

Research Article

Construct Validity and Item Discrimination of The Diabetes Foot Self-Care Behavior Scale in Patients With Type-2 Diabetes

Diyabetik Ayak Öz-Bakım Davranış Ölçeğinin Tip 2 Diyabetli Hastalarda Yapı Geçerliliği ve Madde Ayırt Ediciliği

Emine SAĞLAMOĞLU¹, Başar ÖZTÜRK², Ege TEMİZKAN³, Gamze EKİCİ⁴

¹ Arş. Gör., Hacettepe Üniversitesi, Sağlık Bilimleri Fakültesi, Ergoterapi Anabilim Dalı, Ankara, Türkiye

² Doç. Dr., Biruni Üniversitesi, Sağlık Bilimleri Fakültesi, Ergoterapi Anabilim Dalı, İstanbul, Türkiye

³ Arş. Gör., Hacettepe Üniversitesi, Sağlık Bilimleri Fakültesi, Ergoterapi Anabilim Dalı, Ankara, Türkiye

⁴ Prof. Dr., Hacettepe Üniversitesi, Sağlık Bilimleri Fakültesi, Ergoterapi Anabilim Dalı, Ankara, Türkiye

ABSTRACT

Purpose: This study was planned to test the construct validity of the Turkish version of the Diabetes Foot Self-Care Behavior Scale (DFSBS) in patients with type-2 diabetes. **Material and Methods:** 119 type-2 diabetic patients (57 women; 62 men) with a mean age of 53.3±4.7 years were included in this study. The forward-backward translation of the DFSBS was conducted for translation from English to Turkish according to the methodology outlined by Beaton. The World Health Organization Well-being Questionnaire-22 (WBQ-22) and Nottingham Health Profile (NHP) were administered to the participants along with the DFSBS. **Results:** For convergent construct validity analysis, the correlations between the DFSBS score and WBQ-22 ($r=0.639$, $p<0.001$) and NHP total score ($r=-0.200$, $p<0.029$) were calculated with the Pearson correlation coefficient. The discriminative construct validity analysis showed that there is no difference between men and women in terms of scale scores. The exploratory factor analysis results showed that 75% of the total variance is explainable by two factors. The fit between the factor structure of the Turkish version and the original version was adequate as shown by the confirmatory factor analysis. Additionally, item discriminative power analysis showed that all items were able to discriminate 'high' and 'low' responses. **Conclusion:** The DFSBS is a rare scale that can assess and measure diabetic foot self-care behaviors in a person-centered approach with satisfactory construct validity. This scale can be used to assess self-care behaviors, plan interventions and education programs with diabetic foot clients.

Keywords: Diabetic foot; Self care; Construct validity.

ÖZ

Amaç: Bu çalışma, Diyabetik Ayakta Öz Bakım Davranış Ölçeğinin (DAÖD) Türkçe versiyonunun Tip 2 diyabetli hastalarda test edilmesi ve geçerliliğinin sağlanması amacıyla planlanmıştır. **Gereç ve Yöntem:** Çalışmaya yaşları 53,3±4,7 olan 119 (57 kadın; 62 erkek) Tip-2 diyabetik hasta dahil edilmiştir. DAÖD'ün İngilizce'den Türkçe'ye ileri-geri çevirisi Beaton tarafından belirlenen metodoloji ile yapılmıştır. Katılımcılara DAÖD ile birlikte Dünya Sağlık Örgütü İyilik Hali Ölçeği-22 (İHÖ-22) ve Nottingham Sağlık Profili (NSP) uygulanmıştır. **Sonuçlar:** Yakınsak yapı geçerlilik analizi için DAÖD puanı ile İHÖ-22 ($r=0.639$, $p<0.001$) ve NSP toplam puanı ($r=-0.200$, $p<0.029$) arasındaki ilişkiler Pearson korelasyon katsayısı ile hesaplandı. Ayırt edici yapı geçerliliği analizi, ölçek puanları açısından kadın ve erkekler arasında fark olmadığını göstermiştir. Açıklayıcı faktör analizi sonuçları, toplam varyansın %75'inin iki faktörle açıklanabileceğini göstermiştir. Doğrulayıcı faktör analizinin de gösterdiği gibi, Türkçe versiyonun faktör yapısı ile orijinal versiyonun faktör yapısı arasındaki uyum yeterli olarak bulunmuştur. Ek olarak, madde ayırt edici güç analizi, tüm maddelerin 'yüksek' ve 'düşük' yanıtları ayırt edebildiğini göstermiştir. **Tartışma:** DAÖD, diyabet ayak öz-bakım davranışlarını birey merkezli bir yaklaşımla değerlendirebilen ve ölçeklenen nadir bir ölçektir. Bu ölçek, diyabetik ayak hastalarında öz-bakım davranışlarını değerlendirmek, müdahale ve eğitim programları planlamak için kullanılabilir.

Anahtar Kelimeler: Diyabetik ayak; Özbakım; Yapı geçerliliği.

Sorumlu Yazar (Corresponding Author): Emine SAĞLAMOĞLU E-mail: eminesaglamoglu@gmail.com

ORCID ID: 0000-0001-5902-4718

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Diabetes is a metabolic disease that affects the body's metabolism and is defined by excessive blood glucose levels (also known as blood sugar levels). Over time, this condition can cause major harm to the heart, blood vessels, eyes, kidneys, and nerves (ERFC, 2010; IDF, 2021). The global health impact of diabetes mellitus is increasing. According to International Diabetes Federation, 537 million adults (20-79 years) are living with diabetes around the world in 2021. By 2030, this number is expected to be 643 million, and by 2045, it will reach 783 million (IDF, 2021). According to the Turkish Diabetes, Hypertension, Obesity and Endocrinological Diseases Prevalence Study-II (TURDEP-II), the prevalence of type 2 diabetes in the Turkish adult population has reached 13.7% (Satman et al., 2013). (Gammeri, Iacono, Ricci ve ark., 2020).

Diabetes is leading factor in cardiovascular diseases, nerve damage (neuropathy), blindness, end-stage renal disease, and non-traumatic lower extremity amputations (Boyko et al., 2018). One of the most serious and severe effects of diabetes mellitus is diabetic foot ulcers. In the entire life course, 15% to 25% of patients with diabetes mellitus develop chronic foot or lower extremity ulcers (Yalçın and Yetkin, 2022). Diabetic foot ulcer is a complication that occurs as a result of ulceration associated with neuropathy of the lower extremity and/or peripheral artery disease in a patient with diabetes. Diabetic foot ulcers (DFUs), which are quite common among the diabetic population, cause significant morbidity, mortality, and resource use (Jeffcoate et al., 2020). There are numerous interventions to prevent foot ulcers that include; foot self-care, structured education about foot self-care, foot self-management, treatment of risk factors or pre-ulcerative signs on the foot, orthotic interventions, surgical interventions, foot-related exercises and integrated foot care (van Netten et al., 2020). Self-care is one of the most important interventions for diabetic foot because the development of foot ulcer always happens outside the clinical setting. The "Standards of Medical Care in Diabetes (SOC)", emphasized that all individuals with diabetes should receive self-care education and obtain the assistance required to promote knowledge, judgment, and skill mastery for diabetic self-care (ADAPPC, 2021). Self-care skills and the quality of life of patients with diabetic foot ulcers are closely related. Therefore, self-care skills should be encouraged to enable patients to follow their foot problems at an early stage (Eroğlu, 2018). The ability of the patient to perform basic foot self-care

behaviors such as foot washing, drying, using foot lotion to prevent cracks, and examining the soles and toes of the feet, helps prevent complications related to diabetic foot (Kalayci et al., 2020). In this context, regular and adequate foot self-care is one of the most effective preventions (Bandyk, 2018a, 2018b; Vileikyte et al., 2006). However, adequate foot self-care cannot be performed enough, according to the literature (Bell et al., 2005; Chin and Huang, 2013; Pollock et al., 2004).

Given the importance of self-care for diabetic foot prevention as well as treatment, it is necessary to have tools and instruments that enable clinicians to assess individuals' self-care behaviors and plan patient education interventions accordingly. There are several Turkish instruments for evaluating diabetic foot self-care or diabetic foot awareness, but these tools mostly focus on individuals' subjectively reported self-efficacy (Biçer and Eng, 2014). The Diabetes Foot Self-Care Behavior Scale (DFSBS) is an assessment instrument developed by Ching and Huang (2013) and focuses on individuals' self-care behaviors regarding their feet. Bakır and Samancıoğlu (2021) published the Turkish version of the diabetic foot self-care behavior scale (DFSBS-TR). However, in terms of both academic and clinical applicability, it was thought that it is necessary to work on this scale with an internationally accepted methodology and analyze construct validity as well as item discrimination. For this reason, it was aimed to investigate construct validity and item discrimination of the DFSBS.

METHODS

All participants were recruited from Hacettepe University Occupational Therapy Department and a purposeful sampling method was utilized in order to reach an adequately large sample size. Individuals with type-2 diabetes were invited to participate in the study. The purpose, data collection methods and the value of the study were explained to all individuals that were invited and a written consent was obtained from all who volunteered to participate. Individuals were deemed eligible to participate in the study if they; (1) were between 18 and 65 years of age and (2) had type 2 diabetes. Individuals who had any sort of diabetes related amputations and/or did not have adequate Turkish language skills that could affect the data collection negatively were considered ineligible. A total of 156 individuals were invited and 119 participants were found to be eligible for the study according to the inclusion and exclusion criteria.

The sample size was taken in accordance with the COSMIN guidelines, considering a 40% dropout rate. The COSMIN guidelines have 2 recommendations for sampling. The first recommendation is that at least 100 patients should be included in the sample to assess the psychometric properties of health-related patient-reported outcome measures (PROM). And the second suggestion is that at least 50 people from the same sample should be included in order to ensure test-retest reliability (De Vet et al., 2011; Terrin et al., 2005; Terwee et al., 2012). In our study we investigated the construct validity of the DFSBS, so we considered the first recommendation of COSMIN for sample size.

Assessment Tools

Sociodemographic data: The sociodemographic data included participants' age, sex, body mass index (BMI) and when they were diagnosed with diabetes.

Diabetes Foot Self-Care Behavior Scale (DFSBS): DFSBS was developed by Taiwanese researchers (Chin and Huang, 2013). Researchers can use DFSBS to shed light on self-care difficulties as well as to screen patients' self-care behaviors and routines. The scale consists of 2 parts with 7 items in total. In part one (Part 1), four items relate to specific DM self-care activities and patients are asked how many days they have practiced them in the past week. The second part (Part 2) consists of three questions, patients are asked to mark the frequency of performing a certain self-care behavior. A 5-point Likert scale is used to evaluate each response. The answers to the first four questions, which involve inspecting the toes and soles of the feet as well as washing and drying them throughout the week, range from 0 to 7. The first part is scored as no day (score=1), 1-2 days (score=2), 3-4 days (score=3), 5-6 days (score=4) and the whole week (score=5). This section's grade ranges from 4 to 20. The responses to the following three questions (Part 2), which include utilizing lotions and inspecting shoes, are arranged in the form of a five-point scale. Answers in part 2 range from never (1) to always (5). This section's score ranges from 3 to 15. The DFSBS total score ranges from 7 to 35. Higher scores indicate better foot self-care behavior. The Cronbach's alpha value in the original version of the DFSBS was 0.73 (Chin and Huang, 2013).

Nottingham Health Profile (NHP): The Nottingham Health Profile is a comprehensive patient self-evaluation of various aspects of their subjective health status. The questionnaire was created in

Nottingham in 1975, and several organizations all around the world have utilized it (Hunt et al., 1993). The survey has 38 questions and evaluates sub-dimensions of health status, including energy (three questions), pain (eight questions), emotional reactions (nine questions), sleep (five questions), social isolation (five questions), and physical activity (eight items). A yes or no response is used to answer questions. Each section is scored between 0 and 100. The best health status is indicated by 0, and the worst by 100. Küçükdeveci et al. evaluated the scale's reliability and validity for Turkish population. The reliability (0.88) and internal consistency (0.87) of the NHP were also found good (Küçükdeveci et al., 2000).

World Health Organization Well-Being Questionnaire (WBQ-22): Bradley et al. created the WHO-WBQ as a mood, anxiety, and positive well-being measure for use in WHO research evaluating novel diabetes therapies (Bradley, 2013). There are 4 sections in the WBQ: depression (6 items), anxiety (6 items), positive well-being (6 items) and energy (4 items). On a Likert scale, each item receives a value ranging from 0 (not at all present) to 3 (present all the time). After reversing the results from the depression and anxiety parts, the total score can be calculated by adding the subscale scores. Total well-being score extends from 0 (lowest possible score) to 66 (best possible score). The scale's reliability and validity were evaluated in Turkey by Savli and Sevinc (Savli and Sevinc, 2005).

Data Collection

All data were collected through face-to-face interviews with the participants. After the recording of sociodemographic data, DFSBS-Turkish, NHP and WBQ-22 were applied, all of which were handled consecutively and without breaks. Data collection was performed by the 2nd author. Each assessment took between 15 and 30 minutes.

Translation and Cross-Cultural Adaptation

The translation and cross-cultural adaptation processes of the DFSBS were conducted in accordance with the methodology defined and explained by Beaton et al. (Beaton et al., 2002). The cross-cultural adaptation process is summarized below.

Forward Translation: The first translation of the scale was carried out by two independent translators who were fluent in health-related terminology, were knowledgeable about English language culture, and were native Turkish speakers. By comparing the translated scales from each therapist, a common

Turkish draft was drawn up.

Back Translation: A common Turkish form was translated from Turkish into English and back into English by two native English speakers with no medical background.

Expert Committee: Original versions and all translations were evaluated by the committee. The "reverted" versions were an exact match to the original versions.

Cultural Adaptation: There were no words or phrases that needed to be modified. The final forms were evaluated through pilot studies.

Pilot Study: For the pilot test with 119 individuals, the Diabetes Foot Self-Care Behavior Scale, Nottingham Health Profile, and World Health Organization Well-Being Questionnaire were established. There were no issues with applicability or comprehension.

Statistical Analysis

All statistical analyses were conducted using SPSS v.26 for Windows. Kolmogorov-Smirnov tests were used to determine normal distribution. Central tendency and dispersion calculations were conducted using mean±standart deviation or frequency (%) according to the data types for all of the demographic information as well as assessment results.

Construct Validity

Convergent Construct Validity

For the validity analysis of the DFSBS, "construct validity with hypothesis testing" proposed in the COSMIN methodology was carried out. (Mokkink et al., 2010). The NHP and WBQ-22 were used in conjunction with the DFSBS to demonstrate construct validity. A medium-strength correlation would be expected as a result of the examination. Because while the constructs measured by WBQ-22 and NHP are related to general health status and well-being, DFSBS mostly evaluates self-management skills specific to foot care. Pearson Correlation Test was used to examine the agreement between the scales, and the interpretation of the correlation coefficients was made as follows; $r < 0.30$: weak relationship, $r = 0.31-0.60$: medium strength relationship, $r = 0.61-0.90$: strong relationship, $r > 0.90$: excellent relationship (Akoglu, 2018).

Discriminative Construct Validity

Since the concepts evaluated by the DFSBS scale were developed regardless of gender, we hypothesize not to find a difference between the DFSBS scores of participants with different genders in the sample. In order to test the divergent construct validity, the difference in the DFSBS scores between

the genders were examined by applying the Two-Sample T-Test. The absence of a difference between the genders were interpreted to mean that the divergent construct validity is sufficient (Mokkink et al., 2010).

Bartlett sphericity test was conducted to see the factorability of the DFSBS. An exploratory factor analysis was done to see the factor structure. The fit between the factor structure of the Turkish version and the original version of the DFSBS was shown with fit indices calculated with a confirmatory factor analysis. In order to see the discriminative power of each item, an item discrimination analysis was conducted by comparing the upper and lower 27% for each item.

RESULTS

A total of 62 males (52.1%) and 57 female (47.9%) participated in the study. The mean age of the participants was 53.3 ± 4.7 , while the mean duration of diabetes was 6 ± 2.5 . The participants had an average BMI of 30.1 ± 2.8 . All demographic information is presented in Table 1.

Table 1. Demographic information of the participants

Demographic Information	$\bar{X} \pm SD$	Min – Max	
Age (years)	53.3 ± 4.7	42 – 65	
Duration of Diabetes (years)	6.0 ± 2.5	1 – 13	
BMI (kg/m^2)	30.1 ± 2.8	24.4 – 36.6	
	n	%	
Gender	Male	62	52.1
	Female	57	47.9

Bartlett sphericity test results showed that the items were factorable (Bartlett Test $p < 0.001$) and the sample size was sufficient ($KMO = 0.612$). The exploratory factor analysis results showed that 75% of the total variance is explainable by two factors. The exploratory factor analysis results are presented in detail in Table 2.

Table 2. Factor analysis results.

Item	Factor 1	Factor 2
Factor 1 Item 1	0.892	
Factor 1 Item 2	0.891	
Factor 1 Item 3	0.784	
Factor 1 Item 4	0.744	
Factor 2 Item 1		0.748
Factor 2 Item 2		0.881
Factor 2 Item 3		0.838
Explained variance	%56.80	%18.20
Cronbach's alpha	0.890	0.817

The fit between the factor structure of the Turkish version and the original version was showed with the fit indices (cmin/df=1.156, RMSEA=0.036, GFI=0.980, AGFI=0.929, NFI=0.987) calculated with the confirmatory factor analysis.

In order to see the discriminative power of each item, an item discrimination analysis was conducted by comparing the upper and lower 27% for each item. The analysis showed that all items were able to discriminate between "high" and "low" responses. All item discrimination results are reported in Table 3.

Table 3. Item discrimination results

	Lower %27	Upper %27	p
Factor 1 Item 1	1.4±1.1	4.1±2.4	0.001
Factor 1 Item 2	1.1±1.1	4.1±2.4	0.001
Factor 1 Item 3	1.7±0.8	5.3±1.7	0.001
Factor 1 Item 4	1.5±0.9	5.1±1.9	0.001
Factor 2 Item 1	1.2±0.4	3.2±1.1	0.001
Factor 2 Item 2	1.8±0.6	3.9±1.2	0.001
Factor 2 Item 3	2.2±0.8	4.7±0.5	0.001

In order to test the convergent construct validity of the DFSBS-TR, correlations between WBQ-22, NHP and DFSBS-TR were analyzed. The first factor of DFSBS-TR showed weak negative correlation with the Social Isolation score of the NHP. The second factor score as well as the total score of DFSBS-TR,

on the other hand, showed weak negative correlations with every sub score of the NHP except for pain, sleep and physical. There were strong positive correlations between the WBQ-22 scores and both factors, as well as the total score of the DFSBS-TR. Detailed results of the correlation

analyses are presented in Table 4.

Table 4. DFSBS-TR scores' correlations with other measures

	Factor 1		Factor 2		Total	
	r	p	r	p	r	p
WBQ-22	0.561	<0.001	0.587	<0.001	0.639	<0.001
NHP Emotional	-0.172	0.062	-0.193	0.036	-0.198	0.031
NHP Pain	0.108	0.244	-0.038	0.678	0.077	0.404
NHP Energy	-0.170	0.065	-0.251	0.006	-0.220	0.016
NHP Social Isolation	-0.247	0.007	-0.224	0.014	-0.255	0.005
NHP Sleep	0.072	0.434	-0.085	0.355	0.034	0.714
NHP Physical	-0.074	0.425	-0.195	0.034	-0.106	0.251
NHP Total	-0.155	0.092	-0.254	0.005	-0.200	0.029

All factors of the DFSBS-TR as well as the total score showed negative correlations varying between –

0.197 and -0.480 with age, BMI and duration of diabetes. There were no differences between males and females regarding the scores (Table 5).

Table 5. Relationships between DFSBS-TR and some demographic variables.

	Factor 1		Factor 2		Total		
	r	p	r	p	r	p	
Age	-0.310	0.001	-0.197	0.032	-0.310	0.001	
Duration of Diabetes	-0.383	<0.001	-0.252	0.006	-0.386	<0.001	
BMI	-0.446	<0.001	-0.383	<0.001	-0.480	<0.001	
	Mean±SD	p	Mean±SD	p	Mean±SD	p	
Gender	Male	11,0±6,9	0,244	7,5±3,0	0,053	18,5±8,7	0,117
	Female	12,5±7,3		8,6±3,0		21,2±9,3	

DISCUSSION

This study aimed to investigate the construct validity and item discrimination of the DFSBS. The DFSBS was translated successfully into the Turkish version (DFSBS-TR) using the methodology defined by Beaton et al. and the findings indicate that the DFSBS-TR has good construct validity and item discrimination (Beaton et al., 2002).

The original version of DFSBS is the Chinese version and the assessment was translated and adapted to German, Turkish and Persian. All versions of the DFSBS were reported to have good validity and reliability (Bakır and Samancıoğlu, 2021; Hasanpour Dehkordi et al., 2020; Lecker et al., 2022).

Regarding construct validity, the original version conducted Exploratory and Confirmatory Factor Analyses (EFA and CFA). The construct validity of the original version was also tested with hypothesis testing of correlations between the DFSBS and the foot care subscale of the Diabetes Self-care Scale as well as the Summary of Diabetes Self-care Activity Questionnaire. Additionally for convergent construct validity, concurrent validity and known-group validity were analyzed. The KMO was 0.72 and the Bartlett test of sphericity was 475.86 ($p < 0.001$) in the original version of the DFSBS. Persian adaptation and psychometric testing study tested face and content validity qualitatively and investigated construct validity with Exploratory and Confirmatory Factor Analyses. In the Persian version, KMO was 0.806 and Bartlett test was 1217.725 (Hasanpour Dehkordi et al., 2020). The German adaptation and psychometric testing study tested construct validity with Exploratory Factor Analysis with Principal Component Analysis and hypothesis testing of correlations between the DFSBS and the German version of the Diabetes Self-Care Activities Measure, Frankfurter Catalogue of Foot Self-Care and the Short Form – 36. In the German version study, detailed findings of the EFA and CFA were not shared. On the other hand, thirteen (62%) out of 21 predefined hypotheses regarding the correlations between DFSBS and other assessments were confirmed in the German version (Lecker et al., 2022). The Turkish validity and reliability study of DFSBS investigated validity only in terms of content validity (with expert opinion) and Exploratory Factor Analysis (Bakır and Samancıoğlu, 2021). Our study investigated the construct validity with both Exploratory and Confirmatory Factor analyses. Further investigation of convergent construct validity was done by hypothesis testing of correlations

between the DFSBS-TR, NHP and WBQ-22 and discriminant construct validity was tested by comparing the DFSBS-TR scores between genders.

Identifying the gender differences in the sample is recommended to minimize the errors that will emerge from the inconsistencies between genders (Baker, 1996; Sarouphim, 2001). The discriminant construct validity analysis in our study was evaluated by comparing the DFSBS-TR scores between genders. The results showed no significant differences between genders.

The correlations between the DFSBS, NHP and WBQ-22 were analyzed to demonstrate convergent construct validity. NHP and WBQ-22 measure general health and well-being while DFSBS assesses specific foot care self-care skills. This is thought to be the reason why the scale showed weak negative correlation with NHP. But on the other hand, DFSBS-TR showed a weak negative correlation with NHP except for pain, sleep and physical activity domains. According to the literature there is a significant relationship between sleep quality (Wachid et al., 2019), pain, physical activity (Polikandrioti et al., 2020) and diabetes self-care. For this reason, it seems like there is an inconsistency between our study and the current literature. However, almost the entire literature surrounding diabetes sleep, pain and physical activity focuses on overall self-management skills but not specifically foot-related self-care behaviors. Unlike, foot-related self-care behaviors overall self-management skills and diabetes include nutrition, habits, medication management and similar skills that may be more related to pain, sleep and physical activity (Adu et al., 2019). The high level of positive correlation with WBQ-22 may be due to the fact that self-care skills are associated with the individual's well-being (Polikandrioti et al., 2020). In the German version of DFSBS also found high correlation between diabetes foot self-care and health-related quality of life scores (Lecker et al., 2022).

None of the previous studies investigating the psychometric properties of the DFSBS conducted an analysis in order to see the individual item discrimination. Item discrimination is considered to be an important metric when it comes to the validity of assessment measures in health sciences (Cook et al., 2014; Curry and Nunez-Smith, 2014). In order to see the discriminative power of each item in our study an item discrimination analysis was conducted, and it was found that all items were able to discriminate between "high" and "low" responses.

In this study, there were negative correlations

between age, body mass index, number of years with diagnosed with DM and the DFSBS-TR scores. Despite having data regarding these variables, none of the previous studies draw conclusions in terms of the relationship between diabetes self-care and demographic factors except for education level. However, there are several limitations of our study. Firstly, we did not ask about the educational status of the participants in our study. And other studies found a positive correlation between higher education levels and self-care behavior (Hasanpour Dehkordi et al., 2020). Second, the sample size used for establishing the DFSBS-TR's psychometric properties was smaller than the original version. Future studies can investigate the relationships between different demographic factors and foot self-care behaviors in order to discover possible determinants of diabetes foot self-care behavior.

The DFSBS is a rare scale that can assess and measure diabetic foot self-care behaviors in a person-centered approach. The present study showed that DFSBS-TR had good construct validity and item discrimination, which indicates that it can be used successfully in the clinical environment. This scale can be used to assess self-care behaviors, plan interventions and education programs with diabetic foot clients.

Ethical Approval

Ethical approval was obtained from Biruni University Non-invasive clinical trials ethical committee (Decision no: 2017/8-1).

Authors' Contribution

Idea/Concept: BÖ; Design: GE, BÖ; Control/Supervision: GE; Data collection and/or Processing: BÖ; Analysis and/or interpretation: ES, BÖ, ET, GE; Literature review: ES, ET; Writing the Article: ES, ET; Critical Review: GE.

Conflicts of Interest Statement

None of the authors report having a conflict of interest..

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