

Original Article

Translation, Cross-Cultural Adaptation, Reproducibility, and Validation: Brazilian Version of the Olerud-Molander Ankle Score (OMAS-BrP)

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Abstract

Objective: The aim of this study was to perform the translation and cultural adaptation of the Olerud-Molander Ankle Score (OMAS) in Brazilian Portuguese, in addition to determining its validity and reliability.

Method: This was a cross-sectional case-series study. The translation and adaptation processes were conducted in 5 stages: initial translation (2 bilingual Brazilians); synthesis of translations; back translation (2 bilingual Brazilians not involved in the first part of the study); consensus version and assessment (technical committee); and testing phase. The test-retest reliability and construct validity of the Brazilian Portuguese version of the OMAS (OMAS-BrP) were evaluated in a sample of 40 participants. Construct validity was determined based on the correlations of the OMAS-BrP to the Foot Function Index (FFI) and Short-Form 12 (SF-12).

Results: The OMAS-BrP had excellent test-retest reliability (ICC=0.99). The OMAS-BrP showed moderate and weak correlations with the SF-12 PCS and SF-12 MCS ($r=0.68$ and $p<0.001$; $r=0.38$ and $p=0.014$, respectively). The correlation coefficient between the OMAS-BrP and the FFI was graded as excellent ($r=0.846$ and $p<0.001$). There was a strong correlation between the OMAS-BrP, the SF-12 PCS, and the FFI.

Conclusion: The OMAS-BrP is a valid and reliable questionnaire, with psychometric parameters that are similar to those of its original version and other cross-cultural adaptations. The OMAS-BrP is a useful patient-reported outcome (PRO) measure to evaluate Brazilian Portuguese-speaking patients with ankle fractures.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Ankle fractures/classification; Reproducibility of results; Surveys and questionnaires; Translations; Outcome assessment, health care/methods; Cross-sectional studies.

Introduction

Ankle fractures are common injuries in orthopedic practice. In recent years, their incidence has reached 101-174 fractures per 100,000 person-years^(1,2), and the most frequently affected individuals are young men, and women aged 50 years or older⁽³⁻⁵⁾. In older adults, the ankle is the third most common fracture site after the hip and wrist⁽³⁾.

Given the impact of ankle fractures on overall health and quality of life, health care professionals have paid increasing attention to the analysis of postoperative outcomes from the

patient's perspective⁽⁶⁾. According to the International Classification of Functioning, Disability, and Health (ICF), the assessment of impairment, disability, and quality of life should be based on the patients' perception⁽⁷⁾. This can be achieved using self-report questionnaires and similar instruments.

Several measures of functioning and quality of life after foot and ankle injuries have been developed and validated for use in Portuguese, such as the Foot and Ankle Outcome Score (FAOS)⁽⁸⁾, the Foot Function Index (FFI)⁽⁹⁾, and the Short-Form 12 (SF-12)⁽¹⁰⁾. However, these are general questionnaires and do not evaluate a specific type of injury.

Study performed at the Hospital Mater Dei, Belo Horizonte, MG, Brazil

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In 1984, the Olerud-Molander Ankle Score (OMAS) was developed specifically to evaluate functioning after ankle fractures⁽¹¹⁾. The questionnaire was originally written in English⁽¹²⁾ and was later translated to Turkish⁽¹¹⁾ and Swedish⁽¹³⁾. A literature review did not identify any reports of the translation and/or validation of this instrument to Brazilian Portuguese.

To facilitate cross-cultural comparisons, it is crucial to adapt this instrument to the Brazilian population and establish its equivalence to the original instrument^(9,14). This will include adjusting the OMAS to a different language, population, culture, and setting. Evaluations of validity, reproducibility, and sensitivity to change are also important in determining that the new version of the instrument has retained the characteristics of the original⁽⁹⁾.

The aim of this study was to perform the translation and cultural adaptation of the OMAS Brazilian Portuguese, in addition to determining its validity and reliability.

Method

Study Design

This cross-sectional study was approved by the Institutional Review Board and registered on the Plataforma Brasil database under CAAE (Ethics Evaluation Submission Certificate) number: 00789318.6.0000.5128.

Translation and Cross-cultural Adaptation

The OMAS is a patient-reported outcome (PRO) measure designed specifically for individuals with ankle fractures. The instrument contains 9 questions, each with a different maximum score, allowing for the assessment of the following domains: pain (25 points), stiffness (10 points), edema (10 points), stair climbing (10 points), running (5 points), jumping (5 points), squatting (5 points), support (10 points), and work/activity level (20 points). The total sum of scores across all items can then be classified as poor (0 to 30); reasonable (31 to 60); good (61 to 90) and excellent (91 to 100)⁽¹²⁾. This instrument has been validated based on a Linear Analog Scale ($p < 0.01$), range of motion in dorsal extension ($p < 0.05$), presence of osteoarthritis grade II-IV ($p < 0.001$), and presence of dislocations on radiographs ($p < 0.05$) after ankle fractures⁽¹⁾.

The OMAS was translated and adapted through the following 5-stage process, as proposed by Guillemin, Bombardier, and Beaton⁽¹⁵⁾: initial translation (2 bilingual Brazilians); synthesis of translations; back translation (2 bilingual Brazilians not involved in the first part of the study); consensus version and assessment (technical committee); and testing phase.

In the first stage, the OMAS was translated to Brazilian Portuguese by 2 bilingual Brazilian translators who produced versions T1 and T2 of the instrument. Neither individual was familiar with the content of the questionnaire. In the second stage, a committee formed by the authors of this study analyzed the two translations and combined them into a single version referred to as T1-2. In the third stage, version T1-2 was

sent to two additional translators, who were also Brazilian and proficient in English, for back-translation. The resulting versions of the questionnaire were named BT1 and BT2. The translators were unfamiliar with the original questionnaire. The comparison of the back translation to the original scale allowed us to identify any grammatical inconsistencies or translation errors in the instrument. In stage four, the committee met once again to discuss the back translations and consolidate them into a single version of the questionnaire. We also evaluated semantic and conceptual equivalence, word meanings, colloquialisms, and the similarity of daily activities across countries. This process resulted in the final version of the questionnaire, referred to as BT12. This instrument was then administered to a pilot sample of 50 patients to verify the comprehensibility and acceptability of questions and answers. Any difficulties in the comprehension or interpretation of the questionnaire were noted for subsequent adjustment. Once these issues were addressed, the questionnaire was administered to 40 patients who had ankle fractures between 2018 and 2019.

Reliability (Test-retest reproducibility)

Test-retest reliability is the ability of an instrument to deliver the same results when administered more than once to the same participant.

Intra-rater reliability is evaluated by readministering a questionnaire within 7 days of an initial assessment^(6,16). Patients were asked to perform their daily activities as usual between the two evaluations. The coefficient of Intra-Class Correlation (ICC) type 2,1 was used to determine the reproducibility of the OMAS. These values were classified as follows: 1- Low reproducibility for values below 0.40; 2 - Good reproducibility for values between 0.40 and 0.75; 3- Excellent reproducibility for values greater than 0.75⁽¹⁴⁾.

We also calculated the standard error of measurement (SEM) and minimal detectable change (MDC). The SEM and MDC were calculated as follows: $SEM = s\sqrt{1 - ICC}$ (where s is the standard deviation at baseline)⁽¹⁴⁾ and $MDC = 1.96 \times \sqrt{2} \times SEM$, respectively^(14,17). The SEM reflects the precision of the instrument and the MDC is the smallest difference in scores that could be interpreted as a "real" change beyond measurement error, with $p < 0.05$.

Validity

Construct validity is the extent to which an instrument is able to measure an abstract concept. In this study, the ability of the OMAS-BrP to evaluate functional disability was assessed based on its Pearson correlation with the SF-12 and FFI questionnaires.

The SF-12 was developed and validated as a shorter and faster version of the 36-item Short-Form Health Survey (SF-36)⁽¹⁸⁾. It evaluates health-related quality of life and was translated to Brazilian Portuguese in 1999⁽¹⁵⁾ and validated in 2004⁽¹⁰⁾. It is a brief and understandable questionnaire used to monitor health outcomes in general and specific populations⁽¹⁰⁾. The

questionnaire yields a physical (PCS) and a mental component score (MCS) based on an algorithm developed specifically for the SF-12⁽¹¹⁾.

The FFI is a 23-item instrument developed in the English language in 1991⁽⁹⁾ to evaluate the functional impact of foot and ankle disorders in terms of pain, disability, and activity restrictions. It was translated and adapted to Brazilian Portuguese in 2015⁽⁹⁾ and validated for use in the local population in 2016⁽⁶⁾. It has excellent ICC values⁽¹⁹⁾.

Construct validity was evaluated using the Pearson correlation coefficient and a 95% confidence interval determined by bootstrapping. The Pearson correlation coefficient was interpreted as follows: values of 0.00 to 0.25 indicate little to no correlation; values of 0.25 to 0.50 indicate a weak correlation; values of 0.50 to 0.75 suggest a moderate correlation, while values of 0.75 or more indicate a strong correlation⁽¹⁴⁾.

Sample characteristics were summarized using mean (range) for age, median (interquartile range) for time since surgery, and frequency for gender and side of injury. The mean and standard deviation, as well as the median and interquartile range, were also calculated for OMAS-BrP scores. A sample of 35 patients was required to detect an ICC of 0.85 that was significantly greater than 0.60 at a 5% significance level with a power of 80%. This was calculated using the `calculateICC-SampleSize` function in the `ICC.Sample.Size` package of the R software. Based on an expected ICC of 0.85, two measurements were obtained for each of 40 patients on two separate days, with the minimum acceptable ICC of 0.7, indicating moderate reliability. Paired Wilcoxon tests were used to compare test and retest scores. Independent t-tests and chi-square tests were used to compare age, sex, and OMAS variables between groups. IBM SPSS (IBM Corporation, Somers, NY) version 18.0 was used for all statistical analyses.

Results

Sample characteristics

The questionnaires were administered to 40 patients who had received surgical treatment for ankle fractures. Half of participants were male (n=20). The mean age of patients was 50.2 years, and at least 50% were 51 years or younger. Participants were followed for a mean of 2 years, and 52.5% had fractures of the right ankle. The most prevalent fractures in the sample were supination-external rotation stage 4 (SER-4) fractures, as categorized by Lauge-Hansen⁽²⁰⁾ (Table 1).

The OMAS-BrP had a mean value of approximately 83 and there were no significant differences between the first and second assessments (p=0.149). Mean scores on the SF-12 and FFI were 50.5 and 7, respectively (Table 2).

A better classification on the OMAS-BrP was associated with higher scores on the SF-12, and differences between OMAS-BrP score groups were only observed on the PCS. The FFI also differed significantly between groups, with higher categories of the OMAS-BrP displaying lower FFI values. Age was not associated with scores on the OMAS-BrP, as mean age did not significantly differ between score levels (Table 3).

Table 1. Description of the variables gender, side and type of fracture, time, and age

Gender	
Male	50% (n=20)
Female	50% (n=20)
Side	
Right	52.5% (n=21)
Left	47.5% (n=19)
Type of fracture	
PABD-2	5.0% (n=2)
PABD-3	5.0% (n=2)
PER-4	5.0% (n=2)
SAD-1	2.5% (n=1)
SER-2	27.5% (n=11)
SER-3	15% (n=6)
SER-4	40% (n=16)
Mean duration of follow-up (months)	23.9 ± 9.0 (SD)
Mean age (years)	50.2 ± 13.9 (SD)

ABD: pronation-abduction; PER: pronation-external rotation; SAD: supination-adduction; SER: supination-external rotation; SD: standard deviation.

Table 2. Description of scores on the OMAS-BrP, SF-12, and FFI

Variables	N	Mean ± SD
OMAS-BrP Questionnaire 1	40	83.1 ± 18.0
OMAS-BrP Questionnaire 2	40	83.5 ± 17.7
SF-12 PCS	40	50.5 ± 7.7
SF-12 MCS	40	50.7 ± 6.3
FFI	40	7.0 ± 11.8

SD: standard deviation; OMAS-BrP: Brazilian Portuguese version of the Olerud-Molander Ankle Score; SF-12: Short-Form 12; PCS: physical component score; MCS: mental component score; FFI: Foot Function Index.

Table 3. Description of SF-12 and FFI scores, and age between categories of the OMAS-BrP

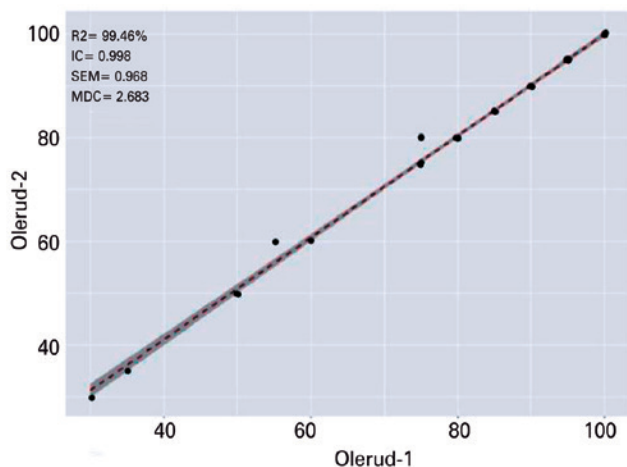
Variables	OMAS-BrP	N	Mean	SE	p-value ¹
SF-12 PCS	Excellent	17	54.5	0.5	0.004
	Good	17	51.1	1.5	
	Reasonable	5	35.6	3.3	
	Poor	1	46.00	-	
SF-12 MCS	Excellent	17	57.1	1.1	0.074
	Good	17	54.2	1.7	
	Reasonable	5	49.5	3.3	
	Poor	1	55.9	-	
FFI	Excellent	17	1.0	0.3	0.000
	Good	17	4.8	1.2	
	Reasonable	5	29.3	7.3	
	Poor	1	33.3	-	
Age	Excellent	17	50.1	4.00	0.448
	Good	17	48.1	2.6	
	Reasonable	5	53.2	5.9	
	Poor	1	72.0	-	

SE: standard error; OMAS-BrP: Brazilian Portuguese version of the Olerud-Molander Ankle Score; SF-12: Short-Form 12; PCS: physical component score; MCS: mental component score; FFI: Foot Function Index; ¹Kruskal-Wallis test.

Reliability and Reproducibility

A strong correlation was observed between scores on both applications of the OMAS-BrP. The ICC (2, K) was 0.99 (0.997-0.999) which indicates excellent reproducibility. We also calculated SEM and MDC values. The SEM contributes to the assessment of the reliability of the sample mean, with lower SEM values indicating greater precision. The SEM of the OMAS-BrP in this study was 0.95, which indicates adequate precision. The MDC refers to the minimum difference between test and retest scores that would indicate a significant difference at a 95% confidence level⁽²¹⁾. The MDC in this study was approximately 2.68, showing that a small difference between two test scores would be sufficient to indicate real change, which is a highly positive finding (Figure 1).

Wilcoxon's test did not reveal statistically significant differences between test and retest scores (p-value=0.149) (Table 4).



*IC: intraclass correlation coefficient; SEM: Standard error of measurement; MDC: Minimal detectable change.

Figure 1. Test-retest reliability of the OMAS-BrP.

Table 4. Wilcoxon's test for test-retest comparisons

	N	Mean	SD	p-value ¹
OMAS-BrP Questionnaire 1	40	83.1	18.0	0.149
OMAS-BrP Questionnaire 2	40	83.5	17.7	

OMAS-BrP: Brazilian Portuguese Version of the Olerud-Molander Ankle Score; SD: standard deviation; ¹Wilcoxon's test.

Table 5. Correlation between the OMAS-BrP and the FFI, SF-12 PCS, and SF-12 MCS

OMAS-BrP	FFI	SF-12 PCS	SF-12 MCS
r	-0.84	0.68	0.38
p	0.001	0.001	0.014

OMAS-BrP: Brazilian Portuguese version of the Olerud-Molander Ankle Score; SF-12: Short-Form 12; PCS: physical component score; MCS: mental component score; FFI: Foot Function Index.

Validity

Construct validity was analyzed using Pearson correlation coefficients. The OMAS-BrP had an excellent correlation with the FFI (r=-0.84 and p<0.001) and a moderate correlation with the SF-12 PCS (r=0.68 and p<0.001). These questionnaires evaluate physical function and the OMAS-BrP was strongly related to both. At the same time, the instrument had a low correlation with the SF-12 MCS, which evaluates mental health (r=0.38, p=0.014) (Table 5).

Discussion

The present study found that the OMAS-BrP had a strong correlation with both the FFI and SF-12 PCS (r=0.84, p<0.001; r=0.68, p<0.001, respectively), demonstrating its applicability to the assessment of functional capacity after treatment for ankle fractures. Furthermore, the instrument showed high reproducibility (ICC=0.99) with a strong correlation between the scores obtained in two administrations of the test to the same sample.

For several years, the OMAS has been used by researchers to assess the results of treatment for ankle fractures^(11,12). Its questions are easy to understand and its items are related to everyday activities⁽¹¹⁾. Joint stiffness is an important factor to be considered after surgical or conservative treatment for ankle fractures. Pain when walking on different surfaces is a major cause of functional disability in patients with ankle fractures. These items are directly addressed in the OMAS⁽¹¹⁾. During the adaptation of the OMAS to Brazilian Portuguese, the questions in the instrument were not significantly changed. Patients were able to understand all items and functional activities listed.

The test-retest reproducibility of an instrument refers to its ability to yield similar results when administered more than once to the same participant, thereby demonstrating consistency over time. It is one of the main indicators of instrument quality, as it reflects the instrument's stability, consistency, and precision. Internal consistency indicates that all items in an instrument measure the same construct. This is a crucial psychometric property since it demonstrates that the instrument is consistently assessing the same characteristic⁽²²⁾. The internal consistency of the OMAS-BrP was high, with values similar to those reported for the Turkish and Swedish adaptations of the instrument (0.84 and 0.76, respectively). The test-retest reproducibility of the OMAS-BrP was excellent (ICC=0.99), with values similar to those obtained in the Turkish and Swedish validation studies (ICC=0.98 and 0.94, respectively)^(11,13). The MDC in this study was 2.68, showing that real changes in the underlying construct will be demonstrated by differences of at least this magnitude between administrations of the OMAS-BrP. This value is much lower than that found in the Turkish and Swedish versions of the instrument (12,00 and 9,10 respectively)^(11,13).

The validity of the OMAS-BrP was evaluated based on its relation to the FFI and SF-12 (MCS and PCS scores). The correlation coefficient between the OMAS-BrP and the FFI was

graded as excellent ($r=0.84$ and $p<0.001$). The FFI is one of the four most frequently used instruments for the functional assessment of the foot and ankle, and its reliability is extremely high. It has been translated and validated in Brazilian Portuguese, with excellent intra- and inter-rater reliability ($ICC=0.99-0.97$) and a high ICC⁽⁶⁾. These findings served as the basis for our selection of the FFI as a comparative measure in the present study.

The correlation between the OMAS-BrP and the SF-12-PCS, which measures the physical component of the questionnaire, was moderate ($r=0.68$ and $p<0.001$), and similar to the corresponding value in the Turkish validation study ($r=0.72$ and $p<0.001$)⁽¹¹⁾. With regard to the SF-12 MCS, which evaluates aspects of mental health, the correlation was weak ($r=0.38$ and $p=0.014$).

The Turkish study used the SF-12 and the Foot and Ankle Ability Measure (FAAM)⁽¹¹⁾ to validate the OMAS, while the Swedish study used the Foot and Ankle Outcome Score (FAOS)⁽¹³⁾.

The present study was the first to perform the translation and cross-cultural adaptation of the OMAS to Brazilian Portuguese. The resulting instrument had excellent reproducibility and validity and was tested in an adequate sample. Its performance was also compared to that of the FFI, a PRO measure with excellent reliability and ICC values.

This study had some limitations. First, the OMAS-BrP was only administered to patients who received surgical treatment for ankle fractures. The fact that only two cross-cultural adaptations of the OMAS have been performed to date (Turkish and Swedish)^(11,13) limits our ability to compare findings with similar studies in the literature.


In future studies, the questionnaire could be used in patients who received non-surgical treatment. As new versions of the OMAS are published and validated in other languages, a more comprehensive comparison of their similarities and differences can be performed.

Conclusion

The OMAS-BrP is a valid and reliable questionnaire, with psychometric parameters that are similar to those of its original version and other cross-cultural adaptations. It is easy to administer and interpret and takes minutes to be read and answered. Therefore, the OMAS-BrP is a useful PRO measure to evaluate the outcome of ankle fractures in Brazilian Portuguese speakers.

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References

1. Nilsson GM, Eneroth M, Ekdahl CS. The Swedish version of OMAS is a reliable and valid outcome measure for patients with ankle fractures. *BMC Musculoskelet Disord*. 2013;14:109.
2. Chien BY, Stupay KL, Miller CP, Smith JT, Briceno J, Kwon JY. Does the quality of preoperative closed reduction of displaced ankle fractures affect wound complications after surgical fixation? *Injury*. 2018;49(10):1931-1935.
3. Al-Nammari SS, Dawson-Bowling S, Amin A, Nielsen D. Fragility fractures of the ankle in the frail elderly patient: treatment with a long calcaneotalibial nail. *Bone Joint J*. 2014;96(6):817-22.
4. Court-Brown CM, McBirnie J, Wilson G. Adult ankle fractures-an increasing problem? *Acta Orthop Scand*. 1998;69(1):43-7.
5. Ebraheim NA, Vander Maten JW, Delaney JR, White E, Hanna M, Liu J. Cannulated intramedullary screw fixation of distal fibular fractures. *Foot Ankle Spec*. 2019;12(3):264-71.
6. Martinez BR, Staboli IM, Kamonseki DH, Budiman-Mak E, Yi LC. Validity and reliability of the Foot Function Index (FFI) questionnaire Brazilian-Portuguese version. *Springerplus*. 2016; 5(1):1810.
7. World Health Organization (WHO). *The International Classification of Functioning, Disability and Health*: 2001. Geneva; 2001.
8. Imoto AM, Peccin MS, Rodrigues R, Mizusaki JM. Translation, cultural adaptation and validation of foot and ankle outcome score (FAOS) questionnaire into portuguese. *Acta Ortop Bras*. 2009;17(4):232-5.
9. Yi LC, Staboli IM, Kamonseki DH, Budiman-Mak E, Arie EK. Translation and cross-cultural adaptation of FFI to Brazilian Portuguese version: FFI - Brazil. *Rev Bras Reumatol*. 2015; 55(5):398-405.

10. Camalier AS. SF-12 health related quality of life in COPD patients: a population-based study in Sao Paulo-SP (thesis). Sao Paulo: Universidade Federal de Sao Paulo (UNIFESP); 2004.
11. Turhan E, Demirel M, Daylak A, Huri G, Doral MN, Çelik D. Translation, cross-cultural adaptation, reliability and validity of the Turkish version of the Olerud-Molander Ankle Score (OMAS). *Acta Orthop Traumatol Turc.* 2017;51(1):60-64.
12. Olerud C, Molander H. A scoring scale for symptom evaluation after ankle fracture. *Arch Orthop Trauma Surg.* 1984;103(3):190-4.
13. Nilsson GM, Eneroth M, Ekdahl CS. The Swedish version of OMAS is a reliable and valid outcome measure for patients with ankle fractures. *BMC Musculoskelet Disord.* 2013;14:109.
14. Zambelli R, Pinto RZ, Magalhães JM, Lopes FA, Castilho RS, Baumfeld D, Dos Santos TR, Maffulli N. Development of the Brazilian Portuguese version of the Achilles Tendon Total Rupture Score (ATRS BrP): a cross-cultural adaptation with reliability and construct validity evaluation. *BMC Sports Sci Med Rehabil.* 2016;8:11.
15. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol.* 1993;46(12):1417-32.
16. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, Bouter LM, de Vet HC. Quality criteria were proposed for measurement properties of health status questionnaires. *J Clin Epidemiol.* 2007;60(1):34-42.
17. Hopkins WG. Measures of reliability in sports medicine and science. *Sports Med.* 2000;30(1):1-15.
18. Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care.* 1996;34(3):220-33.
19. Budiman-Mak E, Conrad KJ, Roach KE. The Foot Function Index: a measure of foot pain and disability. *J Clin Epidemiol.* 1991;44(6):561-70.
20. LAUGE-HANSEN N. Ligamentous ankle fractures; diagnosis and treatment. *Acta Chir Scand.* 1949;97(6):544-50.
21. Ferrari D. Análise da reprodutibilidade de parâmetros biomecânicos em indivíduos saudáveis e portadores da síndrome da dor femoropatelar durante subida de escada (dissertação). São Paulo: Universidade Estadual Paulista (UNESP); 2013.
22. Souza AC, Alexandre NMC, Guirardello EB. Psychometric properties in instruments evaluation of reliability and validity. *Epidemiol Serv Saude.* 2017;26(3):649-59.