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THE RELIABILITY AND VALIDITY OF THE TURKISH VERSION OF THE FULLERTON ADVANCED BALANCE (FAB-T) SCALE

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Highlights
- The FAB-T scale was successfully translated from the original English version (FAB) to Turkish language.
- The FAB-T scale has very high inter-rater and intra-rater reliability.
- There was a good agreement between the FAB-T and Berg Balance Scale (BBS).
- The scale has high correlation with the BBS.
- The FAB-T has no floor and ceiling effect.
Abstract: Purpose: The aim of this study was to evaluate the reliability and validity of the Turkish version of the FAB(FAB-T) scale in the older Turkish adults.
Methods: The reliability and validity of the scale was tested on 200 community-dwelling older adults. FAB-T scale was scored by different physiotherapists on different days to evaluate inter-rater and intrarater reliability. The Berg Balance Scale (BBS) was used for the evaluation of convergent validity, and the content validity of the FAB-T scale was investigated.
Results: The FAB-T scale showed very high inter- and intra-rater reliability. For inter-rater agreement, on the individual test items and total score ICC values were 0.92 (95 %CI: 0.90 — 0.94) and 0.96 (95% CI; 0.95 — 0.97) respectively. The intra-rater agreement, on the individual test items and total score ICC values were 0.93 (95 %CI; 0.91 — 0.95) and 0.96 (95% CI; 0.95 — 0.97) respectively. There was a good agreement between the FAB-T and BBS scales. A high correlation was found between the BBS and FAB-T scales [rho=0.70 (%95 CI; 0.62—0.76)] indicating good convergent validity. Considering the content validity of the FAB-T scale, no floor (floor score: 0%) or ceiling (ceiling score: 6.5%) effect was detected.
Conclusion: The FAB-T scale was successfully translated from the original English version (FAB) and demonstrated strong psychometric features. It was found that the FAB-T scale has very high inter-rater and intra-rater reliability. Considering the convergent validity, the scale has high correlation with the BBS. The FAB-T has no floor and ceiling effect.

Keywords: Reliability, Validity, Fullerton Advanced Balance Scale, Turkish, Older adults

Introduction

The World Health Organization (WHO) states that; "Population ageing is a triumph of humanity but also a challenge to society" (World Health Organization, 2002, p.6). Older adults with higher cognitive impairment are more prone to experience falls and the percentage of falling increases with age (Taylor et al., 2013; Booth, Hood, & Kearney, 2016; Iyigün et al., 2016). Balance problems may contribute to internal factors such as fear of falling and physical activity restrictions, and also affect activities of daily living (ADLs) and health-related quality of life (HRQOL) (Hoang et al., 2017; Boyd & Stevens, 2009; Angın et al., 2016). Falls are amongst the most important causes of morbidity and mortality, and may impose a significant burden on health and social services. Therefore they constitute a major public health concern and are regarded as a geriatric syndrome. (Noll, 2013; Masud & Morris, 2001) Between 30% and 40% of community-dwelling older adults fall at least once a year and the percentage increases with each decade after the age of 65 (Noll, 2013, Michael et al., 2010). The incidence of falls may vary among countries due to many reasons such as cultural and environmental conditions. According to WHO reports, high-income countries account for 25% of the total number of fatal falls worldwide with the mortality rate (6.6-11.3/100.000) being highest in Europe. Although not as high as Europe, fall-related mortality rates in the Eastern Mediterranean region (2.7-4.3/100.000)
are relatively high (WHO, 2002). Despite the limited number of studies, the rate of falling incidence has been reported as 28.5% in Turkey (Halil et al., 2006).

Various injuries, fractures, and complications like fear of falling, functional impairment, and social isolation may occur in relation to falling (Stalenhoef et al., 2002). Hip fractures are common consequences of falls in older adults, and from those, between 25% and 75% never recover their pre-fracture level of function and mortality rate within one year is between 20%-30% (Noll, 2013; Shupert & Horak, 2016). Even if the falls do not cause any fracture, they may still lead to pain and injury, which consequently reduces future mobility (Shupert & Horak, 2016). These people may also have a fear of falling resulting in limited mobility and reduced physical activity. Reduced levels of physical activity may lead to chronic diseases such as sarcopenia, Diabetes Mellitus, metabolic syndrome, Coronary Heart Disease, hypertension, stroke, and cognitive dysfunction (Booth, Roberts, & Laye, 2012). Therefore, falls impair the quality of life of older people (Shupert & Horak, 2016). Falling related complications may constitute a major portion of health service costs. Hence, the prevention of balance problems and falls is crucial to prevent chronic disease and improve global health.

The assessment of balance and risk of falling in older adults is important in order to detect possible threats and to reduce risk factors. Using these kinds of sophisticated assessment tools is very important for preventing falls and reducing healthcare requirements for older adults. There are several functional assessment tools that are being used as fall risk tools for older adults; including the Berg Balance Scale (BBS), Timed Up and Go (TUG) test, Performance-Oriented Mobility Assessment (POMA), and Dynamic Gait Index (DGI). The studies investigating these assessment tools have demonstrated the usefulness of these tests in fall risk prediction; however, they may interact differently according to different functional levels and age of older adults. The results of these studies emphasize that the identified clinical tests are more successful in predicting fall risk in more frail older adults than they are in higher functioning older adults. From the aforementioned scales, the BBS appears to be the most commonly used assessment tool in community-dwelling older adults (Boulgarides et al., 2003). It was stated by Berg et al. when first developing the scale that there was a lack of items measuring reactive postural control (e.g. response to an external stimulus) or standing on an uneven support surface, which might limit the effectiveness of the scale when identifying more subtle balance deficits in more functionally independent older adults. It was indicated that the BBS has relatively easy items for measuring sitting balance (sitting unsupported- item 3), quiet stance (standing unsupported- item 2), and Romberg stance (standing with feet together- item 7), despite having a more difficult item measuring single-leg stance for a short duration (10 seconds). The omission of more challenging balance tasks has resulted in ceiling effects when the scale is administered to older adults at higher functional levels (Berg et al., 1989; Newton, 1997).
It has been suggested that there is a need for development and testing of tools targeting the aging population at higher functional levels (Klein, Fiedler, & Rose, 2011; Hernandez & Rose, 2008). The Fullerton Advanced Balance (FAB) scale was developed in order to identify more subtle changes in the multiple dimensions of balance (e.g., motor, sensory, musculoskeletal) among higher-functioning active older adults. The FAB scale includes more challenging balance tasks (static and dynamic), that are less prone to ceiling effects when administered to more functionally active older adults. It has been suggested that the FAB scale may provide clinicians with a better understanding of the problems underlying balance deficits and result in better treatment plans (Rose, Lucchese, & Wiersma, 2006). Although the FAB scale is a very useful assessment tool, heretofore, it has not been translated into the Turkish language. Therefore, the aim of this study was to evaluate the reliability and validity of the Turkish version of the FAB (FAB-T) scale in older Turkish adults.

Methods

PARTICIPANTS

A total of 200 community-dwelling older adults aged between 65 to 85 years were included in the study. Individuals who were able to walk (assessed with 10 Meters Walking Test- 10 MWT) independently with or without assistive device and who scored above 21 on the Standardized Mini Mental Test (SMMT) were included in the study (Lopez et al., 2005). Individuals who had orthopedic impairments, neurological problems, moderate to severe cognitive problems, severe vision and hearing problems that caused disability in balance and mobility were excluded from the study.

The ethics committee approval of the study was granted by the Board of Scientific Research and Publications of Eastern Mediterranean University dated 12.06.2017 and numbered 2017/45-02. After written and verbal information was provided to individuals about the study, written informed consents were obtained from the volunteers.

PROCEDURE

Translation

In the first phase of the study, permission for preparation of the Turkish version of the FAB scale was obtained from Debra Rose, lead developer of the scale. Then, the original FAB scale was
translated from English to Turkish (forward translation) by two Physiotherapists (PT-1, PT-2) who are native Turkish language speakers and fluent in English. Any inconsistencies in the first translation (Turkish-English) were analyzed by a third independent interpreter, and a common text was formed. This text was then retranslated from Turkish to English (backward translation) by a bilingual translator whose native language was English but who was also fluent in Turkish, and the backward translation was cross-verified with the original version.

In the second phase, following the translation procedure, a pilot study was conducted on older adults (n=58) over the age of 65. Following the results of the pilot study, eight items (1, 3, 5-10) of the FAB scale were translated into Turkish directly without cultural adaptations. One item (item 2) led to confusion when translated directly into Turkish (outstretched arm) and required adaptation relating to semantic equivalence. One item (item 4) required conversion of measurement units to European measurements (inch to cm) for feasibility. There was no detailed explanation in the form of information boxes on the original test form; therefore we added information boxes containing testing administration instructions and small information notes related to each item (Appendix 1). After the adaptation process, the current version was sent back to the lead developer of the FAB scale for review and the suggested changes were made on the Turkish translation. The detailed test administration instructions developed for the FAB scale that included the purpose of each test item, equipment needed, safety procedures, testing procedures, and verbal instructions were also translated from English to Turkish. (Guillemin, Bombardier, & Beaton, 1993; Beaton et al., 2000; Cull et al., 2002.)

Study Design

After translation and cultural adaptation of the scale, study participants were assessed by two different PTs (PT-1 and PT-2), on three different days (day 1, day 2 and day 14) to establish the validity and reliability of the Turkish version of the scale. After demographic information was recorded, the Berg Balance Scale and FAB scale were administered by PT-1 on the first assessment (day 1) (1st assessment) for the evaluation of convergent validity. On the following day (day 2), blinded PT-2 assessed the same participants using only the FAB scale (2nd assessment) for the evaluation of inter-rater reliability. For the evaluation of intra-rater reliability, PT-1 repeated the FAB scale assessment on all participants 2 weeks (day 14) after the second assessment as the third assessment (3rd assessment) (Figure 1). All assessments were completed while the raters observed the participants performing each test item in a live situation.

Instruments

Participant demographic information recorded included age, gender, height (cm), body mass index (BMI), medications, education level and occupational status. The participants were also
questioned about alcohol and cigarette consumption. Balance status was assessed using the Fullerton Advanced Balance (FAB) scale and the Berg Balance Scale (BBS).

Fullerton Advanced Balance (FAB) Scale

The FAB scale was developed to evaluate subtle changes in the multiple dimensions of balance (Rose, Lucchese, & Wiersma, 2006). This performance-based scale consists of 10 test items assessing functional balance (static and dynamic) status in older people. The individual test items are: 1. Feet together, eyes closed, 2. Reach forward to retrieve an object, 3. Turn in a full circle, 4. Step up and over a bench, 5. Tandem walk, 6. Stand on one leg, 7. Stand on foam, eyes closed, 8. Two-footed jump, 9. Walk with head turns, 10. Reactive postural control. Each test item is scored using a 0-4 scale. The highest score that can be obtained on this multidimensional balance assessment is 40 points, and the lowest is zero. Higher scores indicate better balance abilities. The FAB scale is quick to administer (~10-12 minutes) and can be administered in a relatively small area.

Berg Balance Scale (BBS)

The BBS is a valid instrument for assessing the risk of falls and postural control in older adults. It measures the ability of maintaining dynamic and static balance during functional activities (Brauer, Burns, & Galley, 2000; Boulgarides et al., 2003; Berg et al., 1992). The Turkish version of the scale was used in a study and found to be reliable and valid when administered to the Turkish population (Şahin et al., 2008). During the test, participants are asked to perform 14 tasks frequently used in daily life activities. Each item is scored between 0 (unable to perform the task) and 4 (task is performed independently) according to the ability of the person while performing the task. The highest possible score is 56 points. Total scores between ‘0 and 20 points’ indicate high fall risk, from ‘21 to 40 points’ medium fall risk, and ‘41 to 56 points’ low fall risk (Berg et al., 1992).

Statistical Analysis

In this study, we used the PAWS 18 software (release 18:00) for statistical analyses. Prior to further analysis, missing values for each scale were checked. The demographic data of the participants was presented as; age (years), BMI (kg/m²), gender, education level, alcohol and cigarette consumption (%), and number of fallers (‘faller’ participants who fall at least once in the previous 12 months).
Intra-rater and inter-rater correlation coefficients for the individual test items and total score on the FAB Scale were determined using Spearman’s Correlation Coefficients (rho). Spearman’s 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- 0.50 and negligible: 0.00 – 0.30 (Hinkle DE, 2003). To assess intra- and inter-rater agreement, Intraclass Correlation Coefficient (ICC) estimates and their 95% confidence intervals were calculated based on absolute-agreement, 2-way mixed effect model. ICC values were interpreted as follows: moderate agreement: 0.50 – 0.75; good agreement: 0.75 – 0.90 and excellent agreement: > 0.90 (Portney & Watkins, 2000).

The difference of two paired measurements on the FAB-T and BBS scales is plotted against the mean of the two measurements. We hypothesized that 95% of the data points would lie within ± 1.96 standard deviation (sd) of the mean difference.

Convergent validity was examined using a correlation analysis between the FAB-T scale and the BBS total score. Spearman’s Correlation Coefficient was used to investigate the correlation between the FAB-T scale (1st assessment total score) and the BBS. Content Validity was assessed by examining the floor and ceiling effects. We hypothesized that the floor and ceiling effects would be less than 20% (McHorney & Tarlov, 1995).

Results
Sample characteristics
The characteristics of the participants are provided in Table 1. A total of 200 individuals aged between 65 - 85 years were included in the study. The distribution characteristics of the FAB-T scale are shown in Table 2.

Reliability
There were high correlations for individual test items for both intra-rater (1st assessment vs 3rd assessment) and inter-rater (1st assessment vs 2nd assessment) reliability, with the exception of items 2 and item 10 for inter-rater reliability (Table 3). According to Spearman Correlation Coefficients there were very high correlations between the total scores on the FAB-T scale. For inter-rater agreement, ICC values on individual test items and the total score were 0.92 (95 %CI; 0.90 — 0.94), and 0.96 (95% CI; 0.95 — 0.97) respectively. For intra-rater agreement, ICC values on the individual test items and total score were 0.93 (95 %CI; 0.91 — 0.95), and 0.96 (95% CI; 0.95 — 0.97) respectively.
Figure 2 shows the Bland-Altman Plot for the measurements of the FAB - T and BBS scales showing good agreement between the FAB-T and BBS scales. Ninety-six percent of the data points were within ± 1.96 sd of the mean difference.

Validity

Convergent validity: There was a high correlation between the total scores of the BBS and the FAB-T scale, which were obtained from the 1st assessment of all participants, rho=0.70 (%95 CI; 0.62—0.76).

Content validity: In the first evaluation, a ceiling score for the FAB-T scale was calculated as “40” and the ratio to the total population was 6%. The floor score for the FAB-T scale based on the first evaluation was calculated as “0”, and its ratio was 0% in the whole population. As a result, there were no floor and ceiling effects observed for the FAB-T scale in this sample. Twelve individuals out of 200 recorded the highest total score on the FAB scale whereas 66 individuals scored the highest total score on the BBS, with a maximum score of 56 points. Histograms showing the distribution of scores for the FAB-T scale and BBS are shown in Figure 3.

Discussion

Falls and fall-related injuries are amongst the major public health challenges requiring global attention. As the population ages, falls and fall-related injuries will increase in many nations throughout the world. According to the WHO, prevention is key for health promotion and it should be a major issue of focus among health professionals. Considering falls and fall-related injuries, prevention must be accompanied with the early detection of fall risks. Thus, the aim of this study was to validate the Turkish version (FAB-T) of the FAB scale, which is designed to measure balance in functionally independent older adults in the Turkish population. The results showed that the Turkish version of the FAB-T scale has good psychometric properties, in terms of reliability (very high inter-rater and intra-rater reliability), convergent validity (high correlation with the BBS) and content validity (no floor and ceiling effects).

Analysis of inter-rater reliability was carried out to evaluate the degree of agreement among raters, and it was found to be “very high” in a sample of older Turkish people. A “very high” inter-rater reliability indicates a consistent measurement between different testing times, suggesting that there are no changes between the two measurements. For intra-rater reliability, which is defined as the degree of agreement among repeated administrations performed by a single rater, the results showed that the FAB-T scale total score has “very high” intra-rater reliability. Similar to the original English
version [FAB: inter-rater reliability (0.94—0.97) and intra-rater reliability (0.97—1.00)] (Rose, Lucchese, & Wiersma, 2006) and the German version [FAB-D: intra-rater reliability (0.96)] (Schott, 2011) of the scale, FAB-T was found to be reliable as measured at different times by the same rater as well as by different raters.

In terms of the consistency between the FAB-T and the convergent measure BBS; there was a high correlation between the two balance scales in our study (r=0.80). The correlations between the BBS and FAB scale in other languages bear a resemblance with our study; moderate correlation was found in the original version (r=0.75) (Rose, Lucchese, & Wiersma, 2006) and, moderate to good correlation was found on both the Persian version (r=0.65) and the German version (r=0.68). These results obtained in the Turkish version and other versions indicate a similarity of the constructs of the BBS and FAB scales. However, while both the BBS and FAB scales evaluate balance and fall risk, the FAB scale measures more dimensions of balance versus the BBS and the majority of items are considerably more challenging on the FAB scale compared to the BBS. Additionally, it is known that the BBS mainly measures steady state balance and anticipatory postural control (defined as “the ability to shift the center of mass before a voluntary movement”), whereas the FAB scale involves the measurement of static and dynamic balance control, sensory orientation, anticipatory and reactive postural control (defined as “the ability to recover stability after an external perturbation to bring the center of mass within the base of support”) (Sibley et al., 2015). The Bland-Altman Plot shows that there is also good agreement between the FAB-T and BBS scales. These two tests might preferred to be used in people with different functional levels, hence the FAB-T scale would be more useful when used in higher functioning older adults in order to assess multiple dimensions of balance in a shorter time.

In addition, no floor or ceiling effects were detected for the FAB-T scale in our sample of older adults. To the best of our knowledge, there is no published study to date investigating the floor and ceiling effects of the FAB scale in any language for the healthy older adults. Although the study of Schlenstedt et al has detected minimal ceiling effects in patients with Parkinson’s disease it should be bear in the mind that the FAB scale were not developed for the clinical population. It has been stated in the literature that the BBS has a ceiling effect when administered to healthy people less than 75 years of age, even if they have an increased fall risk (Downs, 2015). As stated earlier, the FAB scale includes more difficult static and dynamic balance tasks, and is therefore less prone to ceiling effects (except for item 1 that showed a ceiling effect in the original Rose et al. study). As such it may be a more sensitive instrument in measuring balance deficits in higher functioning older adults. In a study involving a group of older people (n=192), it was found that none of the participants recorded a score of 40 out of 40, with the highest total score obtained for the FAB scale being 38 out of 40 (Hernandez & Rose, 2008).
Counterbalancing the administration of the FAB-T and BBS during the 1\textsuperscript{st} assessment was intended to minimize an order effect; therefore we did not consider that to be a major limitation of this study. The FAB-T scale is designed to identify balance abilities in higher functioning individuals who are at increased risk of falling by evaluating the multiple dimensions of balance (i.e. anticipatory and reactive postural control). Following the recommendations of the developers of the FAB scale, we included older adults with higher physical abilities (FAB-T mean score: 32/40 and BBS mean score: 52/56) in this study. It is recommended that future studies assess the utility of the FAB-T scale when administered to less active older adults or in various patient groups with balance deficits. Discriminating between high-active and low-active groups with the use of the FAB-T scale may be another possible future direction.

Clinical relevance: Valid measurement tools used in the evaluation of older people provide important information to support effective clinical interpretation and intervention by clinicians. This study shows that the FAB-T is a valuable measurement tool for clinicians, especially when administered to older adults at higher levels of functional ability.

Conclusion

The results of this study demonstrate that the FAB-T scale has very high inter-rater and intra-rater reliability. The FAB-T scale was found to be a valid measurement tool considering its convergent validity when compared to the BBS and content validity results in older people. The FAB-T also demonstrated no floor or ceiling effects; it should be noted, however, that more studies should be conducted to determine the floor and ceiling effects of the FAB scale in other translated languages and when administered to different patient groups. For the researchers and clinicians working in the field of older adult health, the FAB-T scale is now available in Turkish for the assessment of various balance problems, and it is believed that the scale will rank among the most valuable instruments for planning effective interventions in fall prevention.

Funding

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Conflicts of interest

There are no conflicts of interest.
References


Figure 1. Study design

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PERMISSION TO TRANSLATE FAB SCALE (April 2017)

Received from Debra J. Rose

TRANSLATION (June 2017)

- Forward translation: Translation from English to Turkish by two physiotherapists (PT-1 and PT-2)
- Backward translation: Reverse translation from Turkish to English by bilingual translator

PILOT STUDY (July 2017)

- The study was done on elderly with older adult participants (N: 58) over the age of 60 years
- 8 questions were translated without any adaptations
RELIABILITY AND VALIDITY (October 2017)

- The study was done on elderly participants (N: 200) between the ages of 65-85 years
- Assessed by:
  - PT-1 on day 1 (1st assessment)
  - PT-2 on day 2 (2nd assessment)
  - PT-1 on day 14 (3rd assessment)

Figure 2. Bland-Altman plot comparing FAB-T and BBS scale
The horizontal lines represent the 95% confidence interval for the difference between FAB-T and BBS scales.

Figure 3. Histograms showing the distribution of scores for the FAB-T scale (A) and BBS (B)
Table 1: Sample Characteristics of the Participants (N: 200)
Sample characteristics are expressed as mean ± sd for continuous variables and n (%) for categorical variables.

Abbreviations: BMI, Body Mass Index; SMMT, Standardized Mini Mental Test; FAB-T, Fullerton Advance Balance- Turkish; BBS, Berg Balance Scale.

<table>
<thead>
<tr>
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<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>103 (51.5)</td>
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<tr>
<td>Male, n (%)</td>
<td>97 (49.5)</td>
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<tr>
<td>Age, (years) x±sd</td>
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<tr>
<td>BMI, (kg/m²) x±sd</td>
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<td>Education Level</td>
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<tr>
<td>Primary (grade 1-5) n (%)</td>
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<td>Middle (grade 6-8) n (%)</td>
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<td>High (grade 9-12) n (%)</td>
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<td>Cigarette consumers n (%)</td>
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<td>Alcohol consumers n (%)</td>
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<tr>
<td>Falling history</td>
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<td>Non-faller, n (%)</td>
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<tr>
<td>SMMT score, (0-30) x±sd</td>
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<tr>
<td>FAB-T score, (0-40) x±sd</td>
<td>31.99±6.66</td>
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<tr>
<td>BBS score, (0-56) x±sd</td>
<td>52.08±5.49</td>
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Table 2: The Distribution Characteristics of the FAB-T Scale

<table>
<thead>
<tr>
<th></th>
<th>1&lt;sup&gt;st&lt;/sup&gt; assessment</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; assessment</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; assessment</th>
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<tbody>
<tr>
<td>Standard deviation</td>
<td>6.669</td>
<td>6.479</td>
<td>6.419</td>
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<tr>
<td>Skewness</td>
<td>-1.179</td>
<td>-1.281</td>
<td>-1.497</td>
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<tr>
<td>Standard error of skewness</td>
<td>0.172</td>
<td>0.172</td>
<td>0.172</td>
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<tr>
<td>Percentiles</td>
<td></td>
<td></td>
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<tr>
<td>25</td>
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<td>29,00</td>
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<tr>
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<tr>
<td>75</td>
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Table 3: Intra-Rater and Inter-Rater Correlation Coefficients for Individual Test Items and Total Score on FAB-T Scale

<table>
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<tr>
<th>FAB-T Item #</th>
<th>Correlation coefficients (rho)</th>
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<tr>
<td></td>
<td>1st assessment vs 3rd assessment (intra-rater)</td>
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<tr>
<td>1</td>
<td>0.72</td>
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<tr>
<td>2</td>
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<tr>
<td>3</td>
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<td>4</td>
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<tr>
<td>6</td>
<td>0.82</td>
</tr>
<tr>
<td>7</td>
<td>0.82</td>
</tr>
<tr>
<td>8</td>
<td>0.87</td>
</tr>
<tr>
<td>9</td>
<td>0.84</td>
</tr>
<tr>
<td>10</td>
<td>0.72</td>
</tr>
<tr>
<td>Total score</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Abbreviations: rho, Spearman’s Correlation Coefficient, FAB-T: Fullerton Advance Balance- Turkish