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Kronik İnmede İnmeli Hastalar için Postüral Değerlendirme Ölçeği'nin Psikometrik Özelliklerinin Berg Denge Ölçeği ve Brunel Denge Değerlendirmesi ile Karşılaştırılması

Comparison of Psychometric Properties of the Postural Assessment Scale for Stroke Patients with Berg Balance Scale and Brunel Balance Assessment for Chronic Stroke

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ÖZ

Amaç: Bu çalışmanın amacı, İnmeli Hastalar için Postüral Değerlendirme Ölçeği' nin (PASS) Türkçe versiyonunun kronik inmede geçerliğini doğrulamak, geçerlik, güvenirlik ve cevap verme özelliklerini Berg Denge Ölçeği (BDÖ) ve Brunel Denge Değerlendirmesi (BDD) ile karşılaştırmaktır.

Yöntem: Çalışmaya 49 kronik inme hastası dahil edildi. Çalışmaya katılanlara ilk gün PASS, BDÖ ve BDD uygulandı. Test-tekrar test güvenirliğini ölçmek için, ilk değerlendirmeden 1 hafta sonra aynı fizyoterapist tarafından ikinci değerlendirme yapıldı.

Bulgular: Korelasyon analizine göre PASS birinci ve ikinci değerlendirme skorları arasında çok yüksek düzeyde bir ilişki tespit edildi (r = 0.984). Cronbach Alpha Katsayısı 0.995 (mükemmel) olarak bulundu. PASS için sınıf içi korelasyon katsayısı (ICC) değeri 0.995 idi. PASS, BDÖ ve BDD arasında yüksek düzeyde ilişki tespit edildi. PASS için tavan ve taban etkisi gözlenmedi.

Sonuç: Çalışmamızın sonuçları, kronik inmeli hastalarda PASS Türkçe versiyonunun geçerli ve güvenilir olduğunu ve dengeyi değerlendirmek için yaygın olarak kullanılan bu üç ölçeğin de kronik inmeli hastalarda tekrarlanabilir ölçümler yaptığını göstermiştir. Bu üç ölçeğin test tekrar test güvenirlik değerleri mükemmel bulunmuştur. Klinisyenler tarafından inme hastalarında gerçek denge değişikliğini belirlemek için kullanılan tespit edilebilir minimal değişim değerleri, bu denge ölçekleri için birbirine yakın bulunmuştur.

Anahtar Kelimeler: Denge, Mobilite, Geçerlik, Güvenirlik.

ABSTRACT

Objective: The purpose of the present study was to verify the validity of the Turkish version of the Postural Assessment Scale for Stroke Patients (PASS) in chronic stroke, and to compare its validity, reliability, and responsiveness characteristics with Berg Balance Scale (BBS), Brunel Balance Assessment (BBA).

Method: 49 chronic stroke patients were included in the study. Those participating in the study were applied PASS, BBS and BBA on the first day. To measure the test-retest reliability, the second assessment for the scales was performed by the same physiotherapist 1 week after the initial evaluation.

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Results: According to the correlation analysis, a very high level of correlation was found between the PASS first and second assessment scores (r = 0.984). Cronbach Alpha Coefficient was found to be 0.995 (excellent). The Intraclass Correlation Coefficient (ICC) value for PASS was 0.995. A high level of correlation was found between PASS, BBS and BBA. No ceiling and floor effects were observed for PASS.

Conclusion: The results of our study showed that Turkish version of PASS is a valid and reliable scale in chronic stroke patients and all these three scales, which are commonly used to assess balance in stroke patients are, made repeatable measurements in patients with chronic stroke. The test re-test reliability values of these three scales were found to be excellent. Minimal detectable change values, which are used to determine a real change in balance in stroke patients by clinicians, were found to be close to each other for these balance scales.

Key words: Balance, Mobility, Validity, Reliability.

1. INTRODUCTION

Balance is a complex process in which maintaining a position is regulated via postural corrections aiming involuntary activities and responses to external perturbations (1). Balance problems are faced very often in stroke patients due to sensory losses, tonus changes, decreased muscle strength, joint limitation, deterioration of coordination, and cognitive losses (2). Balance problems are also associated with increased risk of falls, decreased mobility, and slowed return to daily life activities (3). For this reason, detailed balance assessment is very important from the early stages of the stroke for the estimation of the patient's return to daily life activities. Clinical tests, laboratory tests, and scales are used for balance assessments; however, clinical tests and scales are more preferred. This is because their application is easy, and do not require expensive equipment. For this reason, there are many clinical measurement methods developed to evaluate the balance in stroke. The most commonly used scales are Berg Balance Scale (BBS), Postural Assessment Scale for Stroke (PASS), Fugl-Meyer's balance section (FM-B), Brunel Balance Assessment (BBA), Trunk Impairment Scale (TIS), Activities Specific Balance Confidence Scale (ABC), BesTest, Mini BesTest, and Brief BesTest (4). Monitoring and evaluating the development in stroke patients for balance training should be made with scales that are precise and reliable to changes. For this purpose, the reliability and sensitivity of the scale are also important. Responsiveness is defined as the ability of a result measurement in detecting the changes in time (5). Especially when long-term rehabilitation programs are considered, it becomes important to observe even small changes in slow recovery periods regardless of the degree of the balance problem of the patient.

PASS, BBS, and BBA are three common, valid, and reliable tests for balance assessments in stroke patients in clinical and academic studies. The validity, reliability, and responsiveness studies of them were conducted in different groups of stroke patients in previous studies for all three tests. PASS contains more bed mobility items, BBS evaluates more standing balance parameters, and BBA performed a hierarchical assessment for seating, standing, and step-taking.

The purpose of the present study was to verify the validity of the Turkish version of the PASS in patients with chronic stroke, and to examine and compare its psychometric properties with BBS and BBA.

2. METHOD

A total of 49 patients who were diagnosed with chronic stroke by the neurologist, with minimum 6 months after the stroke were included in the study. All patients voluntarily agreed

to participate in the study, and were able to follow orders verbally, and had stroke once because of ischemia or hemorrhage. Those with disorders in brain stem, cerebellum lesion, cognitive impairment, vision and hearing impairment, any known mental disorder, advanced musculoskeletal disorder (rheumatoid arthritis, advanced osteoarthritis, developmental hip dysplasia, ankylosing spondylitis, etc.) and other major diseases (cancer, amputation) were not included in the study. The study was approved by the Clinical Research Ethics Committee of Süleyman Demirel University Faculty of Medicine (Decision no: dated 07.03.2018 numbered 47)

The demographic data, such as age, gender, height, weight, and clinical data (i.e. disease duration, etiology, affected body side, and history of falls) were recorded in the initial evaluations of the patients who participated in the study. Those participating in the study were applied BBS, BBA, and PASS on the first day. Evaluations were made by a physiotherapist (PTa1) who was experienced in the field for at least 10 years. The second assessment was performed by the same physiotherapist (PTa2) 1 week after the initial evaluation to measure the test-retest confidence for scales.

PASS is a scale that makes postural evaluation of patients with stroke in three different positions (i.e. lying, sitting, and standing). The scale consists of 12 items. It is a 4-point Likert type scoring ranging from 0 to 3 points. Total scoring varies between 0 and 36. There are two subscales: "maintaining posture" and "changing posture". Both sections can be scored separately and the sum of these scores gives the total score. It is an easy-to-implement and not time-consuming scale, and does not require equipment for assessments. It is a valid, reliable, and widely used scale that was translated into different languages (6). The Turkish version study was conducted in acute stroke patients (7).

BBS was designed to assess balance and determine the risk of falls quantitatively, evaluating the ability of people to maintain balance while performing functional activities and in different positions. BBS consists of 14 items, and each item is scored between “0” and “4” according to the ability of the patient to meet the specific time and distance requirements of the test. In the test, which is made difficult by reducing the support surface, 4 points show the ability of completing the task independently, and 0 point shows that the patient cannot start the task. According to the scores obtained from this test, cases are interpreted as “high risk of falling (0-20 points)”, “moderate risk of falling (21-40 points)”, “low risk of falling (41-56 points)”. The highest score of 56 is considered to show the best balance. The Turkish version of the BBS, whose validity and reliability were shown in both acute and chronic stroke patients, is a reliable, valid, and change-sensitive scale for three-month period (8).

BBA Scale is a valid and reliable scale used to assess functional balance and mobility in stroke patients. This scale is advantageous because it creates a real hierarchy, is sensitive to changes, and is sensitive to wide motion capability. It evaluates balance and mobility in seating, standing and taking steps. The scale consists of 12 items. The score is 0-12 points; and 12 points show the best balance (9). The Turkish version was conducted by Arslan et al. (10).

Statistical Analysis

The IBM SPSS Statistics V23.0 (IBM Corp, Armonk, NY, USA) Program was used for statistical analyses.

Reliability

The cronbach alfa reliability coefficient was calculated for reliability. The test-retest reliability and internal consistency were used. To assess the intra-agreement, Intraclass Correlation Coefficient (ICC) estimates and their 95% Confidence Intervals were calculated based on absolute agreement, 2-way mixed effect model. For ICC coefficient, 0.50-0.75 was considered to be moderate agreement, 0.75-0.90 good agreement, and above 0.90 excellent agreement (11).

Validity

For concurrent Validity, spearman correlation analysis was used to determine the relation between PASS, BBS and BBA. Spearman Correlation Coefficient values were interpreted as follows: very high: 0.90-1.00; high: 0.70-0.90; moderate: 0.50-0.70; low: 0.30-.50, and negligible: 0.00-0.30 (12).

The ceiling and floor effects were calculated for content validity. We hypothesized that the floor and ceiling effects would be less than 15%. As the statistically significance level, $p<0.05$ level was taken.

Minimal Detectable Change (MDC)

The MDC at 95% level of confidence represented the smallest change that could be interpreted as a real difference, and was calculated according to the following formula: MDC 95% = 1.96*SEM*√2. SEM values were calculated as follows: SEM = SD × √(1 – ICC), with SD representing the standard deviation of the measure, and ICC representing the test-retest reliability coefficient.

Predictive Validity

Receiver Operating Characteristic (ROC) and Area Under the Curve (AUC) were used to determine the cut-off values for significant predictors of fall risk according to falling history. An AUC value of 0.50 showed no sensitivity, and a value of 1.00 represented excellent sensitivity and specificity (13).

3. RESULTS

This study included a total of 49 chronic stroke patients. The mean age of the patients was 63.27±9.72 years; and the mean BMI was 27.46±4.62 kg/m^2. A total of 26 (54.2%) participants were male, and 23 (45.8%) were female. The mean time after stroke was 29.67±32.07 months. The etiology of stroke was ischemic cerebrovascular disease in 34 (69.4%) participants, and hemorrhagic cerebrovascular disease in 15 (30.6%) patients. While dominant side was left in 7 (14.3%), it was right in 42 (85.7%) patients. The affected side was left in 31 (63.3%), and right in 18 (36.7%) patients. While 19 (38.8%) of the patients had history of falling, 30 patients (61.2%) of them did not. Clinical balance scores of the patients are shown in the Table 1.

Table 1. Clinical Balance Scores of the Participants (N: 49)

	PASS (Mean±SD)	BBS (Mean±SD)	BBA (Mean±SD)
Patients' Scores	27.48±7.70	36.64±16.39	8.04±3.35

PASS: Postural Assessment for Stroke Patients; BBS: Berg Balance Scale; BBA: Brunel Balance Assessment

Reliability

According to the correlation analysis, a very high-level relation was detected between PTa1 and PTa2 PASS (r=0.984). Cronbach's Alpha Coefficient was found to be 0.995 (excellent). The ICC value for PASS was 0.995 (95 %CI; 0.991– 0.998 (excellent agreement) for intra-rater agreement. SEM and MDC values are shown in Table 2.

Table 2. The Relative (ICC Coefficient) and Absolute (SEM and MDC_{95}) Reliability of the Scales (n=33)

	First trial (mean±SD)	Second trial (mean±SD)	Difference (mean±SD)	ICC (2, 1) 95% CI	SEM	$MDC_{95\%}$
PASS	27.63±7.61	28.15±7.17	0.515±1.003	0.995	0.52	1.44
BBS	36.60±16.55	37.30±16.09	0.697±1.237	0.999	0.51	1.43
BBA	8.18±3.48	8.66±3.20	0.484±0.905	0.981	0.46	1.27

PASS: Postural Assessment Scale for Stroke Patients; BBS: Berg Balance Scale; BBA: Brunel Balance Assessment; ICC: Intraclass Correlation Coefficient; SD: Standard Deviation; SEM: Standard Error of Measurement with a 95% CI; $MDC_{95\%}$: Minimum Detectable Change at 95% of Confidence Interval

Concurrent Validity

A high-level correlation was detected between PASS, BBS, and BBA (Table 3).

Table 3: Correlation Coefficients Between PASS and BBS, BBA

	BBS	BBA	PASS
PASS	r= 0.880 p=0.001	-	-
BBS	-	r=-0.816 p=0.001	-
BBA	-		r=-0.748 p=0.001

PASS: Postural Assessment Scale for Stroke Patients; BBS: Berg Balance Scale; BBA: Brunel Balance Assessment

Content Validity

No ceiling and floor effects were observed for the PASS in this sampling. There were no patients who received 0 point. Only 2 people (4.1%) had 36 points in PASS. No floor and ceiling effects were seen for BBS. One patient received 0 point, and 2 received 56 points. No patients received 0 point in BBA, but the ceiling effect was seen. A total of 14 people scored 12 points in the BBA.

Predictive Validity

The clinical cut-off values for the PASS, BBS, BBA was not determined (AUC= 0.491, p=0.918; AUC= 0.468, p=0.712; AUC= 0.522, p=0.798 respectively).

4. DISCUSSION

The results of our study showed that Turkish version of PASS is a valid and reliable scale in chronic stroke patients and all these three scales (i.e. PASS, BBS and BBA) which are commonly used to assess balance in stroke patients are, made repeatable measurements in patients with chronic stroke. The test-retest confidence values of these three scales were found to be excellent. MDC values, which are used to determine a real change in balance in stroke patients by clinicians, were found to be close to each other for these balance scales. However, the use of the scales in determining falls could not be verified for our study population. Balance disorder and mobility problems are among the most common problems in the clinic after stroke. Balance is needed to maintain activities of daily life, and for the best functioning of the locomotor system. For this reason, correct assessment of balance is important for planning effective treatment interventions and for determining safe and unsafe activities for the patient. It is possible for clinicians to determine the changes in balance disorder that occurs over time with a measurable evaluation method.

PASS is a practical test that is easy to apply and understand to assess postural control and balance in patients with low physical performance levels. They also showed that it could be used in determining the discharge recommendations in acute care (14) and in predicting ambulation levels (15). An and Lee (16) examined the validity and reliability of PASS in patients with chronic stroke, and found the intra-rater (ICC 3,1=0.97, 95% CI) and absolute (SEM=1.01) reliability, and BBS to be high. Mao et al. (17) compared the psychometric features of the balance sections of PASS, BBS and FM-B, and emphasized that their validity, reliability and responsiveness were high; however, argued that PASS was slightly better. When the literature was reviewed, there are validity and reliability studies for PASS in acute, sub-acute and chronic patients (6,16,18). The Turkish version study was conducted with stroke patients who recovered the 3-week acute period (The mean time after stroke was 10.03±3.75 weeks). It was shown in the study that the scale was a valid and reliable scale (Cronbach's Alpha 0.903, ICC = 0.999, 95% CI: 0.998-0.999), and BBS and motor sub-scale of Functional Independence Measure (FIM) correlation was found to be strong (7). In our study, the Cronbach's Alpha Coefficient of PASS was found to be 0.995, ICC 0.995 (95% CI), SEM 0.52 and $MDC_{95\%}$ 1.44. Also, the correlation with BBS and BBA was found to be high. Our results were in line with the literature data, and the Turkish version can be used in chronic stroke patients as a valid and reliable scale.

BBS is the most commonly used scale among the balance scales used in the clinic. In the literature, it is seen that it is frequently used in studies since it is a valid and reliable measurement in stroke patients. Blum and Korner-Bitsky (19) examined the availability and psychometric characteristics of BBS in the rehabilitation of the disease in their systematic literature review, and reported that it had a strong reliability, validity and sensitivity to change without the need for strong reliability, and that the test could be applied conveniently and easily without the need for expensive equipment or long-term assessment time. They also argued that attention should be paid to the use of BBS in measuring the changes in severe or mild patients, other scales, such as PASS or the ABC Scale could be used instead, and that BBS did not predict the risk of falling. Lih-Jiun Liaw et al. (20) investigated the reliability of BBS and PASS in 52 people with moderate and severe disease levels with a durability of 6 months or more. They

reported that BBS and PASS had a high test-retest ability (ICC: BBS=0.98, PASS=0.97), and the SEM value, which represented the smallest threshold of change showing a real improvement for a group of individuals, was 2.4 and 1.1 for BBS and PASS, respectively; the MDC value, which represents the smallest threshold of change representing a real improvement for a single individual, was 6.7 and 3.2, respectively. In their study that involved the patients in the first 2 weeks after stroke, Saso et al. (21) found the MDC value of BBS to be 5.97 with an 80% confidence level. Alghadir et al. (22) found that the test re-test confidence was high, SEM values were 1.16 for Timed Up and Go (TUG) and 0.98 for BBS in their studies in which BBS, TUG, and Dynamic Gait Index (DGI) were compared for validity, reliability and responsiveness. In our study, the ICC value of BBS was found to be 0.999, its SEM value was 0.51, and MDC value was 1.43.

BBA Scale is a valid and reliable scale used to assess functional balance and mobility while sitting, standing, and taking steps in stroke patients. Its advantages are that it creates a hierarchical assessment, is sensitive to change, and has a wide mobility. In the literature, it is shown that BBA reflects activities of daily life and walking function (23) and has predictive validity in the assessment of balance disorder, which is indicative of functional improvement (24). In the Turkish version study conducted by Arslan et al. (10), the validity and reliability were found to be high. Similarly, it was shown in the original version (9) and in the Chinese version (25) of BBA that it is a valid and reliable scale in stroke. In our study, SEM value of BBA was found to be 0.46, and 1.27% if MDC was 95%. Also, as far as we are concerned, there is no study providing SEM and MDC values in the literature of BBA Scale, This result will facilitate its interpretation in clinical use. The difference between test-retest results must vary as much as the MDC value to show a real improvement or a real deterioration (26). When we examined the MDC values of all three tests we used in the present study, it is possible to argue that they are sensitive to small changes.

Limitations

Only chronic stroke patients were included in our study. The examination of commonly used balance scales in acute, sub-acute, and chronic stroke patients will be useful to show which test is more useful in which period. The low number of sampling was another limitation. It will be useful to conduct studies with more samplings to generalize our results. In addition, the cut-off value calculation was not significant in the analyses done in the patient group in our study. In future studies, giving the cut-off value of these tests for each period will enhance interpretations.

5. CONCLUSION

The Turkish version of PASS is valid and reliable scale in chronic stroke patients. At the same time, PASS, BBS and BBA are sensitive to minor changes. Also, the test-retest reliability of all the three scales are similar; and the MDC values, which are used to detect a real change, are close to each other.

Ethical Consideration of the Study

The study was approved by the Clinical Research Ethics Committee of Süleyman Demirel University Faculty of Medicine (Decision no: dated 07.03.2018 numbered 47).

Conflict of interest statement

The authors do not have any interest-based relationships.

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