

# Reliability and Validity of the Turkish Version of the Berg Balance Scale

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## ABSTRACT

**Objectives:** The purpose of this study was to develop a Turkish version of the Berg Balance Scale (BBS) and assess its reliability and validity. **Materials and Method:** Sixty healthy volunteers older than 65 years were included in to the study. Subjects who had lower extremity amputation, or were armchair or bedridden were excluded. After translation process, the Turkish version of the scale was administered to each participant twice with an interval of 2 weeks. The intraclass correlation coefficient (ICC) was calculated to assess intra- and inter-observer reliability. Chronbach  $\alpha$  was calculated to evaluate internal consistency of the total BBS score. Interclass correlation coefficient was calculated to examine test-retest reliability. Convergent validity was assessed by correlating the scale with Modified Barthel Index (MBI) and Timed Up&Go Test (TUG). Construct validity was assessed with factor analysis. **Results:** The mean age in years of the participants were  $77.00 \pm 5.67$  (range: 67-92 yrs). The ICC for intra- and inter- observer reliability was 0.98 ( $p < 0.0001$ ) and 0.97 ( $p < 0.0001$ ), respectively. Chronbach  $\alpha$  of the Turkish version of the BBS was 0.98. The test-retest reliability (ICC) of the Turkish version of the BBS was determined as 0.98 for the total score, and ranged from 0.86-0.99 for individual items. In terms of validity, the Turkish version of the BBS was correlated with the MBI (in positive direction) and TUG (in negative direction) ( $r = 0.67$   $p < 0.0001$ ;  $r = -0.75$   $p < 0.0001$ , respectively). **Conclusion:** The Turkish version of the BBS is a reliable and valid scale to be used in balance assessment of Turkish older adults.

**Key Words:** Berg Balance Scale, geriatric patients, rehabilitation, outcome assessment

## INTRODUCTION

The mortality and morbidity resulting from postural instability and falls is significant in that one third of those aged over 65 fall one or more times each year, and that the incidence of falls climbs to 40% for adults over 80 years.<sup>1-4</sup> Many factors contributing to risk of falls in the aging adults have been described in the literature. Intrinsic factors include drugs causing vertigo or sedation, neurological disorders leading to imbalance, visual problems, cognitive disorders, orthopaedic abnormalities and postural instability. Extrinsic factors include inadequate environmental lighting, inap-

proprate or worn footwear, and the uses of equipment such as walkers and other assistive devices.<sup>1,4,6</sup> The main objective in preventing falls in geriatric rehabilitation can be summarized as to enhance balance and postural control.<sup>7</sup>

The Berg Balance Scale (BBS) was originally developed for the assessment of postural control, and is widely used in many fields of rehabilitation.<sup>8-11</sup> The 14 items in the scale asses static sitting and standing balance, as well as anticipatory balance during activities commonly performed in daily function, including transfers, turning, and retrieving objects from the floor.<sup>8</sup>

The scoring is done on a 5-point scale, that considers whether the patient can perform the task safely and independently, often based on a definite time span. Normal performances are graded from 0 (unable to perform) to 4 points (normal performance). Scores on individual items are summed for a total score, with a maximum of 56 points.

The objectives of this study is to evaluate the reliability and validity of a Turkish version of the BBS, and describe its use for evaluation of Turkish older adults.

## MATERIAL AND METHODS

### Subjects

The study sample include 60 volunteers over 65 years old, who were informed about the aim of the study and agreed to participate. Some of them were residents of Istanbul Etiler Nursing Home ( $n=39$ ) and the rest were patients who were attending an outpatient medical services department with various chronic complaints ( $n=21$ ). To be eligible, subjects needed to be at least 65 years of age, and to speak the Turkish language. Individuals were excluded if they had amputation of lower extremities, were primarily bed-bound or wheelchair dependent, had dementia or Alzheimer disease, or were not fluent Turkish speakers.

### Evaluation Parameters

During the first examination, participants were interviewed to gather information about their age, gender, level of education, occupation, use of walking aids, current illnesses, and current medications. Typical ambulatory status was classified using the Functional Ambulation category (FAC)<sup>12</sup> (0=non ambulatory, 5 = independent functional ambulation). In addition, subjects were categorized by level of ambulation and functional environment as being: (1) able to ambulate inside the home but not outside, and dependent for daily living activities; (2) able to ambulate independently at home and perform daily living without assistance, but dependent for outdoor activities, he/she can not go outside unless absolutely indicated; or (3) independent in ambulation both at home and outdoors, as well as independent in functional activities. In addition, each individual rated their self-perception of overall well-being on a Likert-type scale as excellent, very good, good, fair, or poor.

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The Modified Barthel Index (MBI) was used to evaluate level of disability with respect to activities of daily living. The MBI consists of 10 activities, scored with respect to physical assistance required. Items scored are summed to produce a total MBI score. MBI activities include transfers, ambulation, ascending and descending stair, feeding, dressing, personal self-care, taking a bath, use of the toilet, and urinary and/or fecal incontinence. Validity and reliability of the MBI in Turkish language has been established.<sup>13</sup> Chronbach's  $\alpha$ , and intraclass correlation coefficients (ICCs) of the Turkish version of MBI have been reported as 0.93 and 0.99, respectively, with significant correlation of the MBI with BBS ( $r=0.67$ ) as evidence of concurrent validity.<sup>3,13,14</sup>

The timed up and go test (TUG) was used to evaluate mobility. The TUG is a balance and gait index which requires the patient to stand from a chair, walk a 3 meter distance, turn, walk back to the chair, and sit down. The time required to complete the task is measured in seconds.<sup>15</sup> The correlation between TUG and BBS was found as  $-0.76$ .<sup>14</sup>

### Translation Procedure

Translation and cross-cultural adaptation of the BBS into Turkish were based on the recommendations of Guillemin et al,<sup>16</sup> Baeton et al,<sup>17</sup> and the EORTC Quality of Life Group.<sup>18</sup>

As the first step 2 specialists (a physiatrist and a rheumatologist) who were a native Turkish speaker fluent in English translated English version into Turkish. Discrepancies in initial translations were addressed with the assistance of a third independent translator. The Turkish version of the BBS was then translated back into English by 2 English-speaking language specialists who were blinded to the original scale and the objective of the study. The differences between translated versions were evaluated, and a satisfactory compliance with the original scale was achieved by consensus of the translators.

### Evaluation of cultural adaptation

The completed Turkish version was evaluated for cultural appropriateness by 10 psychiatrists and 4 physical therapy specialists, and controversial items were determined. Those items found by the expert reviewers to be confusing or unintelligible were critically reevaluated by 2 experienced psychiatrists well-versed in English, and necessary modifications were done. The updated version was reevaluated by the original group of expert reviewers, to finalize the Turkish version used in this study.

### Procedure

Two psychiatrists reviewed the content, instructions, and scoring criteria for each item of the Turkish version of the BBS. Examinations were done in both the nursing home and outpatient department of the hospital. These psychiatrists (FS, AO) simultaneously and independently examined 20 subjects in order to evaluate inter-observer reliability. The next day, these psychiatrists examined a second set of 20 subjects, in the morning and again in the afternoon, in order to evaluate intra-rater reliability. The final group of 2 subjects was evaluated the following day. All subjects were reevaluated 2 weeks later. In the second examination functional ambulation category, the level of ambulation, self-perception of well-being, and MBI was asked and TUGT and BBS were repeated once more for test-retest evaluation.

### Statistical analysis

The NCSS 2007 software package program was used for all statistical analyses. Descriptive statistics (mean  $\pm$  standard deviation) were determined for subject characteristic and performance on functional scales.

Reliability study: Intra- and inter-rater reliability of the total BBS scores were calculated with using intraclass correlation coefficients (ICC). Cronbach's  $\alpha$  was used to assess internal consistency of the BBS total scores of the 60 subjects. ICCs were used to evaluate test-retest reliability of the measure, with 95% confidence intervals as an indicator of precision of the test-retest agreement.

Convergent validity was assessed by examining correlation between BBS with TUG and MBI scores. Since correlation and validation of BBS with TUG was established previously, these evaluation methods were preferred in the Turkish validation study.<sup>9,14</sup> Factor analysis with varimax rotation was used to evaluate construct validity and dimensionality of the BBS.

### RESULTS

Forty-five female, and 15 male patients, mean age was  $77.00 \pm 5.67$  (range: 67- 92 yrs) years, were evaluated during the study. Twenty five were housewives, most others were retired from various occupations. The majority of subjects graduated from primary school ( $n=22$ ; 36.7%), high school ( $n=20$ ; 33.3%), or university ( $n=14$ ; 23.3%). Only 3 participants reported no medical problems. Co-morbidities included hypertension ( $n=27$ ), cardiac disease ( $n=18$ ), osteoporosis ( $n=14$ ), osteoarthritis ( $n=12$ ), diabetes mellitus ( $n=10$ ), cerebrovascular accidents ( $n=5$ ), thyroid disease ( $n=4$ ), vertigo ( $n=4$ ), pulmonary disease ( $n=3$ ), rheumatoid arthritis ( $n=3$ ), hypercholesterolemia ( $n=3$ ), ischemic heart disease ( $n=5$ ), renal failure ( $n=1$ ), pulmonary disease ( $n=3$ ), Parkinson disease ( $n=1$ ), polyneuropathy ( $n=1$ ), and epilepsy ( $n=1$ ).

Subjects' FAC scores, ambulation levels, general health status, living place, and used assistive devices are summarized in Table 1. The majority of subjects (80%) had optimal FAC and ambulation levels, and 95% of them evaluated their general health status as very good to good. Of the subjects, 39 resided in the nursing home, 19 were living in the community by themselves, and 2 were living with relatives. Forty-six of the 60 subjects ambulated without walking aids, while 11 used a cane, and 3 used unilateral Loftstrand/forearm crutch.

The mean BBS score was  $47.63 \pm 9.88$  points, mean of total MBI score was  $95.41 \pm 10.60$  points, mean TUG period was  $16.63 \pm 19.81$  sec. Mean of each item for BBS in test and retest examinations are shown in Table 2.

### Reliability and validity of the Turkish BBS

Results of intra- and inter- rater reliability tests related to total BBS scores are shown in Table 3. ICC values for intra-and inter-rater reliability were found as 0.98 (95% CI:0.96-0.99), and 0.97 (95% CI: 0.94-0.99), respectively. Internal consistency (Chronbach's  $\alpha$ ) of BBS total score was calculated as 0.93. For test-retest reliability study, ICCs of each item and total score are shown in Table 4. Test-retest correlation coefficients of MBI and TUGT were also found as 0.93 ( $p < 0.0001$ ) and 0.99 ( $p < 0.0001$ ), respectively.

### Concurrent Validity

BBS scores were positively correlated with MBI total score ( $r = 0.67$ ,  $p < 0.0001$ ); higher BBS scores were associated with increas-

**Table 1. Demographic and General Assessment Data**

|  |                                     | <i>n</i>  | %    |
|--|-------------------------------------|-----------|------|
| <b>FAC*</b>  | Needs assistance of one             | 3         | 5    |
|  | Needs verbal supervision            | 5         | 8.3  |
|  | Needs assistance when outdoors      | 4         | 6.6  |
|  | Independent                         | 48        | 80   |
| <b>Ambulation level</b>  | Dependent at home                   | 4         | 3.5  |
|  | Dependent outdoors                  | 19        | 16.5 |
|  | Independent                         | 92        | 80.0 |
| <b>Self-Perception of health</b>   | Excellent                           | 2         | 1.7  |
|  | Very good                           | 60        | 52.2 |
|  | Good                                | 44        | 38.3 |
|  | Fair                                | 9         | 7.8  |
| <b>Living Arrangments</b>  | Nursing home                        | 39        | 65   |
|  | Own home                            | 19        | 31.7 |
| <b>Use of Walking aids</b>   | Without aids                        | 46        | 76.7 |
|  | Cane                                | 11        | 18.3 |
|  | Unilateral Lofstrand/forearm crutch | 3         | 5    |
| <b>BBS (§) total score</b>   | min 7 - max 56                      | 47.6±9.9  |      |
| <b>MBI (¶) total score</b>   | min 54 – max 100                    | 95.4±10.6 |      |
| <b>TUGT (‡) (second)</b>   | min 7 – max 150                     | 16.6±19.8 |      |
| * FAC, functional ambulation categories<br>§BBS: Berg balance scale<br>¶ MBI: Modified Barthel Index<br>‡ TUGT: Timed up&go test |                                     |           |      |

**Table 2. Test (visit 1) and Retest (visit 2) Mean Values of the Berg Balance Scale Items**

|                        | Visit 1    |       | Visit 2    |       |
|------------------------|------------|-------|------------|-------|
|                        | Score      | Range | Score      | Range |
| <b>BBS 1</b>           | 3.67±0.73  | 1-4   | 3.69±0.74  | 1-4   |
| <b>BBS 2</b>           | 3.83±0.7   | 0-4   | 3.81±0.72  | 0-4   |
| <b>BBS 3</b>           | 3.91±0.54  | 0-4   | 3.90±0.76  | 0-4   |
| <b>BBS 4</b>           | 3.82±0.41  | 2-4   | 3.80±0.44  | 2-4   |
| <b>BBS 5</b>           | 3.71±0.62  | 1-4   | 3.67±0.79  | 1-4   |
| <b>BBS 6</b>           | 3.73±0.83  | 0-4   | 3.67±0.90  | 0-4   |
| <b>BBS 7</b>           | 3.62±1.11  | 0-4   | 3.60±1.16  | 0-4   |
| <b>BBS 8</b>           | 2.86±0.96  | 0-4   | 2.96±1.02  | 0-4   |
| <b>BBS 9</b>           | 3.61±1.02  | 0-4   | 3.56±1.13  | 0-4   |
| <b>BBS 10</b>          | 3.65±1.01  | 0-4   | 3.65±0.98  | 0-4   |
| <b>BBS 11</b>          | 3.06±1.11  | 0-4   | 3.07±1.15  | 0-4   |
| <b>BBS 12</b>          | 3.15±1.3   | 0-4   | 3.18±1.29  | 0-4   |
| <b>BBS 13</b>          | 2.91±1.1   | 0-4   | 2.96±1.05  | 0-4   |
| <b>BBS 14</b>          | 2.2±1.33   | 0-4   | 2.07±1.35  | 0-4   |
| <b>BBS Total Score</b> | 47.63±9.88 | 7-56  | 47.63±10.1 | 8-56  |

**Table 3. Intra- and Inter-rater Reliability of Turkish Berg Balance Scale**

|                    | <b>Intraclass correlation coefficients</b> | <b>95 %Confidence Interval</b> |
|--------------------|--|--------------------------------|
| <b>Intra rater</b> | 0.98                                       | 0.96-0.99                      |
| <b>Inter rater</b> | 0.97                                       | 0.94-0.99                      |

ingly independent functional ambulation. There was a strong negative correlation between BBS total score and TUG ( $r = -0.75$ ,  $p < 0.0001$ ); High BBS and low TUG times both indicating better performance on these measures.

**Construct Validity**

Factor analysis of the 14 items in the BBS revealed 2 factors above eigenvalue 1 were more prominent (Table 5). Total matrix variance was 70 % for both factors (factor 1, 58.2 %; factor 2, 11.7 %). Factor 1 involved in mostly static activities where feet were motionless such as standing and sitting unsupported, standing with eyes closed, standing with feet together, retrieving object from floor, turning to look behind, placing alternate foot on stool, standing with one foot in front, standing on one foot; however, Factor 2 was usually related to dynamic activities involving truncal movements such as sitting to standing, standing to sitting, transfers, reaching forward with outstretched arm, turning 360°.

**DISCUSSION**

Berg Balance Scale is frequently used to evaluate postural control and estimate risk of falling in older adults.<sup>14</sup> The English version of

**Table 4. Reliability Study of Berg Balance Scale**

|                        | <b>Test-retest reliability ICC (95% Confidence Interval)</b> |
|------------------------|--|
| <b>BBS 1</b>           | 0.98 (0.97 - 0.99)   |
| <b>BBS 2</b>           | 0.99 (0.96 - 0.99)   |
| <b>BBS 3</b>           | 0.99 (0.99 - 0.99)   |
| <b>BBS 4</b>           | 0.95 (0.91 - 0.97)   |
| <b>BBS 5</b>           | 0.99 (0.98 - 0.99)   |
| <b>BBS 6</b>           | 0.94 (0.90 - 0.97)   |
| <b>BBS 7</b>           | 0.99 (0.99 - 0.99)   |
| <b>BBS 8</b>           | 0.87 (0.78 - 0.92)   |
| <b>BBS 9</b>           | 0.89 (0.82 - 0.94)   |
| <b>BBS 10</b>          | 0.98 (0.97 - 0.99)   |
| <b>BBS 11</b>          | 0.86 (0.76 - 0.91)   |
| <b>BBS 12</b>          | 0.94 (0.89 - 0.96)   |
| <b>BBS 13</b>          | 0.86 (0.76 - 0.91)   |
| <b>BBS 14</b>          | 0.87 (0.79 - 0.92)   |
| <b>BBS Total Score</b> | 0.98 (0.97 - 0.99)   |

**Table 5. Result of Factor Analysis of each Turkish BBS Item**

| <b>Rotated Component Matrix</b>             | <b>Component</b> |              |
|---|------------------|--------------|
|   | <b>1</b>         | <b>2</b>     |
| BBS1 sitting to standing                    |                  | 0.755        |
| BBS2 standing unsupported                   | 0.889            |              |
| BBS3 sitting unsupported                    | 0.857            |              |
| BBS4 standing to sitting                    |                  | 0.894        |
| BBS5 transfers                              |                  | 0.711        |
| BBS6 standing with eyes closed              | 0.826            |              |
| BBS7 standing with feet together            | 0.679            |              |
| BBS8 reaching forward with outstretched arm |                  | 0.605        |
| BBS9 retrieving object from floor           | 0.751            |              |
| BBS10 turning to look behind                | 0.75             |              |
| BBS11 turning 360 degrees                   |                  | 0.527        |
| BBS12 placing alternate foot on stool       |                  | 0.637        |
| BBS13 standing with one foot in front       | 0.673            |              |
| BBS14 standing on one foot                  | 0.891            |              |
| <b>Total</b>                                | <b>8.149</b>     | <b>1.631</b> |
| Initial eigenvalues (% of variance)         | 58.2             | 11.65        |

the measure has been examined for use in assessing individuals with stroke,<sup>19-21</sup> Parkinson disease,<sup>22</sup> and brain injury.<sup>23,24</sup> The BBS is also used to predict length of stay and discharge destination from acute and rehabilitation settings.<sup>24,25</sup> The goal of this study was to evaluate validity and reliability of a Turkish language version of this scale

During translation of the scale, there were only minor differences among the three translators and a group of health professionals who would be using the scale. Table 6 summarize the items whose item stem or rating statements required clarification or revision. Items 2, 3, 6, 11, and 13 required clarification working of criteria used to distinguish between a rating of 3 and a rating of 4. To accomplish this, the Turkish equivalents of the original terms “safely and securely” were changed to “emniyetli bir şekilde.” The Turkish version of the term “supervision” in level 3 was placed at the beginning of the sentence in accordance with Turkish syntax. With these changes, reviewers reached consensus about the interpretation of performance criteria. Reviewer’s recommendations concerning modifications in time intervals and distances in items 8 and 14 were rejected because of our desire to remain faithful to the original intelligible terminology of the scale. On item 10, reviewers found criteria confusing, stating that it was unclear whether the rotation occurred at the head or trunk; the first criterion statement was critically examined, and amended to clarify intent. For Item 5, the most frequently noted problematic item, the term “pivot” was replaced by “to be transferred” to clarify the activity being examined.

In using the Turkish BBS to examine subjects, examiners most often selected a rating of 3 or 4 (81% of the time). This is consistent



**Table 6. Number and Percentages of Unintelligible Questions in the Turkish Version of Berg Balance Scale as Reported by Psychiatrists, and Physiotherapists**

| BBS Item | n | %    |
|----------|---|------|
| 1        | 0 | 0    |
| 2        | 2 | 14.3 |
| 3        | 2 | 14.3 |
| 4        | 0 | 0    |
| 5        | 5 | 35.7 |
| 6        | 3 | 21.4 |
| 7        | 0 | 0    |
| 8        | 4 | 28.6 |
| 9        | 0 | 0    |
| 10       | 3 | 21.4 |
| 11       | 3 | 21.4 |
| 12       | 0 | 0    |
| 13       | 3 | 21.4 |
| 14       | 2 | 14.3 |

with reports of BBS scaling by Kornetti et al,<sup>26</sup> Wang et al,<sup>27</sup> and Halsaa et al.<sup>28</sup> This possibly reflects the higher functional status of subjects recruited for the study, who were living in the community or nursing homes rather than from among individuals with acute medical problems referred to rehabilitation or rheumatology clinics. In our study, mean BBS value was higher ( $47.63 \pm 9.88$ ) than the previously reported cut-off value of 45 for risk of falls, indicating our sample included many subjects with low risk of falling.<sup>9,10,26,29,30</sup> According to FAC, the detection of the maximal level (level 5) in 80% of the patients, and the highest ambulation level (level 3) in 80% of the patients suggests that the participants had good functional capabilities.

Since the BBS can be used both for evaluation and reevaluation of postural control, often by more than one physician or physiotherapist over time, it is important to evaluate intra- and inter-rater reliability were calculated. The ICC values for intra- and interobserver reliabilities were determined as 0.98 and 0.97, respectively. This is consistent with previous findings evaluating the original scale as well as Brazilian, Norwegian, and Italian translated versions.<sup>7,8,14,28,30,31</sup> Intraclass coefficients above 0.80 are indicators of higher reliability which was achieved in all investigations.<sup>32</sup>

Chronbach's  $\alpha$  coefficient provides us with internal consistency of the scale tested where values over 0.80 are accepted as a higher index of consistency.<sup>32</sup> In our study Chronbach's  $\alpha$  coefficient is higher (ie, 0.98) for the BBS total score. The corresponding values in the Norwegian and Italian studies were found as 0.87 and 0.95, respectively (7,28). Only in the Taiwanese study Chronbach's  $\alpha$  value of 0.77 was detected.<sup>31</sup>

Test-retest reliability is used to assess the consistency of a measure from one time to another. This value was estimated using ICCs.<sup>33</sup> Strong ICC and Chronbach  $\alpha$  values in the Turkish version of BBS

imply the homogeneity of variables and reproducibility of the items like the original scale.<sup>9,10</sup>

Concurrent validity was assessed by looking at the magnitude and direction of the correlation of Turkish BBS score to other performance or scores on other measures. We anticipated a negative correlations between BBS score and TUG times, such that high BBS scores (indicating effective postural control) would be associated with lower TUGT times (indicating effective mobility). We anticipated a positive correlation between BBS scores and MBI, where high scores on both measure indicate higher levels of function. Our findings of a strong negative correlation with TUG ( $r=-0.75$   $p=0.0001$ ), and a strong positive one with MBI ( $r=0.67$ ,  $p=0.0001$ ) are similar to previous studies, and provide evidence of validity of the Turkish version of the BBS.<sup>9,14</sup>

In our study 2 factors had a 70% matrix variance as demonstrated by factor analysis (Table 4). Factor 1 was related to static activities in which lower extremities were motionless. Factor 2 included dynamic activities associated with movement of the trunk. Factors with similar constructs were reported in the studies of the Italian (2 factors) and Norwegian (3 factors) versions of the BBS.<sup>7,28</sup>

The results of this study indicate that the Turkish version of BBS is a reproducible, reliable, and valid measure of postural control for Turkish-speaking patients aged over 65 which can be used in the rehabilitation of the elderly.

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