EVALUATION OF THE VALIDITY AND RELIABILITY OF THE TURKISH VERSION OF THE ACTIVITY-SPECIFIC BALANCE CONFIDENCE SCALE IN INDIVIDUALS WITH LOWER EXTREMITY AMPUTATIONS

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ABSTRACT

Falls are common in individuals with lower extremity amputations, often leading to physical injuries and fear of falling. This fear can reduce daily activity, social participation, and quality of life. Therefore, balance assessment should consider not only physical performance but also psychological factors, motivation, and confidence, which influence balance and prosthesis use. The Activity-Specific Balance Confidence (ABC) Scale is a 16-item self-efficacy measure designed to assess fear of falling. To evaluate the validity and reliability of the Turkish translation of the ABC scale in a lower limb amputee population. The ABC scale was administered to 80 individuals with limb loss twice, with a one week interval between tests. Confirmatory Factor Analysis was performed to asses construct validity The Cronbach's alpha coefficient was calculated to analyze internal consistency. Spearman's correlation coefficient were calculated to determine test–retest reliability. Confirmatory factor analysis confirmed that the Turkish version of the ABC Scale has a single-factor structure. The Spearman's correlation coefficient (ICC) for the Turkish version was 0.93, indicating high test–retest reliability. Cronbach's α was 0.937, split-half reliability was 0.943, and McDonald's ω was 0.90. These findings indicate excellent internal consistency of the scale. The Turkish version of the ABC scale is a valid and reliable tool for assessing balance confidence in lower limb amputees using prostheses.

Keywords: Balance confidence, Lower-limb amputation, Reliability and validity, Prosthesis users

ALT EKSTREMİTE AMPUTASYONU OLAN BİREYLERDE AKTİVİTEYE ÖZGÜ DENGE GÜVENİ ÖLÇEĞİNİN TÜRKÇE VERSİYONUNUN GEÇERLİK VE GÜVENİRLİĞİNİN DEĞERLENDİRİLMESİ

ÖZET

Düşmeler, alt ekstremite amputasyonu olan bireylerde yaygındır ve sıklıkla fiziksel yaralanmalara ve düşme korkusuna yol açar. Bu korku, günlük aktivite düzeyinde, sosyal katılımda ve yaşam kalitesinde azalmaya neden olabilir. Bu nedenle denge değerlendirmesi, yalnızca fiziksel performansı değil; psikolojik faktörleri, motivasyonu ve özgüveni de dikkate almalıdır, çünkü bunlar dengeyi ve protez kullanımını etkiler. Aktiviteye Özgü Denge Güveni (ABC) Ölçeği, düşme korkusunu değerlendirmek amacıyla geliştirilmiş 16 maddelik bir öz-yeterlilik ölçüm aracıdır. Alt ekstremite amputasyonu olan bireylerde ABC Ölçeği'nin Türkçe çevirisinin geçerlik ve güvenirliğini değerlendirmek. Geçerlik–Güvenirlik Çalışması. ABC Ölçeği, uzuv kaybı olan 80 bireye iki kez uygulanmış olup testler arasında bir haftalık süre bırakılmıştır. Yapı geçerliğini değerlendirmek için Doğrulayıcı Faktör Analizi yapılmıştır. İç tutarlılığı analiz etmek için Cronbach alfa katsayısı hesaplanmıştır. Test–retest güvenirliğini belirlemek için Spearman korelasyon katsayısı hesaplanmıştır. Doğrulayıcı faktör analizi, ABC Ölçeği'nin Türkçe versiyonunun tek faktörlü bir yapıya sahip olduğunu doğrulamıştır. Türkçe versiyon için Spearman korelasyon katsayısı (ICC) 0.93 bulunmuş olup yüksek test–retest güvenirliğini göstermektedir. Cronbach alfa 0.937, yarıya bölme güvenirliği 0.943 ve McDonald's ω 0.90 olarak hesaplanmıştır. Bu bulgular ölçeğin mükemmel iç tutarlılığa sahip olduğunu göstermektedir. ABC Ölçeği'nin Türkçe versiyonu, protez kullanan alt ekstremite amputasyonlu bireylerde denge güvenini değerlendirmek için geçerli ve güvenilir bir araçtır.

Anahtar kelimeler: Denge güveni, Alt ekstremite amputasyonu, Güvenirlik ve geçerlik, Protez kullanıcıları

INTRODUCTION

Rehabilitation with gait training following lower extremity amputation includes exercises aimed at increasing the use of prostheses in daily life activities and improving the individual's balance(1, 2). Balance training is one of the most crucial components of post-amputation rehabilitation due to the increased risk of falling associated with prosthesis use, which presents a significant challenge for individuals who have undergone lower extremity amputation(1, 3). Studies on this subject have reported that 52% of individuals who have experienced limb loss fall at least once within a year (4).

Additionally, fear of falling is a serious concern among amputees, leading to decreased participation in daily and social activities and reduced prosthesis usage time(5). Even among young patients who have undergone amputation due to trauma, fear of falling and challenges with balance confidence during activities are observed (6).

Falls are commonly observed in the daily lives of individuals with lower extremity amputations. Common consequences of falling for amputees include physical injuries and the development of a fear of falling. Fear of falling is associated with reduced levels of daily activity and social participation, potentially leading to a decrease in quality of life(5). Therefore, it is vital to consider balance assessment not only as a physical performance parameter but also to carefully evaluate the individual's psychological factors, motivation, and confidence levels, all of which influence balance and ensure optimal prosthesis utilization (7).

Powell et al. demonstrated that the Activities-Specific Balance Confidence Scale (ABC), which they developed, is a valid tool for assessing the influence of an individual's confidence on balance (8). Ayhan et al. conducted a study on the validity and reliability of the Turkish version of this scale in geriatric individuals, confirming its validity and reliability within this population(9). However, considering that individuals using prostheses exhibit distinct physical and psychological characteristics related to balance and confidence compared to geriatric individuals, it is essential to ascertain the validity and reliability of the scale specifically for these patients. Therefore, the aim of our study is to evaluate the validity and reliability of the Turkish version of the Activity-Specific Balance Confidence Scale in individuals with limb loss.

MATERIAL AND METHODS
Sample size

Given that the Activity-Specific Balance Confidence Scale consists of 16 items, the sample size was determined in accordance with the commonly recommended criterion of including at least five participants per item (10).

Participants

The study included 80 patients who had undergone lower-extremity amputation and were still using prosthesis in daily life.

Inclusion criteria: To know how to read and write in Turkish, Being over 18, Not having a cognitive problem, Unilateral or bilateral lower extremity amputation, Using the existing prosthesis in daily life activities

Exclusion criteria: Upper extremity amputation

Data Collection: In the first stage of the study, necessary permissions were obtained from the researchers to use the Turkish version of the Activity-Specific Balance Confidence Scale (ABC) was administered twice, with a one-week interval between assessments. Data were collected through face-to-face surveys, and all assessments were conducted during the same session. The mobility levels of all participants were evaluated using the Amputee Mobility Predictor(AMP) and Klevels are recorded(11).

Activity-Specific Balance Confidence Scale: The ABC scale assesses balance confidence during activities of daily living. It is designed to evaluate both balance confidence and fear of falling. Consisting of 16 items, individuals rate their confidence in avoiding a loss of balance during daily activities as a percentage, ranging from 0 to 100. It is a quick and easy survey, typically completed in about 5 minutes (9).

DATA ANALYZE

Validity

A confirmatory factor analysis (CFA) was conducted to determine the construct validity of the Activity Spesific balance confidence scale has a single-factor structure. Initially, the dataset was examined to assess whether the assumption of multivariate normality was met. The results of the Henze–Zirkler and Mardia multivariate normality tests indicated that the dataset did not satisfy the multivariate normality assumption (HZ = 3.25, p <0.05; Mardia Skewness = 2808.88, p <0.01; Mardia Kurtosis = 29.586, p <0.01). The statistical significance of both tests suggests that this assumption was violated.

Due to the violation of the multivariate normality assumption, the WLSMV (Weighted Least Squares Mean and Variance Adjusted – Robust WLS) estimation method was employed. WLSMV provides reliable results in cases where data are not normally distributed or are non-continuous, and compared with the traditional WLS method, it offers more stable estimates, particularly in studies with small sample sizes.

Internal Consistency

The Cronbach's alpha internal consistency coefficient was calculated to analyze the internal consistency of the Turkish version. Cronbach's alpha is a statistical coefficient commonly used in almost all scale studies to determine internal consistency.

Reliability

To calculate test-retest reliability, the scale was first applied to 80 amputees, and the scale was reapplied one week after obtaining the results. The agreement between the two measurements was examined. Test-retest reliability was determined by calculating the intraclass correlation coefficient (ICC) and the Spearman correlation coefficient (r). Before conducting the Spearman correlation analysis, the normality of the data distribution was examined using the Kolmogorov-Smirnov test, and frequency distributions were also examined through plot graphs. It was determined that the data did not follow a normal distribution, leading to the decision to use this analysis.

Amputee participants first completed the Turkish version, followed by assessments using the other scales. The correlation between the scales was calculated using the Spearman correlation coefficient. Prior to calculating the correlation, the normality of

the data distribution was examined using the Kolmogorov-Smirnov test, and frequency distributions were analyzed through plot graphs. It was determined that the data did not follow a normal distribution. Therefore, the Spearman correlation coefficient was used for the analysis of construct validity.

RESULTS

A total of 80 male individuals with lower extremity amputation due to trauma who were currently using a prosthesis were included in this study. Participants' demographic characteristics, amputation levels, types of prosthetic knee joints, suspension systems, prosthetic feet, duration of prosthesis use, and activity levels are presented in Table1.

Table 1. Demographics and amputee information

n=80	Mean	SD
Age (year)	36	9
Weight (cm)	80	11
Height (cm)	175	6
Amputation Level	**n**	**%**
Syme	2	2,5
Transtibial	33	3,75
Knee disarticulation	15	5
Transfemoral	17	7,5
Bilateral transtibial	3	18,75
Bilateral transfemoral	4	33,75
Bilateral transfemoral-transtibial	6	41,25
Prosthetic Knee	**n**	**%**
Microprocessor knee	43	53,75
Mechanic knee	3	3,75
No prosthetic knee	34	42,5
Prosthetic Feet	**n**	**%**
Carbon	69	86,25
Hydraulic	8	10
Microprocessor	3	3,75
Suspansion	**n**	**%**
Pin System	4	5
Active Vacuum	25	31,25
PassiveVacuum System	47	58.75
Soft System	3	3.75
Negative Pressure	1	1,25
Daily Prosthetic Use	**n**	**%**
3-6 hour	6	7,5
6-11 hour	20	25
11-14 hour	54	67,5
K Levels		
K3	8	10
K4	72	90

SD: Standart Deviation

Construct Validity

Confirmatory factor analysis (CFA) was calculated to determine the construct validity of the Activity-Specific Balance Confidence Scale, developed by Powell et all which has a single-factor structure. First, it was examined whether the data set met the assumption of multivariate normality. As a result of the Hz. Zirkler and Mardia multivariate normality tests, it was determined that the data set did not meet the assumption of multivariate normality (Hz = 3.25, p <0.05; Mardia Skewness = 2808.88, p <0.01; Mardia Kurtosis = 29.586, p < 0.01). The statistical significance of both tests indicates a violation of this assumption.

Due to the violation of the multivariate normality assumption in the data set, WLSMV (Weighted Least Squares Mean Variance – Robust WLS) was used as the estimation method. WLSMV is an estimation method that provides reliable results when data are not normally distributed or continuous and offers more stable results in smaller sample sizes compared to the WLS method**.** A table containing the standardized regression coefficients, standard errors, and z-values for the items is presented below (Table 2).

Table 2. Standardized Regression Coefficients, Standard Errors, and Z-Values of Scale Items

	Standart Value	Standart Error	Z value
Factor → item 1*	0.655	-	-
Factor → item 2	0.707	0.219	5.895**
Factor → item 3	0.822	0.215	7.430**
Factor → item 4	0.741	0.141	7.172
Factor → item 5	0.696	0.483	3.779
Factor → item 6	0.771	0.374	6.300
Factor → item 7	0.757	0.224	7.872
Factor → item 8	0.770	0.168	5.470
Factor → item 9	0.673	0.132	5.951
Factor → item 10	0.707	0.147	5.491
Factor → item 11	0.728	0.287	4.732
Factor → item 12	0.810	0.266	5.435
Factor → item 13	0.473	0.274	4.467
Factor → item 14	0.738	0.257	5.154
Factor → item 15	0.796	0.376	5.299
Factor → item16	0.657	0.305	5.634

(*): reference variable (**): p<0.01

When Table 2 is examined, the standardized coefficients from the latent variable to the items range between 0.47 and 0.82. All of these coefficients are statistically significant. Since item number one is considered the reference variable, its standard error and z-value were not calculated. Below is the path diagram for the standardized coefficients.

Tablo 3. Fit indices for the single-factor structure

Fit Indexes	Value	Cut off Values	Decision
RMSEA (Robust)	0.045	<0.05 excellent fit <0.08 good fit <0.010 poor fit	Good
SRMR	0.09	<0.05 excellent fit <0.08 good fit <0.010 poor fit	Mediocre
TLI (Robust)	0.987	>0.95 excellent fit _0.90 good fit	Excellent
CFI (Robust)	0.989	>0.95 excellent fit _0.90 good fit	Excellent
AGFI	0.974	>0.95 excellent fit _0.90 good fit	Excellent
Chi-Square/df	41.341/104 =0.40	_2.5 excellent fit _5 mediocre fit	Excellent

When the relevant values were examined, the ratio of chi-square to degrees of freedom (0.40), AGFI (0.974), CFI (0.989), TLI (0.987), and RMSEA (0.045) were found to indicate excellent model fit, while the SRMR value (0.09) suggested moderate fit. These findings can be interpreted as confirmation of the single-factor structure (Table 3, Figure 1).

Internal Consistency

Several internal consistency coefficients were calculated as indicators of the scale's reliability. The Cronbach's Alpha coefficient of the scale was calculated as 0.937, the split-half reliability coefficient as 0.943, and McDonald's Omega coefficient as 0.90. These findings indicate that the internal consistency of the scale is excellent. An internal consistency coefficient of 0.80 or higher is interpreted as high reliability.
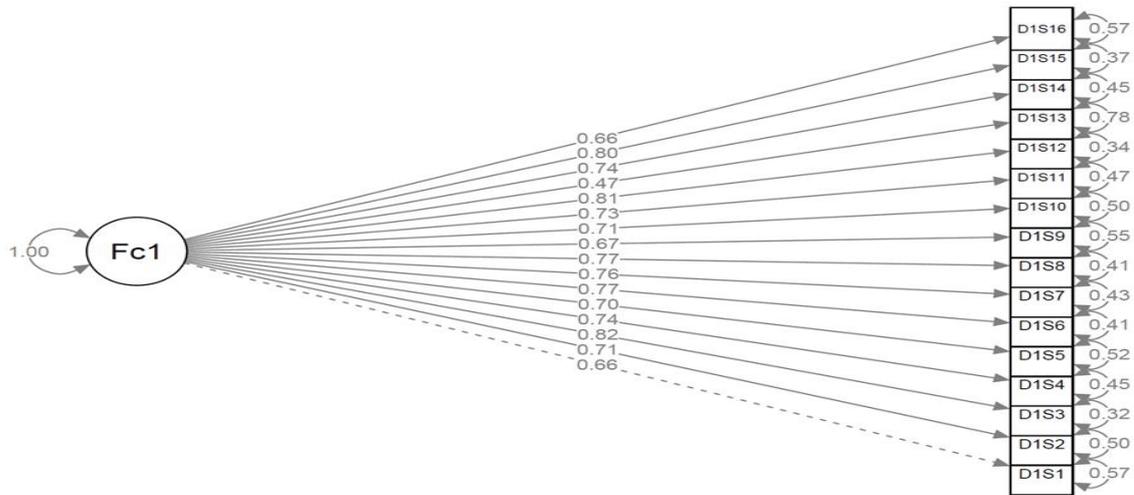
Figure 1. Confirmatory Factor Analysis

Test-Retest Reliability

The Spearman's correlation coefficient was calculated for the scores obtained from the same group at two different time points. A positive, very high correlation of 0.93 was found between the two measurements, which is statistically significant at the 0.01 alpha level (Table 4). Additionally, the difference between the mean scores obtained at different times was not found to be statistically significant ($t(79) = -0.161$, $p > 0.05$). These findings indicate that there is no significant difference between the scores obtained at different times and that the scores show a strong positive correlation. In other words, the test-retest reliability coefficient of the scale can be considered high.

Table 4. Test-Retest Reliability of the Turkish Version of the Activity-Specific Balance Confidence (ABC) Scale

	r	p
Test-Retest Reliability	0.93*	<0.001

DISCUSSION

In this study, the validity and reliability of the Turkish version of the Activity-Specific Balance Confidence (ABC) Scale were investigated in lower limb amputee patients. After reaching the necessary sample size, the validity and reliability of the Turkish scale were analyzed using statistical tests.

The findings of our study demonstrate that the test-retest reliability of the Turkish version of the ABC scale is high. The correlation coefficient of the measurements obtained from the two administrations is the reliability coefficient of the scale and provides information about the measurement stability of the scale. The test-retest reliability was found to be r=0.93, indicating that the reliability of the Turkish version is at a high level, as recommended in the literature. When examining the reliability values of the original English version of the ABC scale, the reliability coefficient was found to be 0.96, showing that the test-retest reliability of the Turkish version is quite close to that of the original

form. These results indicate that the ABC Scale provides consistent results when used repeatedly with amputees, and therefore, it can be confidently used in this population.

The internal consistency findings of our study reveal that the items comprising the Turkish version of the ABC scale have high internal consistency. Internal consistency analysis broadly tests the alignment, similarity, and homogeneity of the items that make up a scale. Additionally, it determines the degree to which the items contribute to the overall score. The most commonly used analysis to determine the internal consistency of measurement tools is the calculation of the Cronbach's alpha value. It is reported that for a scale to have high internal consistency, this value should be greater than 0.70. In the internal consistency analysis of our study, Cronbach's alpha for the Turkish version of the scale was calculated as 0.93. This result indicates that the alignment of the items within the scale is high. Furthermore, an analysis was conducted to determine how much the Cronbach's alpha value would change if each item were removed, and it was concluded that the internal consistency of the items is high.

Construct validity of Turkish version of ABC Scale was found high. The model-fit indices obtained in this study largely meet or exceed conventional thresholds for good model fit, supporting the single-factor structure of the scale. In the literature, CFI and TLI values above ~0.95 are often taken as indicators of excellent fit, while RMSEA values ≤ 0.05 (or at least <0.06) signal close fit of the model to the data. The AGFI value of 0.974 similarly suggests that the model has a robust goodness-of-fit. Taken together, these indices provide strong evidence that the factor structure is well represented by a single latent construct. Given this pattern it is reasonable to interpret the results as supporting the hypothesized one-factor model, with the caveat that some residual discrepancy remains.

ABC parameter 8 (maintaining balance when bumped in a crowd), 9 (walking on uneven surfaces), 11 (walking down a ramp), 14 (walking on slippery surfaces), and 12–13 (stepping onto and off an escalator) represent activities that pose substantial challenges in the daily lives of individuals with lower extremity amputation. These activities require advanced prosthetic control, dynamic balance, and adaptive mobility in response to environmental perturbations. As individuals gain greater proficiency in prosthetic use and their balance and mobility improve through rehabilitation, the ability to perform these activities increases. Therefore, the inclusion and evaluation of such activity-specific balance tasks are particularly important for accurately assessing functional capacity and monitoring rehabilitation progress in individuals with lower extremity amputation.

All participants in the present study were classified as K3 or K4 according to the Amputee Mobility Scale, reflecting moderate to high functional mobility. Bilateral amputees included in the study also demonstrated high activity levels and long daily prosthesis use durations. Previous research has emphasized that, particularly among individuals with K3 and K4 activity levels, higher ABC scores are associated with greater functional independence, increased participation in daily activities, and longer prosthesis use duration(12) In this context, the ABC Scale

serves as a clinically meaningful tool for evaluating balance-specific confidence in active amputee populations. A limitation of this study is that the sample predominantly consisted of individuals with moderate to high activity levels; therefore, this should be taken into consideration when applying the scale to amputees with lower activity levels

The findings of this study indicate that the Turkish version of the ABC Scale is a valid and reliable instrument for assessing balance confidence in individuals with lower limb amputation. Given the critical role of balance confidence in functional mobility, fall risk, and prosthetic use, the ABC Scale represents an important outcome measure for both clinical practice and research involving amputee population(13)

CONCLUSION

The Turkish version of the ABC scale demonstrates high internal consistency, validity, and reliability in amputee individuals. It is suitable for use in clinical settings and scientific research to assess functional outcomes in amputees.

ETHICAL APPROVAL

Ethics approval was obtained from Hacettepe University Non-Interventional Clinical Research Ethics Committee (Decision number: GO 21/623, Date: 26.05.2021) The study was conducted in agreement with the Declaration of Helsinki, and informed consent was obtained from all patients.

AUTHOR CONTRIBUTION

Study design: SY, GY; literature search: SY, GY; Data collection: SY, Data analysis: YD, GY, Manuscript writing: SY, GY; Critical reading; KA, SY, GY, YD Final approval; KA, YD, GY, SY

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