducted while the patients in sitting position. Three trials were performed for both limbs according to the published protocols and the highest value of the three trials was used as the score [15,16]. Peripheral muscle strength values were reported by kg units, which higher values indicate greater muscle strength.

Metrics evaluated in the study

Internal consistency was evaluated by determining the statistical relationship of one item with other items in the FSS-ICU to help understand how items in the FSS-ICU measure the underlying construct [17]. The intra-rater (test–retest) reliability was used to determine stability of data recorded by one rater across two assessments using the FSS-ICU in the same patient at different time points that are close in time [18]. The inter-rater reliability was used to determine variation between the two independent raters who measure the same patient using the FSS-ICU [18]. Construct validity of the FSS-ICU was assessed using convergent validity and divergent validity. Convergent validity tests that constructs expected to be related are actually associated with each other (i.e., stronger correlations were expected between the FSS-ICU and other physical function-related measures). Divergent validity tests that constructs that should have no or negligible relationship are actually weakly associated with each other (i.e., negligible to weak correlations were expected between the FSS-ICU and body mass index, heart rate, systolic and diastolic blood pressure) [18]. An exploratory factor analysis was used to assess the underlying factor structure of the FSS-ICU (i.e., all items should be represent a single domain because of the aim of assessing physical function) [17,18]. Floor and ceiling effects were evaluated to understand the limits of the FSS-ICU score in representing the relative extremes of physical functional status (within the ICU setting) by assessing the frequency of values at the lowest and highest possible values [19].

Statistical analysis

Descriptive statistics were used to describe patients' demographic characteristics and assessment results. Continuous variables were expressed by mean (standard deviation), while categorical variables were reported as number (%).

Internal consistency was assessed by calculating and categorizing Cronbach's alpha coefficient as follows: excellent, $>$0.80; adequate, 0.70–0.79; and inadequate, $<$0.70 [19]. Intra-rater and inter-rater reliabilities were assessed using the intraclass

Table 2. Patients' characteristics and assessment results ($n = 50$).

Variables	Mean (SD)
Age (years)	69 (12)
Gender (male)[a]	34 (68)
Disease types[a]	
Acute coronary syndrome	25 (50)
Transcatheter aortic valve replacement	9 (18)
Heart failure	7 (14)
Implantable cardiac defibrillator implantation	4 (8)
Tachycardia	4 (8)
Pulmonary embolism	1 (2)
Body mass index (kg/m^2)	27 (4)
Heart rate (beats/minute)	81 (22)
Systolic blood pressure (mmHg)	116 (22)
Diastolic blood pressure (mmHg)	66 (12)
Handgrip strength – right (kg)	26 (12)
Handgrip strength – left (kg)	25 (12)
Knee extension strength – right (kg)	16 (5)
Knee extension strength – left (kg)	15 (5)
Perme ICU mobility score (range: 0–32)	22 (5)
Katz ADL score (range: 0–6)	4 (2)
FSS-ICU – rolling score (range: 0–7)	6 (2)
FSS-ICU – supine to sit transfer score (range: 0–7)	5 (2)
FSS-ICU – sit to stand transfer score (range: 0–7)	5 (2)
FSS-ICU – sitting on the edge of bed score (range: 0–7)	6 (2)
FSS-ICU – walking score (range: 0–7)	3 (2)
FSS-ICU – total score (range: 0–35)	25 (9)

ICU: intensive care unit; ADL: activities of daily living; FSS-ICU: Functional Status Score for the Intensive Care Unit.
[a]Reported as number (%).

correlation coefficient (ICC) using the two-way random effects and absolute agreement methods [20]. The data measured by one rater across two trials for the FSS-ICU were used to assess the intra-rater reliability and the data measured by two raters who measured the same group of subjects were used to assess the inter-rater reliability.

A principal component exploratory factor analysis was used to investigate relationships between each of the five functional tasks of physical function. We applied the Kaiser criterion to retain any latent factors with eigenvalues equal to or greater than 1. Factor loadings of >0.5 were deemed to be highly relevant to the latent factor. Concurrent construct validity was evaluated using Spearman's correlation coefficients between the FSS-ICU score and other variables. To evaluate convergent validity, *a priori* hypothesis was determined as the FSS-ICU score would have moderate to high correlations ($|r_s|>0.40$) with handgrip and knee extension strength, Perme ICU mobility score, and Katz ADL score. To evaluate divergent validity, *a priori* hypothesis was determined as the FSS-ICU score would have negligible to weak correlations ($|r_s| < 0.30$) with body mass index, heart rate, systolic and diastolic blood pressure. Since we planned to recruit stable patients (as they would have stable heart rate and blood pressure), we expected that these variables would not have been correlated with the FSS-ICU scores.

The percentage of assessments with the minimum and maximum FSS-ICU scores was calculated to evaluate the floor and ceiling effects.

Statistical significance was defined at $p < 0.05$. The statistical analysis was performed using IBM SPSS software (Version 25.0, IBM Corp., Armonk, NY).

Results

There were few edits after the pretest. According to Expert Committee, the sentence word order for Item 5 (Score 5) was changed to make the sentence clearer. For Item Wheelchair Mobility (Score 4), one word was changed with its modern use in Turkish language. Details regarding these specific edits appear in the Supplementary material.

Fifty patients with a mean (standard deviation) age of 69 (12) years participated in the study. Table 2 presents the characteristics and assessment results of the participants.

Internal consistency of the FSS-ICU was excellent (Cronbach's alpha coefficient = 0.949). Intra-rater and inter-rater reliability were also excellent for all five functional tasks and total scores with the ICC values ranging from 0.955 to 0.996 (Table 3).

The exploratory factor analysis revealed a single factor explaining 85.9% of variance with factor loadings in the range from 0.842 to 0.964 (Table 3). The Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy (0.837) and Bartlett's Test of Sphericity ($p < 0.001$) results showed that the respondent data for factor analysis was suitable. The FSS-ICU score had moderate to high correlations with handgrip and knee extension strength, Perme ICU mobility score, and Katz ADL score as pre-hypothesized (Table 4). The FSS-ICU score also had negligible correlations with body mass index, heart rate, systolic and diastolic blood pressure (Table 4).

The floor and ceiling effects of the Turkish version of the FSS-ICU were calculated as 0% and 6%, respectively.

Discussion

In this study, the FSS-ICU was translated and culturally adapted for use in Turkey. The Turkish version of the FSS-ICU showed excellent internal consistency, intra-rater and inter-rater reliability, and construct validity in the patients admitted to a coronary ICU.

The Turkish version of the FSS-ICU has excellent internal consistency which is comparable with the previous international psychometric study of the FSS-ICU across five international datasets from the USA, Australia, and Brazil [6]. The intra-rater and inter-rater reliability of the FSS-ICU were not investigated in the pilot study and the larger international study [6,10]. However, Ragavan et al. demonstrated that the FSS-ICU has high inter-rater reliability [ICC = 0.992 (95%CI = 0.984–0.996)] among six physiotherapists scoring 31 patients in 10-bed ICU [21]. A recent Brazilian Portuguese validation study of the FSS-ICU also demonstrated that it has a good inter-rater reliability during the evaluation of 30 patients in the critical care by two physiotherapists [ICC = 0.88 (95%CI = 0.73–0.95)] [7]. Another study has also reported excellent inter-rater reliability of the FSS-ICU [(ICC = 0.985 (95%CI = 0.981–0.987)] in eight physiotherapists across 76 patients in surgical, medical, and neurological ICUs [22]. The Turkish version of the FSS-ICU has now demonstrated high inter-rater reliability, comparable to the previous studies. In this study, the intra-rater reliability of the FSS-ICU was investigated for the first time. It is an important finding since the intra-rater reliability shows evidence on the reproducibility of a clinical measurement [23]. Reproducible clinical measurements are recognized as representing a well-defined characteristic of interest. In addition, well-designed research studies must include procedures that measure agreement among the various clinicians and researchers which is defined as "inter-rater reliability" [24]. The findings have shown that the FSS-ICU has excellent intra-rater and inter-rater reliability in addition to the other psychometric properties.

The Turkish version of the FSS-ICU has a good concurrent construct validity including convergent and divergent validity. The international psychometric study of the FSS-ICU also demonstrated that it has a good concurrent construct validity as the Turkish version [6]. In this study, to support the construct validity of the FSS-ICU, an explanatory factor analysis was performed for

Table 3. Intra-rater and inter-rater reliabilities, and factor loadings for the functional tasks of the Functional Status Score for the Intensive Care Unit (FSS-ICU).

	Intra-rater reliability [ICC (95%CI)]	Inter-rater reliability [ICC (95%CI)]	Factor loadings
FSS-ICU – rolling score	0.988 (0.979–0.993)	0.992 (0.985–0.995)	0.933
FSS-ICU – supine to sit transfer score	0.992 (0.986–0.996)	0.993 (0.986–0.996)	0.955
FSS-ICU – sit to stand transfer score	0.986 (0.976–0.992)	0.989 (0.981–0.994)	0.964
FSS-ICU – sitting on the edge of bed score	0.976 (0.957–0.986)	0.955 (0.919–0.975)	0.937
FSS-ICU – walking score	0.993 (0.987–0.996)	0.982 (0.968–0.990)	0.842
FSS-ICU – total score	0.996 (0.993–0.998)	0.993 (0.988–0.996)	–

ICC: intra-class correlation coefficient; CI: confidence interval.

Table 4. Concurrent construct validity of the Functional Status Score for the Intensive Care Unit (FSS-ICU).

	FSS-ICU – total score
Convergent validity	
Handgrip strength – right	0.767 (<0.001*)
Handgrip strength – left	0.764 (<0.001*)
Knee extension strength – right	0.707 (<0.001*)
Knee extension strength – left	0.701 (<0.001*)
Perme ICU mobility score	0.923 (<0.001*)
Katz ADL score	0.801 (<0.001*)
Divergent validity	
Body mass index	−0.072 (0.619)
Heart rate	−0.239 (0.106)
Systolic blood pressure	0.120 (0.422)
Diastolic blood pressure	0.210 (0.156)

ICU: intensive care unit; ADL: activities of daily living.
Values are presented as Spearman's correlation coefficients (p values).
*Statistically significant at $p < 0.05$.

the first time. Given the conceptual correlation and potential for collinearity among the five functional tasks of the FSS-ICU including rolling, supine to sit transfer, sit to stand transfer, sitting on the edge of bed, and walking, we decided to conduct the explanatory factor analysis. The findings demonstrated a single factor for the physical function.

Little floor and ceiling effect was observed for the Turkish version of the FSS-ICU score. The findings of the floor and ceiling effect are consistent with the previous international psychometric study of the FSS-ICU [6]. This finding indicates that the FSS-ICU can assess a wide range of physical function impairments in the context of the ICU setting which is valuable given variability between patients' physical functioning.

The FSS-ICU is a robust tool to evaluate physical function in both the ICU setting and in the acute hospital setting for ICU survivors [6]. The FSS-ICU provides detailed physical functioning evaluation compared to most of the other available measures and has detailed free instructions (registration required at www.improvelto.com), free training package including video available from primary author [3]. Additionally, the measurement properties of the FSS-ICU are excellent including good reliability, validity (including construct, divergent, known-groups, and predictive), responsiveness, minimal important difference, and low floor and ceiling at awakening and ICU discharge [3]. Therefore, the FSS-ICU demonstrates high international acceptance. This study presents a robust tool with good psychometric properties to use in Turkey and countries with Turkish-speaking populations. Thus, for the first time offering a Turkish scale for assessing physical function in the ICU.

This is the first to provide evidence for the intra-rater reliability and construct validity with a factor analysis of the FSS-ICU. Additionally, it is the only available outcome measure specifically designed to assess physical function of the patients admitted to the ICU in Turkey. This study has some limitations. First, we did not investigate other psychometric properties such as predictive validity, responsiveness, and minimum important difference. However, a previous study showed that these psychometric properties were acceptable for the FSS-ICU [6]. Second, this study was limited with a single ICU setting of a single hospital. In addition, the study sample included a single population of a coronary ICU. Therefore, this would decrease the generalizability of the results. Last, we used a relatively short (one-hour) interval to evaluate intra-rater reliability which represents within-day reliability; however, despite the potential for patient fatigue, there was excellent intra-rater reliability. On the other hand, a one-hour interval between assessments may result in potential recall and inflate intra-rater reliability results. Future studies should continue to investigate the between-day reliability.

Conclusions

The Turkish version of the FSS-ICU is the only available outcome measure specifically designed to assess physical function in the ICU setting in Turkey having good psychometric properties including internal consistency, intra-rater and inter-rater reliability, and construct validity.

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Disclosure statement

The authors report no declarations of interest.

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Supplementary Material

Expert Committee suggestions for the Turkish version of the Functional Status Score for the Intensive Care Unit (FSS-ICU)

1. For Item 5 (Score 5), "Hasta fiziksel yardım olmadan yalnızca gözetim veya ipucuyla 45 m yürüyebilir mi (eğer gerekirse hasta yardımcı cihaz kullanabilir)? Evetse, 5 puan." was changed to "Hasta fiziksel bir yardım olmadan 45 m yürüyebilmek için yalnızca gözetim veya ipucuna mı ihtiyaç duyar (eğer gerekirse hasta yardımcı cihaz kullanabilir)? Evetse, 5 puan."
2. For Item Wheelchair Mobility (Score 4) "nadiren" was changed as "ara sıra". The two words mean "occasional", yet, "ara sıra" is a much more modern Turkish use.