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ORIGINAL ARTICLE

Translation, reliability, agreement and validity of the Turkish version of Cumulated Ambulation Score in patients with hip fracture

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ABSTRACT

Objectives: This study aims to translate and investigate the inter-rater reliability, agreement and validity of the Turkish version of the Cumulated Ambulation Score (CAS-TR) in patients with hip fracture.

Patients and methods: This study included patients with a hip fracture of the femoral neck between July 2019 and March 2020 at the Dr. Lütfi Kırdar Kartal Training and Education Hospital, Department of Orthopedics and Traumatology, Istanbul. The CAS manual and score-sheet were translated into Turkish. An orthopedician and a physiotherapist independently administered the CAS-TR to 36 patients (12 males, 24 females; mean age 78.7 years; range, 65 to 90 years) at postoperative days one, two, three and 30. Weighted Cohen's kappa coefficient was used to measure inter-rater reliability. Turkish version of modified Barthel Index was used for analysis of validity.

Results: The majority of the patients had type III fracture (72.2%) according to Garden's classification. The kappa value was ≥0.90 for days one-three, the total and 30th day score of CAS-TR. The observed agreement ranged between 91.6% and 100% for all assessments. Validity analysis showed a significantly positive correlation between day two and day 30 CAS-TR and Barthel scores.

Conclusion: We found almost perfect reliability, high percentage agreement and acceptable convergent validity of the CAS-TR. We recommend the CAS to be used as an easily applicable instrument to assess basic mobility status in Turkish patients with hip fracture. Orthopedic and geriatric patients and patients undergoing any type of surgery can be assessed with CAS for early evaluation of mobility status.

Keywords: Arthroplasty, femoral neck fracture, hip, mobility.

Several risk factors associated to hip fractures have been identified. Among these factors, the age is the most important one.[1] The world's elderly population is growing faster than all other age groups. The World Health Organization reported that the number of people aged 65 years and over will be 1.5 billion by 2050, representing 16% of world's population.[2] Hip fractures remain important health problems, both for individuals and for health systems. It is a major cause of disability, dependency and death in the elderly.[3-5] After hip-fracture surgery, physical functions of the vast majority of patients are impaired.[6,7]

With early rehabilitation and independent mobility after a hip fracture, secondary complications that may cause disability and mortality may be reduced. It is essential to assess mobility level in early postoperative period. Cumulated Ambulation Score (CAS) is a simple test defined to assess basic mobility skills that include getting in and out of bed, rise from a chair and walk around indoor with an appropriate walking aid.[8,9] Independence in these three physical functions is essential for the patient's ability to be discharged to their own homes. Previous

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studies reported that CAS can be a predictor for postoperative outcomes in relation to length of hospitalization, discharge home, occurrence of larger medical complications in addition to short- and long-term mortality after a hip fracture.[8,10,11] and used as an outcome in other studies.[12,13] The CAS was developed in Denmark and first published by Foss et al.[8] in 2006, and examined for reliability and described in details by Kristensen et al.[9] in 2009. The CAS has been published in scientific journals in English,[9] Italian[14] and Spanish[15] languages, but it is also available in Swedish, Norwegian and Indonesian-Bahasa languages at ResearchGate. Additionally, versions in Portuguese, Japanese, French, Estonian, Dutch and Spanish-Argentinian languages are in preparation.

In clinical practice and research studies, valid tools are needed to assess the mobility level objectively for elderly patients. Therefore, in this study, we aimed to translate and investigate the inter-rater reliability, agreement and validity of the Turkish version of the Cumulated Ambulation Score (CAS-TR) in patients with hip fracture.

PATIENTS AND METHODS

This study included patients with a hip fracture of the femoral neck between July 2019 and March 2020 at the Dr. Lütfi Kırdar Kartal Training and Education Hospital, Department of Orthopedics and Traumatology, Istanbul. Fifty-seven patients with femoral neck fracture were admitted to the department during the study period. Of these, six patients died, six patients had accompanying fractures, four patients did not return for day 30 assessment, three had neurologic disorder, and two refused to participate in the study, and thus 36 patients (12 males, 24 females; mean age 78.7 years; range, 65 to 90 years) participated in the study. The study protocol was approved by the Marmara University, Faculty of Health Sciences Ethics Committee (27.06.2019/77). A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

The inclusion criteria were as follows: hip hemiarthroplasty treatment for femoral neck fracture, which allows immediate unrestricted weight bearing, being aged 65 years and older and walking ability (independent walking with or without walking aid) before the fracture. Patients were excluded from the study if they had hip fractures of other etiology (trochanteric or subtrochanteric), concomitant fractures in upper or lower extremity, total hip replacement, any rheumatological or neurological disease, or any mental disorder. Femoral neck fractures were classified according to Garden's classification.[16]

The CAS measures the level of independence in *(i)* getting in and out of bed (from supine in bed to sitting on the side at the bed, to standing or transfer to sitting in chair placed beside the bed, and return to the supine position in the bed), *(ii)* sit-to-stand from a chair with armrests (from sitting to standing to sitting) and *(iii)* indoors walking with or without an appropriate walking aid (high walker on wheels, walker, rollator, or crutches) allowed in transfer and walking if necessary.[9] Each activity is assessed on a three-point ordinal scale from 0-2 points (0=not able to, despite human assistance and verbal cueing, 1=able to, with human assistance and/or verbal cueing from one or more persons, 2=able to safely, without human assistance or verbal cueing, use of a walking aid allowed) resulting in a total one-day CAS ranging from 0-6 points.[9] Score of six indicates a completely independent ambulatory level. A three-day CAS is obtained by summing postoperative day one, two and three CASs (0-18 points).[8]

In the process of translation, a four-step procedure was followed as in other validation and reliability studies in the literature together with the recommendations of the Mapi Research Institute for linguistic validation.[17,18] First, translation of the English version of the CAS into Turkish was approved by one of the developers of the CAS, Dr. Kristensen. Second, the English version of the scoring form and manual was translated into Turkish independently by a physiotherapist and orthopedician with advanced level of English. The translations were reviewed by the same persons and another physiotherapist and a consensus version was obtained, which was then translated back into English by an academician and a PhD student with advanced level of English. The original and back-translated English versions were compared, necessary corrections and language adaptations were performed, and the final Turkish version and back-translated English version of CAS scoring form and manual were obtained. The back-translated English version was approved by Dr. Kristensen. The sample instrument was administered to 10 elderly people to test its comprehensibility before the final Turkish version of the CAS-TR (Appendix 1) was administered to the patients included in the present study.

Two researchers, an orthopedician and a physiotherapist administered the CAS-TR to patients at postoperative day one, two and three, and again

30 days after surgery with an interval of one to two hours in a randomized order. The two researchers were blinded to each other's rating until end of study.

In addition, the Barthel index was applied to patients on postoperative days two and 30 for use in validity analysis. Originally, Barthel index was developed in 1965 and updated in 1989 and thus the modified Barthel index (MBI) was developed. Functional independence is evaluated in 10 items including transfers, mobility, stairs, feeding, bathing, dressing, grooming, bowels, bladder, and toilet use. Modified Barthel index has three different weights of five-point rating scales: a score range of 0-5 for bathing, personal hygiene (grooming), and ambulation/wheelchair; a score range of 0-10 for feeding, dressing, toilet transfer, bladder control, bowel control, and stair climbing; and a score range of 0-15 for chair/bed transfers and ambulation. A higher score represents a higher degree of independence in performing activity daily living (ADL). The scores for each item are summed and the total ranges from 0 (complete dependence) to 100 (independence in terms of ADL).[19,20]

Statistical analysis

Data analysis was performed using the SPSS version 16.0 for Windows (SPSS Inc., Chicago, IL, USA). A value of p less than 0.05 was considered to be statistically significant for a two-tailed test. Weighted Cohen's kappa coefficient was used to measure inter-rater reliability. Standard error of measurement (SEM) and 95% confidence interval for kappa coefficient were estimated. The convergent validity was analyzed with the correlation coefficient (Spearman test) between the CAS-TR and the Turkish version of MBI scales assessed at postoperative days 2 and 30.

RESULTS

The majority of the fractures were type III fracture (72.2%) according to Garden's classification. Demographic and baseline characteristics of the patients are shown in Table I. None of the patients were working actively. Mean total CAS-TR obtained in postoperative day one+day two+day three (three-day CAS) by rater 1 was 5.4, and 5.3 by rater 2, and with no systematic between rater difference (p=0.571).

Kappa value of >0.90 is considered perfect according to a study by Landis and Koch.[21] The kappa value was ≥0.90 for all one-day assessments and for the three-day CAS-TR, while the SEM ranged from 0 to 0.05 (Table II). The observed agreement ranged between 91.6% and 100% for all CASs.

TABLE I
Demographic characteristics and measurement results of patients

Variables	n	%	Mean±SD	Min-Max
Age (year)			78.1±7.9	65-90
Body mass index (kg/m²)			26.5±3.4	20-35
Gender				
Female	24	66.7		
Male	12	33.3		
Walking aid use before the fracture	12	33.3		
Fracture classification				
Garden 2	2	5.5		
Garden 3	26	72.2		
Garden 4	8	22.2		
Postoperative day 1 CAS-TR			0.9±0.9	0-3
Postoperative day 2 CAS-TR			1.9±0.8	0-4
Postoperative day 3 CAS-TR			2.6±0.9	1-5
Three-day (Day 1+2+3) CAS-TR			5.4±2.1	1-11
Postoperative day 30 CAS-TR			5.6±0.8	2-6
Postoperative day 2 Barthel score			38.1±13.9	5-55
Postoperative day 30 Barthel score			79.1±18.1	40-100

SD: Standard deviation; Min: Minimum; Max: Maximum; CAS-TR: Turkish version of the Cumulated Ambulation Score.

TABLE II
Reliability analysis of Turkish version of Cumulated Ambulation Score

	Observed agreement				
	n	%	Kappa value	95% CI	SEM
First day CAS-TR	36	100	1		0
Second day CAS-TR	33	91.6	0.90	0.802-0.99	0.05
Third day CAS-TR	36	100	1		0
Total CAS-TR	33	91.6	0.903	0.825-0.98	0.04
30th day CAS-TR	36	100	1		0

CI: Confidence interval; SEM: Standard error of measurement; CAS-TR: Turkish version of Cumulated Ambulation Score.

There were moderate positive correlations between day two and day 30 CAS-TR and Barthel scores (r= 0.334 and 0.501, respectively) (Table II). Moderate positive correlation was also found between Barthel transfer and mobility scores and CASs obtained on the 30th day (Table III).

There were significantly positive correlations between days two, three and 30 CASs (r=0.440, 0.448 and 0.404, respectively).

DISCUSSION

The CAS was adapted linguistically into Turkish and almost perfect inter-rater reliability, high agreement and acceptable validity for Turkish patients were established in the present study. The study also showed that the CAS-TR is an applicable instrument to assess basic mobility status in Turkish patients with hip fracture.

Although the fracture is surgically repaired, permanent functional disability and ambulation loss may occur in patients with hip fractures. A previous study reported that the proportion of patients living in nursing homes increased from 15% before to 30% after the hip fracture; the proportion of walking without any aid decreased from 76 to 36%; and 43% of the patients lost their pre-fracture ability to mobilize outside their own home.[22]

Assessing patients' postoperative mobility levels and determining the proper and structural rehabilitation programs can reduce hospital stay, while improving mobility can lower the disability and mortality rates.[23-25] Therefore, evaluation of mobility is important in patients with hip fracture. In the literature, there are some functional tests (Timed Up and Go, Self-Paced Walking, Berg Balance Scale) described to assess mobility after hip fracture.[26,27] However, after surgical treatment, more demanding structural functional testing may be difficult in an elderly patient population in the acute postoperative period. The patient's simple daily activities can be observed by the clinician and simple mobility assessment can provide convenience for the clinician and the patient. CAS is a simple, reliable and useful tool defined to assess the basic mobility skills of all patients with hip fracture, and until independent ambulation is reached.[9] It provides an early forecasting of rehabilitation process and hospitalization, in addition to short- and long-term mortality.[8,10,11] The CAS was widely used at

TABLE III
Correlation analysis between Turkish version of Cumulated Ambulation and Barthel scores

	Postoperative day 2			Postoperative day 30		
	Total Barthel score	Barthel transfer score	Barthel mobility score	Total Barthel score	Barthel transfer score	Barthel mobility score
Postoperative day 2 CAS-TR score						
p	0.046	NS	0.007			
r	0.334		0.443			
Postoperative day 30 CAS-TR score						
p				0.002	0.008	0.003
r				0.501	0.433	0.476

CAS-TR: Turkish version of Cumulated Ambulation Score; NS: Not significant.

the majority of Danish hospital patients with hip fracture,[28] and for more than five years included as an obligatory score in the Multidisciplinary Danish Hip Fracture Database.[10] Also, the CAS was recently included in the Irish Hip Fracture Database.

The kappa value for the CAS-TR was calculated as 1 (perfect) for postoperative days one, three and 30, and >0.90 (almost perfect) for postoperative day two and the cumulated three-day CAS-TR scores. Correspondingly, Kristensen et al.[9] reported kappa values ≥0.92 for the three individual activities described in CAS and the total one-day CAS. Grana et al.[14] estimated the kappa value for Italian version of CAS as 1 for postoperative day two (48 hours after surgery) and ≥0.95 for the CAS at the three months of follow-up.

The observed agreement ranged between 91.6% and 100% for CAS-TR. Similarly, Kirstensen et al.[9] reported ranges between 0.90% and 0.98% and Grana et al.[14] reported ranges as 97.5 to 100%. The overall almost perfect reliability and high agreement of the CAS, as confirmed in the present study, were also reported for the Spanish version of the CAS.[15]

The validity analysis showed that there is moderate positive correlation between CAS-TR and the Turkish version of modified Barthel scales assessed at postoperative days 2 and 30. Grana et al.[14] had used Katz Activities of Daily Living scale for validity analysis of Italian version of CAS. Unlike our study results, they found a strong relationship between ADL scale and CAS scale; the reason for this different result may be the differences between rating of Katz and Barthel scales. The validity of CAS has been assessed in different ways in 15 studies and high to moderate correlations were reported by authors.[27]

There were significantly positive correlations between CASs obtained at postoperative days two, three, and the three-day CASs and day 30 CAS. This indicates that early mobility scores may be a determinant for the long-term mobility function skills. Also, the Italian version of CAS showed significantly positive correlation between 48 hours after surgery and three months of follow-up.[14]

Only patients with femoral neck fractures who underwent surgery with a hemiarthroplasty were included in this study, which can be considered a limitation. However, all orthopedic and geriatric patients,[27,28] and patients undergoing any type of surgery can be assessed with the CAS for early evaluation of mobility status, and for planning of acute and post-acute rehabilitation. Also, Jønsson et al.[29] assessed physical performance of patients undergoing acute high-risk abdominal surgery using the CAS. Further, determination of the CAS for long-term mobility level could not be examined, which can be considered another limitation of this study. Still, previous studies reported that the CAS is a valid predictor of length of hospitalization, discharge home, medical complications, and associated with 30-day and long-term (postoperative one and five years) mortality rates in older patients after hip fracture surgery.[8,10,11,27]

In conclusion, the results of this study showed that the CAS-TR is a reliable and valid tool for use in Turkish patients with hip fracture. The CAS can be implemented easily in acute care settings, and considered a useful instrument to monitor the basic mobility outcome during the early recovery period. We recommend the CAS-TR to be used for the assessment of basic mobility of patients with hip fracture in Turkey until independence is reached as well as for use in other frail patient groups.

Declaration of conflicting interests

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APPENDIX 1

Turkish version of Cumulated Ambulation Score

Kümülatif Ambulasyon Skoru (CAS-TR) için Puanlama Tablosu

CAS (0-2 Puan) - Detaylar için skorlama kılavuzuna bakın.
(2) Birinin yardımı ve sözlü uyaran olmadan güvenli bir şekilde yapabiliyor.
(1) Birden fazla kişinin yardımı veya birden fazla sözlü uyaran ile yapabiliyor.
(0) Yardım ve sözlü uyarana rağmen yapamıyor (örn: Yataktan çıkamıyor)

Başvurudan önceki seviye	Tarih	…/….	…/….	…/….	…/….	…/….	…/….	…/….	…./….	Taburculuk günü
	Yataktan kalkma / yatağa yatma									
	Kolçaklı sandalyeden kalkma									
Yürüme										
	Tekerlekli yüksek yürüteç (Walker)									
	Yürüteç									
	Rolatör / 4 tekerlekli yürüteç									
	Baston / koltuk değneği									
	Yardımcı cihazsız yürüme									
Günlük CAS skoru (0-6)										
	Merdiven inip-çıkma									

1 günlük CAS skoru (0-6 puan) temel 3 aktivitenin toplam puanıdır ve belirli bir gün için en yüksek puanı belirler; yatağa yatmak-yataktan kalkmak (0-2), kolçaklı sandalyeye oturmak-sandalyeden kalkmak (0-2) ve yürüme (gerekli ise yürüme yardımcısı kullanarak) (0-2).
Ek olarak, merdiven inip çıkma da değerlendirilebilir; ancak bu temel mobilite tanımının bir parçası olmadığı için toplam skora dahil edilmez.

3 günlük CAS-skoru (0-18 puan) = Ameliyat sonrası 1. gün + 2. gün + 3. gün =……..

CAS: Cumulated Ambulation Score.

KÜMÜLATİF AMBULASYON SKORU-TÜRKÇE VERSİYONU (CAS-TR)-KILAVUZU

Turkish version of the Cumulated Ambulation Score (CAS-TR)-Manual

AÇIKLAMALAR VE UYGULAMA:

CAS;[1] bağımsız ambulasyona ulaşana kadar temel hareketlilikteki (aşağıda tanımlanan) gelişmelerin günlük değerlendirilmesinde kullanılabilecek bir puanlama sistemidir.

- Yatağa yatmak ve yataktan kalkmak
- Kolçaklı sandalyeden ayağa kalkmak ve oturmak
- Kapalı ortamda yürüyüş

Üç aktivitenin her biri 0-2 puan, günlük skor (günlük CAS) 0-6 olarak puanlanır.[2-5]

CAS'ın, rehabilitasyon süreci ve hastanede kalış süresi için erken gösterge sağlayan güvenilir ve kullanışlı bir araç olduğu kanıtlanmıştır. Bunun amaçla, ameliyat sonrası ilk üç günün toplam (kümülatif) puanı CAS 0-18'i verir (Üç günlük CAS).

- CAS 0-18 (3 günlük CAS)[1]
- Postoperatif 1-3 gün için CAS >9 olmasının, 14 gün içinde taburculuk, doğrudan eve taburculuk, majör medikal komplikasyonlar yaşanmaması ve 30 günlük sağkalım için öngösterge olduğu kanıtlanmıştır.[1]

CAS içinde yer alan 3 aktivitenin puanlaması, 2009 güvenirlik çalışmasında tanımlanmıştır.[2]

Yatağa yatma ve yataktan kalkma: **(Sırtüstü pozisyondan yatak kenarında oturmaya gelmek, yatak kenarındaki sandalyeye oturmak veya yatak kenarında ayakta durmak ve yatakta sırtüstü yatar pozisyona geri dönmek).**

- Aktivite bağımsız yapıldığında 2 puan verilir: Bağımsız olarak, güvenlik nedeniyle bile olsa, sözlü uyaran veya birinin yardımının gerekli olmadığı anlamına gelir. Tüm yürüme yardımcıları kullanılabilir.
- Birinin yardımına ihtiyaç duyulduğunda 1 puan verilir: Birinin yardımı; sözlü uyaran, bir veya daha fazla kişiden alınan kapsamlı yardıma kadar her şeyi olabilir ve yardımcı araçları içerir.
- Yataktan çıkamayan hastalar için 0 puan verilir: Bu; yardımcı araç kullanımı da dahil, bir veya daha fazla kişiden alınan kapsamlı yardıma rağmen, hastaların ayağa kalkamayacağı veya bir sandalyede oturamayacağı anlamına gelir.

Kolçaklı bir sandalyeye oturup-kalkma: (Oturmadan-kalkmaya, ayakta durmadan-oturmaya)

- Aktivite bağımsız olarak yapıldığında 2 puan verilir: Bağımsız olarak, güvenlik nedeniyle bile olsa, sözlü ipucu veya birinin yardımının gerekli olmadığı anlamına gelir.
- Birinin yardımına ihtiyaç duyulduğunda 1 puan verilir: Birinin yardımı; sözlü uyaran, bir veya daha fazla kişiden alınan kapsamlı yardıma kadar her şeyi olabilir ve yardımcı araçları içerir.
- Sandalyeye oturamayan hastalar için 0 puan verilir: Bu, yardımcı araç kullanımı da dahil, bir veya daha fazla kişiden alınan fazla miktarda yardıma rağmen sandalyede oturamayan hastaları ifade eder.

Kapalı ortamda yürüyüş:

- Bir yürüme yardımcısıyla bağımsızlık sağlandığında 2 puan verilir: Bağımsız olarak, güvenlik nedeniyle bile olsa, sözlü uyaran veya birinin yardımının gerekli olmadığı anlamına gelir. Tüm yürüme yardımcıları kullanılabilir.
- Birinin yardımına ihtiyaç duyulduğunda 1 puan verilir: Birinin yardımı; sözlü uyaran, bir veya daha fazla kişiden alınan kapsamlı yardıma kadar her şeyi olabilir ve yürüme yardımcılarını da içerir.
- Yürüyemeyen hastalar için 0 puan verilir: Bu, yürüme yardımcıları kullanımı da dahil, bir veya daha fazla kişiden alınan fazla miktarda yardıma rağmen yürüyemeyen hastaları ifade eder.

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