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Original Article

Validity and Reliability of the Turkish Version of Balance Outcome Measure for Elder Rehabilitation

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ABSTRACT

Objective: This study aimed to determine validity and reliability of the Turkish version of Balance Outcome Measure for Elderly Rehabilitation (BOOMER) and to evaluate its psychometric properties.

Methods: The study included 60 elderly individuals (30 women, 30 men; mean age 72.03±7.86 years). Participants completed the four subtests of the BOOMER (Step Test, Timed Up and Go Test, Functional Reach Test, Timed Static Stand Test) and the Berg Balance Scale (BBS). Descriptive statistics were calculated, Cronbach's alpha and Kendall's W coefficient were used for internal consistency, and Spearman's correlation was used to examine item-total relationships and correlations between the BOOMER and the BBS.

Results: The total BOOMER score was found to be 12.52±0.95. Significant correlations were observed between the subtests and the total BOOMER score (r=0.414–0.565, p<0.01). The Cronbach's alpha coefficient was low at 0.022, but the Kendall W coefficient showed moderate reliability at 0.339. For the BBS, the alpha was initially 0.304, but it increased to 0.548 after item-total correlation analysis. A positive and significant correlation was found between the BOOMER total score and the BBS total score (r=0.419, p=0.001).

Conclusion: The BOOMER scale is a practical measure that can assess static, dynamic, and functional balance in older adults in a short time. Its significant correlation with the BBS supports the concurrent validity of the scale. However, considering the low internal consistency values, it is recommended that reliability findings be strengthened through further studies in different populations and with larger samples.

INTRODUCTION

Balance problems are common in older adults and are usually caused by factors such as muscle weakness, chronic diseases, side effects of medications, and disorders of the vestibular and somatosensory systems.[1,2] The aging process leads to changes in the body's center of gravity and deterioration in posture alignment. Thus, this requires a wider support surface and negatively affects balance Additionally, secondary issues such as fear of falling can limit daily living activities.[3]

Balance is achieved through the integration of information from the somatosensory, vestibular, and visual systems by the central nervous system.[4] While the somatosensory system transmits proprioceptive data from muscles and joints, the vestibular system regulates head movements, body alignment, and head-eye coordination In addition, the visual system supports postural control with environmental cues. Therefore, decreased visual acuity can directly negatively affect balance.[5]

The central nervous system maintains balance by activating muscles using specific strategies.[6] In mild postural disturbances, the ankle strategy is used, and muscles contract from distal to proximal. However, with aging, this process slows down, and proximal muscles engage earlier.[7] In more severe imbalances, the hip strategy or step strategy is applied.[8] Young individuals maintain balance with a single large step, while older individuals often have to take many small steps.[8]

Balance measurements can be unidimensional or multidimensional. Unidimensional tests (e.g., Step Test, Functional Reach Test) assess a specific aspect of postural control and are quick to administer.[9] Multidimensional tests are more comprehensive; the Berg Balance Scale (BBS) is an example.[10] However, the validity of these tests in different

rehabilitation settings for older adults may be limited.[11] In clinical practice, using comprehensive yet simple measurements together yields more accurate results.[12] While comprehensive tests such as the BBS are considered the gold standard, their lengthy administration time can lead to limitations in clinical practice.[12] The Balance Outcome Measure for the Elder Rehabilitation (BOOMER), developed in response to this need, combines short and practical subtests such as the Step Test, Timed Up and Go Test, Functional Reach Test, and Timed Static Stand Test to comprehensively assess static, dynamic, and functional balance in older adults.[13] Therefore, this study aimed to determine validity and reliability of the Turkish version of balance outcome measure for elder rehabilitation scale, and evaluate its psychometric properties.

MATERIALS AND METHODS

Procedures

This study was conducted between November 2022 and January 2023. Ethical approval was obtained from the Human Research Ethics Board of Marmara University (No: 48, Date: 30/03/2023) and conducted according to the Declaration of Helsinki. Verbal and written explanations were provided to participants about the study, and all participants provided written informed consent. This study was registered on ClinicalTrials.gov with registration number NCT07129213.

Subjects

This research was carried out on sixty (n=60) healthy elderly participants who were aged between 60-88 years. None of the participants used any assistive devices such as a cane or walker. Essential information for inclusion and exclusion criteria using a socio-demographic questionnaire. Inclusion criteria included individuals who can read and write Turkish, have a Mini Mental State Examination score of 24 or higher, and have no visual or auditory pathology. Exclusion criteria included individuals who had undergone amputation or have walking problems such as paraplegia or tetraplegia, have Alzheimer's disease and dementia, and were unable to follow the commands necessary for the study. Besides, individuals who declined to participate in the study were excluded.

Since this research was a cross-sectional survey, the researchers employed several tests, including the BOOMER and the BBS test, to collect essential data for the study.

The BOOMER consists of the following tests:

Step Test (ST): The Step Test required weight shifting and movement while in a single-leg stance, in addition to controlling motor activity of the lower extremities. The number of repetitions of placing one foot onto a 7.5-cm step and returning it to the ground within 15 seconds was recorded. Scores were calculated based on the average of both legs. If the participant could not perform the test, it was regarded as grade 0; 0–5 repetitions were grade 1, 5–8 repetitions grade 2, 8–12 repetitions grade 3, and >12 repetitions were considered grade 4.

Timed Up and Go (TUG) Test: This screening test measured the likelihood of falling in older adults. The participant stood up, walked 3 meters, turned 180 degrees, walked back, and sat down with their back against the chair. The completion time (in seconds) was recorded. If the participant was unable to perform the task, it was graded 0; ≥30 s was grade 1, 29–20 s grade 2, 19–10 s grade 3, and <10 s was regarded as grade 4.

Functional Reach Test (FRT): This test assessed dynamic balance by measuring the distance reached with an outstretched arm while maintaining a fixed base of support. The distance between the starting point and the maximal forward reach was recorded in centimeters. If the participant could not perform the test, it was graded 0; 1–15 cm was grade 1, 16–20 cm grade 2, 21–30 cm grade 3, and >30 cm was grade 4.

Timed Static Stand (TSS) Test: This screening test involved observing participants standing with their feet together and eyes closed, thereby narrowing their base of support. Time (in seconds) was recorded until balance was lost. If balance was lost immediately, the score was 0; <30 s was grade 1, 30–60 s grade 2, 60–<90 s grade 3, and ≥90 s was grade 4.

The overall BOOMER score was calculated by summing the item scores, yielding a total score between 0 and 16. Higher scores indicated better balance ability and a lower risk of falling.[12]

Berg Balance Scale: The BBS was used as an objective method to assess balance. Participants were asked to perform predetermined tasks to determine whether they could maintain balance safely. The questionnaire consisted of 14 items, each rated from 0 to 4, with 0 representing the lowest level of function and 4 representing the highest. The test required approximately 20 minutes to complete. Most items required the participant to maintain a specific position for a defined period. When a participant did not meet the required time or distance, when supervision was needed, when external support was touched, or when assistance was provided by the examiner, points were progressively deducted. The total score ranged from 0 to 56. Since the BBS had previously been confirmed as a valid indicator of balance performance, we used it to determine the reliability of the BOOMER balance outcome measure.[14,15]

Statistical Analysis

The sample number of the study was calculated with the program named G*Power 3.1.9.2. The sample size of the study was calculated as 60 in total, with an error of +/-0.5, an effect size of 0.44 calculated for the estimated standard deviation of 1.26, a power of 95%, and a margin of error of 5% for Type I. The sample size of the study was calculated by power analysis based on the effect size of previously published similar studies.[13]

Data analysis will be done using the SPPS-26 statistical package program. In the analysis of socio-demographic

Table 1. Demographic characteristics of the individuals

Characteristics (n=60)	Mean (SD)
Age (years)	72.0 (7.9)
Height (cm)	169.4 (9.1)
Weight (kg)	74.5 (9.5)
BMI, kg/m2	26.2 (4.8)
Gender (n) (%)	
Female	30 (50%)
Male	30 (50%)

SD: Standard deviation; BMI: Body mass index.

data, descriptive statistics such as percentage, frequency, median, minimum-maximum values, mean and standard deviation will be used. To determine the content validity of the scale, analyses related to content validity ratio and content validity index values will be completed. Principal component analysis was used in explanatory factor analysis. Bartlett Sphericity test and Keiser-Mayer-Olkin tests was used to determine the adequacy of the scale content and sample size. The factor structure and factor load of the scale was examined with confirmatory factor analysis. Spearman's rank correlation coefficient was preferred for item–total analyses because the BOOMER items are ordinal (0–4 scoring) and the data did not meet normality assumptions.

RESULTS

A total of 60 elderly individuals (30 women, 30 men) were included in the study. Descriptive statistics regarding the demographic characteristics of the participants were presented in Table 1.

BOOMER Scale Results and Their Relationship with BBS

The mean scores obtained from the BOOMER scale items were 3.40±0.49 for the ST, 3.20±0.40 for the TUG test, 3.28±0.45 for the TSS test, and 2.63±0.52 for the FRT. The total BOOMER score was calculated as 12.52±0.95 (Table 2).

The total BBS score was found to be 43.25±2.10 on average. In the analysis conducted within the scope of convergent validity, a significant and positive correlation was found between the BOOMER total score and the BBS total score (r=0.419; p=0.001). Furthermore, each of the BOOMER items was significantly correlated with the BBS total score (r=0.414–0.565; p<0.01) (Table 2).

Item–Total Correlations

The relationship between the BOOMER scale item scores and the total score was evaluated using Spearman correlation analysis. ST (r=0.565; p<0.001), TUG test (r=0.414; p=0.001), TSS test (r=0.523; p<0.001), and FRT (r=0.492; p<0.001) each showed a significant and positive correlation with the total score. These findings supported that the BOOMER scale's items contributed to the scale as a whole and had internal consistency (Table 3).

Reliability Analyses

The Cronbach's alpha coefficient for the BOOMER scale was found to be 0.022. The presence of only four subtests in the scale may have contributed to this low alpha value. The nonparametric fit index Kendall's correlation coefficient W was calculated as 0.339, indicating a moderate level of reliability. Furthermore, Spearman correlation analysis revealed that each item was significantly correlated with the total score (p<0.05). These results indicated that BOOMER had limited internal consistency.

The initial Cronbach's alpha coefficient for the BBS was 0.304. When items with low item–total correlations were removed, this value increased to 0.548. According to the

Table 2. Correlations between the mean values of the BOOMER scale's items, total score and the Berg Balance Scale

BOOMER Items	Mean±SD	Correlation with BBS (r)	p
Step Test	3.40±0.49	0.565	<0.001
Timed Up and Go Test	3.20±0.40	0.414	0.001
Timed Static Stand Test	3.28±0.45	0.523	<0.001
Functional Reach Test	2.63±0.52	0.492	<0.001
BOOMER Total	12.52±0.95	0.419	0.001

BOOMER, Balance Outcome Measure for the Elder Rehabilitation; Correlation is significant at the 0.01 level (2-tailed).

Table 3. Correlations between BOOMER item scores and total scores

BOOMER Items	Item-Correlation (r)	p
Step Test	0.565	<0.001
Timed Up and Go Test	0.414	0.001
Timed Static Stand Test	0.523	<0.001
Functional Reach Test	0.492	<0.001

BOOMER: Balance Outcome Measure for the Elder Rehabilitation; Correlation is significant at the 0.01 level (2-tailed).

exploratory factor analysis, three factors were identified, highlighting distinct aspects of balance.

Construct Validity

In the exploratory factor analysis conducted on the BBS, the Kaiser–Meyer–Olkin (KMO) value was 0.430, and Bartlett's sphericity test was found to be close to the significance level (χ^2=111.5; df=91; p=0.071). Three factors with eigenvalues above 1 were extracted, explaining 37.6% of the total variance. Following Varimax rotation, different items were grouped under these three factors.

DISCUSSION

This study aimed to examine the validity and reliability of the Turkish version of the Balance Outcome Measure for Elder Rehabilitation. In this context, the psychometric properties of the scale were evaluated and comparative analyses were conducted with an established balance assessment tool. The findings indicated that the BOOMER may be a valid and reliable measure for assessing static, dynamic, and functional balance in older adults.[12,13]

The subscales of the BOOMER scale (ST, TUG test, FRT, and TSS test) showed significant correlations individually. This finding supports that each subscale contributes to the total BOOMER score and that the scale provides a comprehensive assessment.[13] However, the low Cronbach's alpha coefficient may be due to the limited number of items and the different dimensions measured by the tests. Therefore, although internal consistency is limited, Spearman correlation analyses support the internal validity of BOOMER. Furthermore, the extremely low Cronbach's alpha coefficient (0.022) may also be attributed to the limited number of items in the BOOMER scale. Short scales with few items frequently produce low alpha values, even when items measure related constructs; thus, Cronbach's alpha may underestimate the true reliability of the instrument.[14]

The BBS is a widely used measure in balance assessments for older adults and is considered the gold standard. However, its time-consuming nature can be a limitation in clinical practice. This study found a positive and significant correlation between BOOMER and BBS. This suggests that BOOMER may be a practical and functional alternative to BBS that can be administered in a shorter time.[14] Thus, BOOMER may offer clinicians a faster and more accessible assessment option, providing ease of use, especially in busy clinical settings.

In addition to its significant correlation with the BBS, the BOOMER provides several practical advantages in clinical practice. The scale can be administered in a considerably shorter time, requires minimal equipment, and is easy to apply in crowded outpatient settings, home-based rehabilitation, or community health centers where time and resources are limited. Unlike the BBS, which involves 14 separate items and often requires additional space and supervision, the BOOMER combines four brief subtests that collectively assess static, dynamic, and functional balance.[15] This structure not only reduces the physical and cognitive burden on older adults but also enables clinicians to obtain clinically meaningful balance information within minutes. The practicality, time efficiency, and multidimensional nature of the BOOMER make it a highly feasible alternative for routine screenings, rapid fall-risk evaluations, and follow-up assessments in geriatric rehabilitation.[15,16]

Moreover, the brevity of the BOOMER allows clinicians to integrate balance assessment into routine evaluations without significantly extending appointment duration.[16] This practical feature may increase the likelihood of regular balance monitoring, which is essential for early detection of fall risk. In resource-limited settings where comprehensive assessment tools cannot be used due to time, staff, or space constraints, the BOOMER offers a feasible alternative that maintains clinical relevance without compromising assessment quality.[14,17]

The findings reveal that BOOMER is applicable in assessing the balance abilities and fall risk of elderly individuals. The scale has significant clinical potential due to its simplicity, quick application, and coverage of different balance components (static, dynamic, and functional). On the other hand, BBS provides a detailed but more time-consuming reference framework.[17] It can also be used in preventive rehabilitation strategies by contributing to the early identification of individuals at high risk of falling.

A major limitation of this study was the relatively small sample size (n=60), which may have restricted the generalizability of the findings and reduced the statistical power of certain analyses. The limited number of participants also makes it difficult to fully evaluate the stability of the BOOMER scale across different subgroups of older adults. Furthermore, because test–retest reliability was not assessed, the temporal stability of the BOOMER remains unclear. Future studies should include larger and more diverse samples and incorporate test–retest procedures to evaluate intraclass correlation coefficients, standard error of measurement, and minimum detectable change values.[18,19]

Future studies should re-evaluate the validity and reliability of BOOMER using larger samples, different clinical populations, and longitudinal follow-up designs. In particular, it is recommended to calculate the intraclass correlation coefficient, standard error of measurement, and minimum detectable change values to support test–retest reliability.

In addition to these recommendations, future research should also explore the responsiveness of the BOOMER, particularly its ability to detect clinical change following rehabilitation interventions. Establishing responsiveness and minimal clinically important difference (MCID) values would enhance the scale's usefulness in monitoring treatment progress. Furthermore, cross-cultural comparisons between different BOOMER adaptations may provide insight into the scale's broader applicability and help determine whether cultural or population-specific factors influ-

ence balance performance. Examining the performance of BOOMER in clinical subgroups—such as individuals with vestibular disorders, frailty, Parkinson's disease, or mild cognitive impairment—may also deepen the understanding of its clinical utility and expand its use beyond community-dwelling older adults.

CONCLUSION

In general, the BOOMER scale is a time-efficient, easy-to-administer, and functional tool for assessing balance in older adults. Its ability to be administered in a shorter time compared to the BBS provides significant practical benefits in the clinical setting. However, further research in different populations is needed to more robustly support its reliability and internal consistency.

Ethics Committee Approval

Ethical approval was obtained from the Human Research Ethics Board of Marmara University (Date: 30.03.2023, Decision No: 48).

Informed Consent

All participants provided written informed consent.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: E.A.K., E.T.C ; Design: E.A.K. ; Supervision: E.A.K.; Materials: E.A.K.; Data collection &/or processing: M.M., F.J., M.E.; Analysis and/or interpretation: E.A.K.; Literature search: E.A.K.; Writing: E.A.K.; Critical review: E.A.K.

Conflict of Interest

None declared.

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Geriatrik Rehabilitasyonda Denge Sonlanım Ölçeğinin Türkçe Geçerlik ve Güvenirliği

Amaç: Bu çalışma, Geriatrik Rehabilitasyonda Denge Sonlanım Ölçeğinin (GRDSÖ) Türkçe versiyonunun geçerliliğini ve güvenilirliğini belirlemeyi ve psikometrik özelliklerini değerlendirmeyi amaçlamıştır.

Gereç ve Yöntem: Çalışmaya 60 yaşlı birey (30 kadın, 30 erkek; yaş ortalaması 72.03±7.86 yıl) dâhil edildi. Katılımcılara GRDSÖ'nün dört alt testi (Adım Testi, Zamanlı Kalk ve Yürü Testi, Fonksiyonel Uzanma Testi, Zamanlı Statik Duruş Testi) ve Berg Denge Ölçeği (BDÖ) uygulandı. Tanımlayıcı istatistikler hesaplanmış, iç tutarlılık için Cronbach alfa ve Kendall'ın W katsayısı kullanılmış, ayrıca Spearman korelasyonu ile madde-toplam ilişkileri ve GRDSÖ ile BDÖ arasındaki korelasyonlar incelendi.

Bulgular: GRDSÖ toplam puanı 12.52±0.95 bulunmuştur. Alt testler ile toplam GRDSÖ puanı arasında anlamlı korelasyonlar gözlenmiştir ($r=0.414–0.565$, $p<0.01$). Cronbach alfa katsayısı 0.022 ile düşük bulunmuş, ancak Kendall W katsayısı 0.339 ile orta düzeyde güvenilirlik göstermiştir. BDÖ için başlangıçta alfa 0.304 iken, madde-toplam korelasyon analizi sonrası 0.548'e yükselmiştir. GRDSÖ toplam puanı ile BDÖ toplam puanı arasında pozitif ve anlamlı korelasyon saptanmıştır ($r=0.419$, $p=0.001$).

Sonuç: GRDSÖ ölçeği, yaşlı bireylerde statik, dinamik ve fonksiyonel dengeyi kısa sürede değerlendirebilen pratik bir ölçektir. BDÖ ile gösterdiği anlamlı korelasyon, ölçeğin eşzamanlı geçerliliğini desteklemektedir. Bununla birlikte, düşük iç tutarlılık değerleri göz önünde bulundurularak, farklı popülasyonlarda ve daha büyük örneklemlerle yapılacak ileri çalışmalarla güvenilirlik bulgularının güçlendirilmesi önerilmektedir.

Anahtar Sözcükler: Berg Denge Ölçeği; denge; geçerlilik; güvenilirlik; yaşlı.