Translation, inter-rater reliability, agreement, and internal consistency of the Spanish version of the cumulated ambulation score in patients after hip fracture

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Translation, inter-rater reliability, agreement, and internal consistency of the Spanish version of the cumulated ambulation score in patients after hip fracture

Authors

Patrocinio Ariza-Vega.[1,2], PhD, Marta Mora-Traverso.[3], MSc, Mariana Ortiz-Piña.[4], MSc, Mauren Celeste Ashe.[5,6], PhD, Morten Tange Kristensen.[7,8], PhD.

[1]Rehabilitation and Traumatology Service, University Hospital of Granada, Granada, Spain
[2]Department of Physiotherapy, University of Granada, Granada, Spain.
[3]Department of Preventive Medicine and Public Health, University of Granada, Granada, Spain.
[4]Vista Nevada Nursing Home for older adults, Granada, Spain.
[5]The University of British Columbia, Vancouver, Canada.
[6]Centre for Hip Health and Mobility, Vancouver, Canada.
[7]Physical Medicine and Rehabilitation Research – Copenhagen (PMR-C),Copenhagen, Denmark.
[8]Departments of Physiotherapy and Orthopaedic Surgery, Copenhagen University Hospital, Hvidovre, Copenhagen, Denmark.

Corresponding Author: Patrocinio Ariza Vega, PhD. Department of Physiotherapy. University of Granada. Rehabilitation and Traumatology Service, University Hospital of Granada. Avenida de la Investigación, s/n . CP 18016. Granada. Spain. Telephone: 0034 958021596, E-mail: pariza@ugr.es

Abstract

Purpose: To translate the Cumulated Ambulation Score (CAS) into Spanish (CAS-E) and to examine the interrater reliability and agreement of the CAS-E.

Materials and Methods: Two occupational therapists, independently reviewed 60 patients consecutively admitted to a traumatology service of a public hospital with a hip fracture, and rated the three CAS activities from 0 to 2, within the first post-surgery week. We determined the internal consistency of CAS-E using Cronbach's α coefficient. To test reliability, we used weighted kappa statistics, the standard error of measurement (SEM) and the smallest real difference (SRD). We determined the systematic between-rater bias using the McNemar–Bowker test.

Results: No between-rater bias was seen, and the Cronbach's α for the CAS-E was 0.89. The weighted kappa was ≥ 0.83 for the three individual activities and the total CAS-E, while the observed agreement was ≥ 0.87. The SEM and the SRD for the total CAS-E (0-6 points) were 0.18 and 0.83 points, respectively.

Conclusions: We present the CAS for use in Spanish speaking countries and provide evidence for excellent relative and absolute reliability of the CAS-E to assess basic mobility for patients with hip fracture in an acute care hospital.

Key words: hip fracture, basic mobility, reliability, older adults, psychometric properties

Introduction

The loss of functional independence after hip fracture is widely reported in the literature [1–3], and early mobilization is recommended [4] to reduce the risk for prolonged hospital stay, morbidity [5], and mortality [5,6]. To optimize recovery post-hip fracture, rehabilitation should begin soon after surgery [4,5], and clinicians need valid and reliable measurement instruments (e.g., outcome measures, such as scales or scores) to describe and evaluate changes in patients'

function to guide rehabilitation. For real-world uptake, outcome measures must also be simple to use and quick to administer within the demands of daily clinical practice.

Outcome measures frequently used to objectively describe older adults' function after hip fracture include the Functional Independence Measure (FIM) [7], Barthel Index [8], Timed Up and Go Test (TUG) [9] or the Tinetti Performance Oriented Mobility Assessment (POMA) [10]. However, these scales are most useful for the assessment of all patients in the later phases of rehabilitation (some floor effect is seen in the acute care setting) [9,10]. The FIM is time consuming [7], the POMA cannot be used in patients with cognitive impairment [10], while the TUG prerequisite the ability to rise from a chair and walk, independent of support from another person [9]. Thus, there is a need for an efficient, easily applicable and stable outcome measure to monitor all older adults' basic function, across the mobility spectrum and continuity of care.

The Cumulated Ambulation Score (CAS) [11] is a valid and reliable outcome measure to quantify patients' ability to perform three basic mobility activities: (i) getting in and out of bed; (ii) sitting and rising from a chair (with armrests); and (iii) indoor walking (with/without walking aid) [11]. Each subcomponent of the CAS is graded out of 2 points and the total CAS score can range from 0 (dependent) to 6 (independent). The simplicity of the CAS makes it an ideal outcome to use in a busy clinical setting. Previous research recognized the CAS as valid for use with patients with hip fracture (including those with cognitive impairment) (5), total knee replacement [12,13] and older adults with an acute medical hospital admission [14,15]. Other literature observed its predictive ability for hospital length of stay and short-term (one month) post-operative mortality in patients hip with fracture [5]. In addition, the CAS can detect

differences between groups of patients in relation to anemia [16], pain [17], type of fracture [18], age [16] and the pre-fracture functional level [16,18]. Overall, the CAS is an important clinical instrument that overcomes limitations of other outcome measures and is easy to integrate within daily practice [19].

The popularity of the CAS is gaining momentum and is adopted for use in many countries [20–23]. In Denmark, the CAS is a mandatory component of the nationwide Danish Multidisciplinary Hip Fracture Database [24]. In this way, the CAS can provide population level data for future evaluation of change scores across settings (acute hospital to community). Such a versatile measure is important for clinical practice and population health. For southern Europe, the cross-cultural validity and reliability of the CAS is established in Italian [20]. Spanish is the second most common language spoken globally, but the CAS is not available in Spain, where the annual age-adjusted incidence of hip fracture in older adults (65 years and older) is 766 and 325 cases/100,000 for women and men respectively [25]. Given the high rate of hip fracture in Spain, it is important to maximize recovery, and reliable and valid outcome measures are essential to evidence-based practice. Therefore, the aim of this study was to translate the English version of the Cumulated Ambulation Score into Spanish (CAS-E), and examine the interrater reliability and agreement of the CAS-E.

Methods

Procedure

We enrolled 60 consecutive patients with hip fracture, admitted to the trauma service of the Hospital of (*blinded for peer-review)*, between January 2017 and March 2017. We included all

older adults aged 65 years and older. For patients with cognitive impairment, the informed consent was signed by their relatives. The study was approved by the ethics committee of the (*blinded for peer-review*), and all patients, or their proxy, signed a consent form before starting the study.

We extracted descriptive information from the medical chart, such as, weight and height, type of fracture and surgery. During an in-person interview (conducted between day 2 and 6 post-surgery) we collected the following sociodemographic and clinical information: age, gender, highest level of education, residence (pre-fracture and discharge), cognitive status [Short Portable Mental State Questionnaire (SPMSQ)] [26], self-perceived health (5 item Likert scale), pre-fracture functional level [Functional Independence Measure (FIM)] [7], and pain (visual analogue scale (VAS)] [27].

The Cumulated Ambulation Score (CAS)

The CAS describes three basic mobility activities: (i) getting in and out of bed (the sequence of events is as follows: patient is supine on the bed, then moves to sitting, standing or transferring to a chair next to the bed, then returns to sitting, then supine position on the bed); (ii) sit to stand to sit from a chair with armrests (with or without aids), and (iii) walking indoors (with or without walking aids) [11]. All three CAS activities are graded out of two points and they are summed to generate a total 1-day score from 0 (dependent [bed bound]) to 6 (independent). Each activity is scored with two points when verbal or physical assistance is not required (independent), even for safety reasons; 1 point is assigned when human assistance (verbal or physical assistance) is required from one or more persons; and no points are given when the patient is not able to do the

activity despite human assistance (dependent) [11]. Overall, it takes 5-10 minutes (depending on patients' mobility level) for the clinician to observe the patient complete the three activities of the CAS in the clinical setting.

Translation of the CAS

We followed the recommendations provided by Ramada-Rodilla and colleagues [28] to translate the comprehensive English version of the CAS manual [29]. Two people (unfamiliar with the CAS) independently translated it from English to Spanish using the expressions of the Spanish culture and language (to preserve the original intent of the test). A third person synthesized the new CAS from the two versions described above. This person had not read the original English version of the test.

The back translation was conducted by a fourth person who was a native English speaker. This English version was forwarded to and approved by (*author, blinded for peer-review*), one of the original CAS developers [11]. The objective in this phase was to identify possible differences, difficulties, or errors of the Spanish translation in relation to the official English version. The final version of the Spanish translation of the CAS (CAS-E) is located in supplementary data (Appendix).

Inter-rater Reliability

We followed the guide provided by Kottner and colleagues [30] to exam the inter-rater reliability. One senior dual-educated occupational and physiotherapist *(blinded for peer-review)* and one novice CAS user *(a graduate student and occupational therapist; blinded for peer-*

144 *review)* tested interrater reliability of the CAS-E. For our preliminary work, the raters first met to
145 confirm the procedures for the CAS-E. Following this the senior therapist *(blinded for peer-*
146 *review)* completed the CAS-E with 15 in-patients with hip fracture, while the novice CAS
147 *(blinded for peer-review)* observed the procedure. The following day, the two raters concurrently
148 evaluated six patients with the CAS-E (not included in the results of this study) and discussed the
149 scores. The senior therapist was previously trained by one of the creators of the CAS.
150 In brief, to assess the inter-rater reliability of the CAS-E, the raters used several procedures to
151 add strength to the procedure. First, they used a random number generator to decide the order of
152 who gave the CAS-E instructions to the patients. In this way, a rather provided the instruction to
153 30 patients and the other rather did the same to the other 30 patients. Second, raters assessed
154 patients in the same session (concurrently), but they did not discuss the ratings and recorded their
155 scores independently (a third person collected rating scores at the end of each day). Third, all
156 testing was completed before patients' usual daily rehabilitation.
157
158 *Sample size*
159 We based the sample size for the reliability testing following recommendations of Hopkins WG
160 [31], who suggest precision for reliability estimates require a minimum of 50 study patients. We
161 included 10 additional patients (total n=60) for consistency with the reliability study for the
162 original CAS [11].
163
164 *Statistical analysis*
165 We present continuous data as means (standard deviation), medians (q25, q75) or number and
166 percentages depending on the data and its distribution. We used the Shapiro-Wilk Test for

examination of normal distribution of continuous data, and Chi-square or Fisher's Exact test to explore differences for categorical data. We used Cronbach's α coefficient [32] to test for internal consistency between raters. To calculate the inter-rater reliability (for individual activities and the total CAS-E) we used a linear weighted kappa and 95% confidence interval [33] for ordinal scales. We calculated the observed (exact) agreement between raters and the prevalence of scores 0–2 for the three activities and assessed systematic between-rater bias using the McNemar-Bowker test. We provide a Bland-Altman plot to illustrate differences between raters' scores. We use the Standard Error of Measurement (SEM) to report the absolute reliability at group level based on the standard deviation (SD) of patient scores for both raters and the Intraclass Correlation Coefficient ($ICC_{2.1}$), and calculated as SEM = SD x √(1-ICC) (34). To calculate the smallest real difference (SRD; smallest measurement change that can be interpreted as a real change for an individual person) we used the following equation; SRD = SEM x √2 x 1.96 [35]. We used IBM SPSS Statistics Version 20.0 (IBM Corp., Armonk, New York) and set the level of significance at $P<0.05$.

Results

We provide sociodemographic and clinical data for all patients in Table 1. It took 48 days for the two raters to complete the CAS-E on the 60 consecutive in-patients with hip fracture, who were evaluated between day 2 and 6 post-surgery.

[Table 1 near here]

Translation: There were few challenges translating the English version of the CAS into Spanish (CAS-E), and there were only two ambiguities resulting from semantic and/or idiomatic peculiarities of the English and Spanish. They included: i) "... to sitting in chair placed beside the bed....." and ii) categories of score "... from one or more people".

Internal Consistency: The Cronbach's α for the CAS-E between raters was 0.89.

Inter-rater reliability: The weighted kappa was ≥ 0.83 for the three individual activities and the total CAS, while the observed agreement ranged from 0.87 (total CAS) to 0.97 (getting in and out of bed) as shown in Table 2. The ICC for the total CAS was 0.97. The SEM and the SRD for the total CAS (0-6) were 0.30 and 0.83 CAS-E points respectively, while the corresponding values for the three activities ranged from 0.13 to 0.18 (SEM) and from 0.36-0.50 (SRD), respectively (Table 2).The scores by the two raters differed in eight of the 60 patients but the difference was only 1 point, except for 2 points in one patient, and with no systematic between-rater bias ($p > 0.14$) for the three individual activities or the total CAS-E, as illustrated in the Bland-Altman plot (Figure 1). No significant differences were found between the eight patients with score differences and patients with equal scores in any of the patient's characteristics shown in Table 1 ($p > 0.07$).

[Table 2 near here]

[Figure 1 near here]

Discussion

This study provides a translated version of the CAS into the Spanish language following the guideline of Ramada and Rodilla [28] and shows the excellent reliability of the CAS-E. The CAS-E makes an important contribution to the clinical community given the high number of people who speak Spanish, and specifically for the number of older adults who fracture their hip each year in Spain.

We report a very high concordance between therapists for total score and three sub-components of the CAS-E [34]; in accordance with previous studies conducted in Denmark [11] and Italy [20]. We further established inter-rater agreement between clinicians with different years of experience. Although the observed inter-rater agreement for the CAS-E (0.83) was lower than the original CAS study [11] and the recent Italian version (CAS-I) [20], it was higher than the cut-point of 0.80 suggested by Sim and Wright [33]. To date, the cultural adaptation of the CAS has exhibited high reliability for the following health professional groups (regardless of clinical experience): physiotherapists [11], and occupational therapists with the present study. The significance of this finding is that it highlights the versatility of administering and monitoring recovery with the CAS. Ultimately, this should improve clinical care by the inclusion of the CAS in the assessment protocols of the patients with hip fracture, to provide day-to-day information about progress in basic mobility during hospitalization, and potentially to monitor the level of pre-fracture mobility recovery at the time of acute hospital discharge, corresponding to the use in the nationwide Danish Multidisciplinary Hip Fracture Database [24].

The internal consistency of the CAS-E, was good (>0.70) [32], and with all SEM and SRD values below 1 point as in previous studies [11,20]. This illustrates the ability of CAS-E to detect small changes in basic mobility for patients with hip fracture. Hip fracture can present some challenges for older adults, but if therapists can provide evidence of even small changes in their recovery process, it may support their motivation to continue with therapy [36]. Psychosocial factors are an important part of the recovery process [37–40]. Moreover, clinicians need fast and reliable tools, such as the CAS, to assess the efficacy of the rehabilitation treatments and to register small changes of patients' function. The CAS has been used in previous studies showing significant differences at group level in basic mobility related to anemia [16] and hip pain [17]. This type of information could be useful for physicians to considerer whether a patient is having a setback during the recovery process (measured by the CAS), may be due to anemia or poorly controlled pain.

Strength of this study is that we included all patients independent of e.g. their residential status and fracture type, to address the heterogeneity of the population who fracture their hip [41]. Second, we used robust methods to perform the study; the raters conducted their ratings concurrently for all three activities of the CAS-E, but blinded to each other's rating until end of study, and both raters gave the instructions to the patients (with delivery of instructions randomly assigned). However, we also note some limitations. It was only conducted at one site, and we did not follow-up with patients after hospital discharge, as in the validation of the CAS-I where patients were followed for three months after surgery [20]. However, as the main function of the CAS is to characterize basic mobility early in the recovery period until independence is reached, our goal was only to determine the stability of the CAS-E in the acute care setting.

Conclusions

In summary, the CAS-E is a reliable and stable outcome measure to assess the basic mobility status of patients with hip fracture. It is a highly valuable instrument that can be integrated into clinical practice to monitor and progress older adults' function after hip fracture. This study provides support for its application for hospitals in Spain and probably also for use in other Spanish speaking countries.

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Declaration of interest statement

The authors report no conflicts of interest.

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Appendix. Spanish version of the Cumulated Ambulation Score (CAS-E).

Escala de Movilidad Acumulada (CAS-E)

Actividad	Capaz de hacerlo independientemente (Sin guía verbal ni ayuda física), 2 puntos	Capaz de hacerlo con guía verbal o ayuda física de una o varias personas, 1 puntos	Incapaz de hacerlo incluso con ayuda de otras personas, 0 puntos
Levantarse de la cama y acostarse			
Levantarse y sentarse en una silla			
Caminar dentro de casa con o sin ayuda técnica			
Puntuación Total:			

Levantarse de la cama y acostarse; (De supino en cama a sentarse en el borde de la cama, permanecer sentado o sentarse en una silla junto a la cama, y volver a la posición de supino en cama).

Se asignan 2 puntos cuando la actividad se desarrolla independientemente. Independientemente significa que no es necesaria guía verbal ni ayuda física de una persona, incluso por razones de seguridad. Los pacientes pueden usar ayudas técnicas.

Se asigna 1 punto cuando se requiere ayuda de una persona. La ayuda de otra persona puede ser desde cualquier indicación verbal hasta la ayuda física por parte de una o varias personas. Los pacientes pueden usar ayudas técnicas.

Se asignan 0 puntos si los pacientes no son capaces de levantarse de la cama. Esto significa que los pacientes no pueden levantarse de la cama y sentarse en una silla incluso con la ayuda de una o varias personas. Los pacientes pueden usar ayudas técnicas.

Levantarse y sentarse en una silla con reposabrazos; (Levantarse, permanecer de pie y sentarse).

Se asignan 2 puntos cuando la actividad se desarrolla independientemente. Independientemente significa que no es necesaria guía verbal ni ayuda física de una persona, incluso por razones de seguridad. Los pacientes pueden usar ayudas técnicas.

Se asigna 1 punto cuando se requiere ayuda de una persona. La ayuda de otra persona puede ser desde cualquier indicación verbal hasta la ayuda física por parte de una o varias personas. Los pacientes pueden usar ayudas técnicas.

Se asignan 0 puntos si los pacientes no son capaces de levantarse de la silla. Esto significa que los pacientes no pueden levantarse y sentarse en una silla incluso con la ayuda de una o varias personas. Los pacientes pueden usar ayudas técnicas.

Caminar dentro de casa

Se asignan 2 puntos cuando se consigue caminar independientemente usando una ayuda técnica. Independientemente significa que no es necesaria guía verbal ni ayuda física de una persona, incluso por razones de seguridad. Los pacientes pueden usar ayudas técnicas.

Se asigna 1 punto cuando se requiere ayuda de una persona. La ayuda de otra persona puede ser desde cualquier indicación verbal hasta la ayuda física por parte de una o varias personas. Los pacientes pueden usar ayudas técnicas.

Se asignan 0 puntos a aquellos pacientes que no son capaces de caminar. Esto hace referencia a aquellos pacientes que no son capaces de caminar incluso siendo ayudados por una o varias personas al mismo tiempo que usan una ayuda técnica para caminar.

La puntuación total es de 0 a 6 puntos. Cada una de las tres actividades tiene una puntuación entre 0 y 2 puntos.

447 **Tables**

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Table 1. Characteristics of patients (N=60). Values are presented as median (q25-q75); number of patients (%) and mean (standard deviation) [minimum-maximum] depending on the variable.

Age, y mean (SD); min-max	81.6 (6.8); 64-96
Gender	
Women	46 (77)
Men	14 (23)
Body Mass Index, (BMI) kg/m^2	
Underweight, BMI < 18.5	1 (2)
Normal, BMI =18.5-24.9	18 (30)
Overweight, BMI $\geq$ 25	41 (68)
Highest level of Education, n (%)	
Cannot read and write	16 (27)
Can read and write	25 (42)
Primary school	13 (22)
High School	3 (5)
College (University)	3 (5)
Type of fracture	
Intracapsular	40 (67)
Extracapsular	20 (33)
Type of Surgery	

Dynamic Hip Screw / Intra Medullar Hip Screw	32 (53)
Hemiarthroplasty	28 (47)
Cognitive Status	
No cognitive impairment	27 (45)
Mild cognitive impairment	14 (23)
Moderate cognitive impairment	10 (17)
Severe cognitive impairment	9 (15)
Self-perceived health	
Very good	1 (2)
Good	21(35)
Average	23 (38)
Bad	12 (20)
Very bad	3 (5)
Pre-fracture Functional Level (measured by FIM) Median (q25-q75)	102 (79-124)
Pain during activity (measured by VAS), mean (SD)	5.15 (2.41)
Pre-fracture residence	
Home, lives alone	17 (28)
Home, lives with someone	28 (47)
Relative´s home	9 (15)
Nursing home	6 (10)
Discharge destination	
Home, lives alone	4 (7)

Home, lives with someone	30 (50)
Relative´s home	18 (30)
Nursing home	8 (13)
Total CAS-E, mean (SD); min-max	
novice therapist	3.32 (1.86); 0-6
senior therapist	3.30 (1.91); 0-6

CAS-E. Cumulated Ambulation Score-Spanish version; FIM. Functional Independence Scale; VAS. Visual Analogue Scale

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Table 2. Relative and absolute reliability of the Cumulated Ambulation Score (CAS) between an experienced and inexperienced occupational therapist core user in patients with hip fracture (n=60).

Activity (score)	Weighted kappa value (95% CI)	Observed agreement n (%)	Prevalence in % of CAS score 0-2			SEM	SRD
			0	1	2		
Getting in and out of bed (0-2)	0.94 (0.86-1.0)	58 (96.7)	13	60	27	0.13	0.36
Sit-to-stand-to-sit from a chair (0-2)	0.94 (0.87-1.0)	58 (96.7)	17	53	30	0.13	0.36
Walking with an aid, indoor (0-2)	0.90 (0.80-1.0)	56 (93.4)	27	43	30	0.18	0.50
Total CAS (0-6)	0.83 (0.73-0.94)	52 (86.8)	n/a	n/a	n/a	0.30	0.83

SEM. Standard Error of Measurement; SRD. Smallest Real Difference

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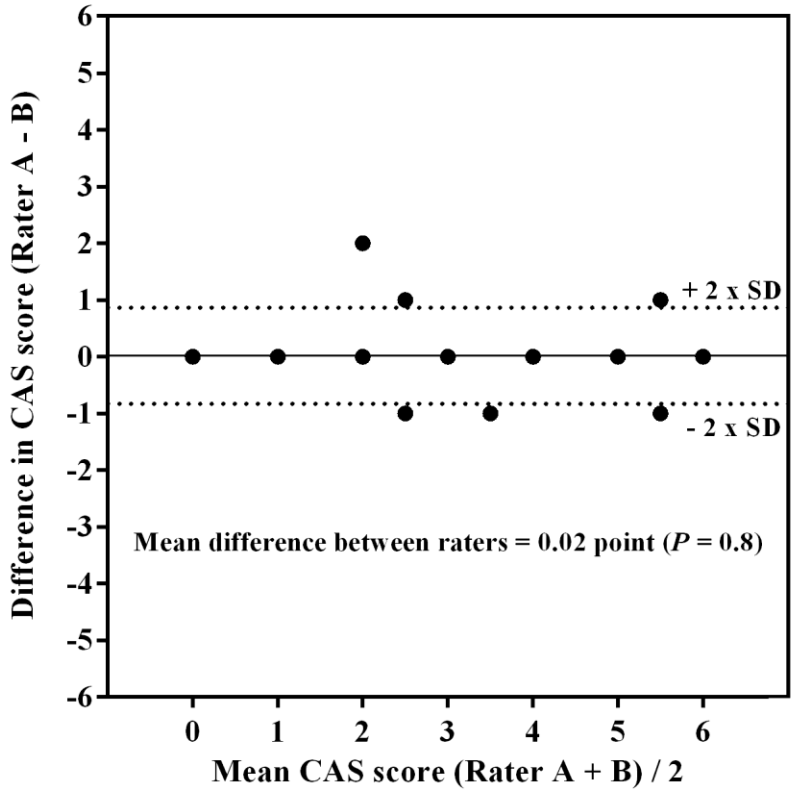

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455 **Figure 1.** Bland-Altman plot between a novice (rater A) and senior (rater B) occupational
456 therapists scores for the Spanish version of the Cumulated Ambulation Score (CAS-E).

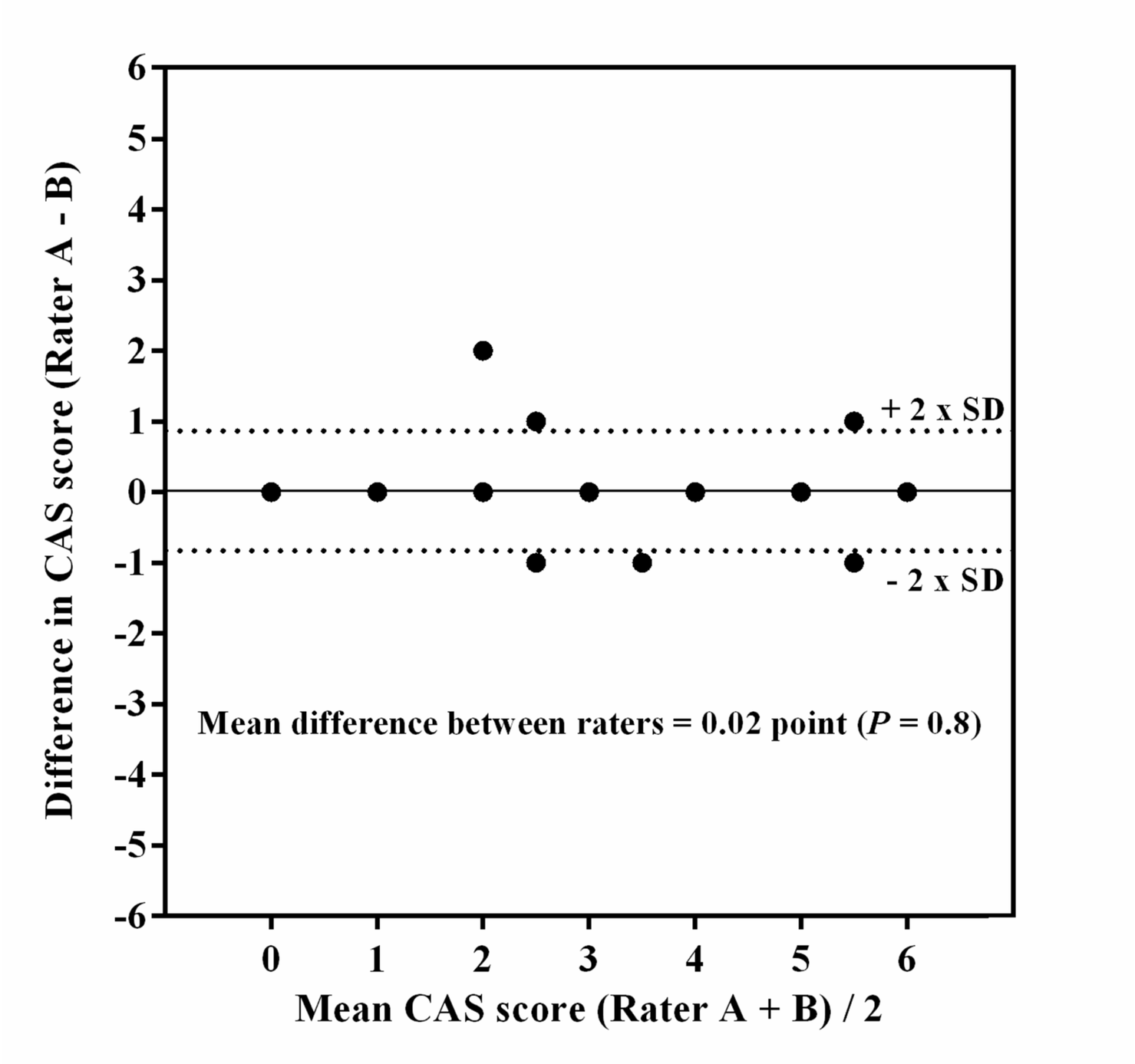

Figure 1. Bland-Altman plot between a novice (rater A) and senior (rater B) occupational therapists scores for the Spanish version of the Cumulated Ambulation Score (CAS-E).

Implications for Rehabilitation

•The Spanish version of the Cumulated Ambulation Score, the CAS-E is a reliable outcome measure to assess basic mobility of patients with hip fracture.

•The CAS-E is useful to indicate small changes in basic mobility of patients with hip fracture until an independent level is reached.

•The CAS-E can be used with a high reliability by experienced and inexperienced physiotherapists or occupational therapists.