

Research Article

Cross-cultural adaptation, validity, and reliability of Turkish version of Identification of Functional Ankle Instability (IdFAI) scale

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Objective: This study aimed to develop the Turkish version of Identification of Functional Ankle Instability (TV_IdFAI) scale and evaluate its validity and reliability.

Methods: A total of 100 participants (54 men and 46 women; 50 volleyball players and 50 sedentary individuals) between 18 and 38 years of age were included this study. The construct validity, reference validity, sensitivity, specificity, and test-retest reliability of TV_IdFAI were evaluated. For the test-retest reliability, the scale was applied to all participants again in 10–14 days. A correlation between the scale scores and test-retest results was examined with intraclass correlation coefficient. To evaluate the construct validity, a factor analysis method was used. For reference validity, a sports physician evaluated all participants and the clinical diagnoses were compared with total score of the scale. Sensitivity and specificity were calculated to evaluate the classification success of the scale with specified cutoff.

Results: TV_IdFAI scale was grouped under two separate factors. It was determined that the variance for factor 1, factor 2 and for scale was 46.68%, 15.70%, and 62.38%, respectively. There was a statistically significant relationship 0.74 (95% CI 0.64–0.84; $p < 0.001$) between the physician's diagnosis and TV_IdFAI in terms of reference validity. The sensitivity and specificity of TV_IdFAI was 0.61 and 0.80, respectively. The reliability of TV_IdFAI was 0.94 (95% CI 0.92–0.96; $p < 0.001$).

Conclusion: This study shows that TV_IdFAI is a simple, easy to apply, reliable, and valid scale to define functional ankle instability in Turkish population.

Level of Evidence: Level II, Diagnostic study

Ankle sprain is one of the most common injuries in contact sports demanding high jumps (1, 2). In volleyball, 41% of all injuries (1) and 23% of all acute injuries (3) are ankle sprains. Functional ankle instability (FAI) is the involuntary ankle movement in a physiologically normal range of motion (4) and is one of the most common permanent conditions after ankle sprains with a prevalence of 40% (5). Considering the high prevalence of ankle sprains (1-3, 5), it is important to evaluate the ankle in the quickest and most efficient way in clinical practice. Self-reported questionnaires are one of the commonly used assessment methods (4). Identification of FAI (IdFAI) is a simple, valid, and reliable measure used to categorize the presence of FAI in individuals (6, 7). There was no validated

scale in Turkish language for clinical practice and research to determine the level of ankle instability. Therefore, the purpose of this study was to develop the Turkish version of IdFAI (TV_IdFAI) scale and to evaluate its validity and reliability in volleyball players and general population.

Materials and Methods

Participants

This study was accepted by the Ethics Committee of Hacettepe University (GO 14/601-26). Written information regarding the study was provided to all participants and written consent was obtained from all the participants. Volunteers recruited were professional volleyball clubs members and

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university students. The inclusion criteria were as follows: above 18 years of age and clinically diagnosed with the presence of ankle instability by a sports physician. Having any acute injuries, physical disabilities, or health problems that would affect clinical evaluation and scale application were the only exclusion criteria.

Sample size

The rule of 10 events per variable (EPV) is one of the useful methods to estimate sample size in observational studies (8). Each question from the scale was considered a variable in this study. Therefore, the sample size was calculated based on the number of questions from the scale multiplied with 10 EPV. Thus, a total of 100 participants (10 questions×10 EPV) including 50 volleyball players and 50 sedentary individuals were included.

Physician's diagnosis

A single sports physician, with 20 years of experience, clinically diagnosed the participants for the presence of ankle instability based on evaluation, palpation, and clinical tests. An anterior drawer test for anterior talofibular ligament, a talar tilt test for calcaneofibular ligament, a posterior drawer test for posterior talofibular ligament, and an eversion stress test for the integrity of the deltoid ligament were used (9, 10). Excessive translation of the talus or increased laxity of the ligaments on the injured side compared with the uninjured side was accepted as ankle instability (9, 10). A squeeze test was used to rule out syndesmotic ankle (11). Results were evaluated in two categories: instability and no instability.

Procedures

Permission to start the cross-cultural adaptation procedure was obtained from the developers of the IdFAI scale through e-mail. The guidelines of American Academy of Orthopedic Surgeons (AAOS) were followed to translate IdFAI into TV_IdFAI (12). The first step was to translate the questionnaire from the English to Turkish language. Translators should be experienced and well aware of the structure of English and Turkish language (13). In this study, two certified translators translated the original English questionnaire into Turkish and then two other certified translators translated the Turkish version into English. The necessary arrangements were made

without changing the sense of the scale. Two amendments were made for cultural adaptation. First, in addition to the definition of “giving way” in the explanation section, the definition of “instability” was added because Turkish counter-fare was insufficient. Second, as there is no definition of an athletic trainer in Turkey, “sports physiotherapist” was amended for “athletic trainer” in the third question (Appendix).

Descriptive characteristics of the participants including age, sex, height, body weight and body mass index were recorded. An experienced sports physician clinically examined both ankles of all participants and diagnosed the presence of ankle instability. Participants completed TV_IdFAI scale in 5–10 minutes and recompleted it within 10–14 days for retest (14). The results of the dominant sides were used for the construct validity based on the IdFAI study (6).

Statistical analysis

Factor analysis was used to transform interrelated data structures into fewer independent new data structures to assess the construct validity of the scale. A correlation matrix between the questions ensured that the determinant was close to zero. Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and the Bartlett test of sphericity were used to determine the use of factor analysis. When $p < 0.05$ (Bartlett test), the correlation matrix was determined appropriate for the factoring. The suitability of the sample was decided with KMO more than 0.80. Eigenvalues were examined to determine the number of factors. Criterion for eigenvalues greater than 1 was accepted as a factor. Factor analysis was conducted using the principal component method and applying the “Varimax” transformation. Factor loads were calculated to determine which questions were collected in which factor. The sports physician evaluated the FAI presence in all individuals and compared the scores with obtained total scores of the scale. According to this reference result, the classification success of TV_IdFAI total scores was analyzed by receiver–operator characteristics (ROC) analysis as well as the best cutoff point related to the scale total scores. Sensitivity and specificity were calculated to evaluate the classification success of the scale with specified cutoff. The test–retest method was used to determine the reliability of TV_IdFAI, and the correlation of the retest results with the scale scores was examined by the intraclass correlation coefficient (ICC). Cronbach's alpha was calculated for each subscale and the total scale as a measure of internal consistency and reliability. A Chi-square test was used to determine the relation between categorical variables. Statistical analyses were performed with the licensed Statistical Package for Social Sciences (SPSS) analysis version 21.0 (IBM Corp.; Armonk, NY, USA). A significance level of $p < 0.05$ was considered statistically significant for all analyses.

Results

A total of 100 participants (54 men, 46 women) were included in the study (Table 1). The dominant side of 90 participants

H I G H L I G H T S

- TV_IdFAI was the first Turkish scale to measure ankle instability.
- Cross-cultural adaptation of IdFAI scale is reliable and valid in Turkish population.
- TV_IdFAI is simple and easy to apply as a patient reported outcome measurement.
- Professionals can use TV_IdFAI to measure functional ankle instability in both sports and general population.

Table 1. Physical characteristics of participants: BMI values were statistically similar ($p=0.144$) even the volleyball athletes and sedentary individuals were different in terms of their physical characteristics, which shows there was no physical difference between the individuals that would affect the measurements

Characteristics	Volleyball players (n=50, 28 M, 22 F)			Sedentary individuals (n=50, 26 M, 24 F)			P Value
	Mean (SD)	Min	Max	Mean (SD)	Min	Max	
Age, y	22.4 (3.95)	18	36	24.5 (4.61)	20	38	0.015
Height, cm	190 (8.4)	172	208	172.7 (9.8)	155	190	0.000
Weight, kg	79.6 (9.9)	58	106	68.1 (13.2)	45	95	0.000
BMI	21.99 (1.7)	18.31	26.01	22.66 (2.7)	18.17	27.76	0.144*
TV_IdFAI test	11.96 (9.25)	0	32	11.98 (7.54)	0	25	0.991
TV_IdFAI retest	11.44 (9.02)	0	29	11.36 (7.73)	0	28	0.962

M: male; F: female; SD: standard deviation; Min: minimum; Max: maximum; BMI: body mass index (calculated as weight in kilograms divided by height in meters squared)

Table 2. The Eigenvalues of TV_IdFAI: The scale formed under two factors

Component	Total	Eigenvalues	
		% of Variance	% of Cumulative
1	4.668*	46.680	46.680
2	1.570*	15.701	62.381
3	.955	9.555	71.936
4	.769	7.690	79.625
5	.572	5.721	85.346
6	.530	5.296	90.642
7	.327	3.274	93.916
8	.319	3.187	97.103
9	.173	1.731	98.834
10	.117	1.166	100.000

TV_IdFAI: Turkish version of Identification of Functional Ankle Instability

was right, and the rest was left. Only 7 participants had no ankle sprain, 26 participants had sprain only on the right side, 12 participants had sprain only on the left side, and 55 participants had ankle sprain on both the sides.

The conditions for factor analysis were completed (Bartlett's test, $p<0.001$; the determinant of the correlation matrix: 0.003; KMO: 0.807). Eigenvalues were examined to determine the number of factors after ensuring the factorability of TV_IdFAI (Table 2). As a result, factor 1 consisted of items 1-2-5-6-9-10, and factor 2 consisted of items 3-4-7-8. According to the sports physician's diagnosis, 54% of the participants had no instability and 46% had instability in their dominant sides. These 46 participants with ankle instability consisted of 24 volleyball players and 22 sedentary individuals. Only 2 sedentary participants had ankle instability on the left side, 20 sedentary participants and 24 volleyball players had ankle instability on the right side. When the per-

Table 3. Sensitivity and specificity for all scales (4)

	Sensitivity (95% CI)	Specificity (95% CI)
IdFAI	0.83	0.94
AII	0.73	0.85
CAIT	0.56	0.86
FAAM	0.59	0.78
FAOS	0.56	0.76
AJFAT	0.18	0.77
CAIS	0.41	0.75
FAIQ	0.06	0.75
TV_IdFAI*	0.61*	0.80*

CI: confidence intervals; IdFAI: Identification of Functional Ankle Instability; AII: Ankle Instability Instrument; CAIT: Cumberland Ankle Instability Tool; FAAM: Foot and Ankle Ability Measure; FAOS: Foot and Ankle Outcome Score; AJFAT: Ankle Joint Functional Assessment Tool; CAIS: Chronic Ankle Instability Scale; FAIQ: Foot and Ankle Instability Questionnaire; TV_IdFAI: Turkish version of Identification of Functional Ankle Instability

formance of TV_IdFAI according to the sports physician's diagnosis was examined, the area under the ROC curve was 0.738 (95% CI: 0.640–0.835; $p<0.001$). The best cutoff point of TV_IdFAI is 10.5. Thus, a total score of 11 or more means the presence of ankle instability, and a total score of 10 or less means no instability. The sensitivity and specificity of TV_IdFAI was 0.611 and 0.804, respectively, and the comparison with other scales is shown in Table 3 (4). The Cronbach alpha's coefficient was 0.790 ($p<0.001$) and 0.707 ($p<0.001$) for factor 1 and 2, respectively. ICC value was 0.942 (95% CI: 0.915–0.961; $p<0.001$) for the reliability of TV_IdFAI.

Discussion

The construct validity of TV_IdFAI indicates that it was collected under two factors based on eigenvalues (>1). These two

factors were named according to the meaning and contents of questions. Therefore, factor 1 was named as “the presence and degree of instability,” and factor 2 was “ankle sprain intensity.” The variance for factor 1 and factor 2 was 46.68% and 15.70%, respectively, and the variance for total scale was 62.38%, which is lower than expected total variance of 66% (15). Thus TV_IdFAI fulfills the conditions of factorability and can be separated into the factors; however, it partially meets the construct validity criteria.

IdFAI differs from our study as it has three factors. Factor 1 (history of ankle instability) consists of questions 5-6-7-10, factor 2 (initial ankle sprain) 1-2-3-4, and factor 3 (instability during activities of daily living) 8-9. The variance for factor 1, factor 2, for factor 3, and IdFAI was 53.7% 17.4% 6.3% and 77.4%, respectively (6). The number of factors was the main difference between IdFAI and TV_IdFAI, hence the total variance, although the eigenvalue of the third component was very close to 1 (Table 2). The main reason could be the difference between study populations speaking different languages or performing different activity levels. We recruited volleyball players and sedentary individuals, whereas IdFAI population consisted of university students. It was also recommended that a factor should be defined with at least three items, preferably four, in order to provide a minimum coverage of the construct’s theoretical domain and adequate identification for the construct (15-17). In this direction, factor 3 in IdFAI consists of two variables that would be inadequate, whereas our factors are defined by four and six items, satisfying the recommended number of items.

In IdFAI study, a correlation between IdFAI and Lower Extremity Functional Screen (LEFS) was investigated for criterion validity ($p < .01$) (6). One weakness of TV_IdFAI was the absence of criterion validity as it is the first Turkish scale for ankle instability. However, we addressed this by using an experienced physician’s diagnosis for reference validity. Not using imaging measurements because of physical limitations is another weakness of the study. The presence of ankle instability was determined by physical examination only.

Ankle Instability Instrument (AII) scale has three factors with the variance of 32.3% for factor 1 (4 questions), 10.7% for factor 2 (5 questions), 7.0% for factor 3 (3 questions) and 50.0% for scale (18). The construct validity of AII scale was suitable for factorability, and question distribution was appropriate; however, its power was low. Ankle Joint Functional Assessment Tool (AJFAT) has no validity study; however, the measurements before and after 4 weeks of balance training were used and there was a significant correlation between the measurements (19). The physical examination, functional performance tests, stress radiography for talar tilt grade and visual analog scale (VAS) score were used for the content and structure validity of Chronic Ankle Instability Scale (CAIS), which was determined to be a valid scale (20). The criteri-

on validity of Cumberland Ankle Instability Tool (CAIT) was evaluated with LEFS ($p < .01$) and VAS ($p < .01$), and the structure and content validity was acceptable (21). Foot and Ankle Ability Measure (FAAM) includes two different subscales: daily life activities (21 questions) and sports (8 questions) (22). It has been reported that FAAM is usable but validity and reliability studies are needed (22). Foot and Ankle Instability Questionnaire (FAIQ) has no validity or reliability study (23). Foot and Ankle Outcome Score (FAOS) contains five factors and has total variance of 90% for the validity (24). It is an example scale for total variance and question distribution of factors. The validity of Turkish version of FAOS was investigated with AIMS2 (Arthritis Impact Measurement Scale 2) and SF36, with a strong and significant correlation between the scales (25). In Foot and Ankle Disability Index (FADI), criterion validity was assessed before and after the results of a rehabilitation program reporting statistically significant results (26). Therefore, validity of TV_IdFAI is acceptable compared with these scales.

The best cutoff point (10.5) is the same as IdFAI (6). The specificity (0.804) of TV_IdFAI is higher than the sensitivity (0.611). In other words, the scale provides more reliable results in identifying individuals with ankle instability. In contrast, the sensitivity is low but acceptable. Therefore, these results should be supported and controlled by other means and methods, and by a physician, in determining the individuals without ankle instability. It is thought that it would be more appropriate to use TV_IdFAI for diagnosis. Sensitivity and specificity of IdFAI is 0.83 and 0.94, respectively (4). Therefore, IdFAI is very successful in identifying the presence of ankle instability in individuals. IdFAI was superior to TV_IdFAI in terms of sensitivity and specificity; however, when compared with other scales, TV_IdFAI has greater values than most of other scales (Table 3) (4).

The ICC values for the test–retest reliability of TV_IdFAI and IdFAI are 0.94 and 0.92, respectively; which means TV_IdFAI is superior to IdFAI (6). The reliability of the AII (18), CAIS (20), CAIT (21), FAOS (24), Turkish version of FAOS, (25) and FADI (26) scales were reported as good or excellent with values between 0.79 and 0.96. The reliability of TV_IdFAI is also excellent with 0.94 and greater than most of the other scales.

In conclusion, TV_IdFAI is a simple, easy to apply, reliable, and valid scale to describe FAI. With 10.5 cutoff point, a total score of 11 or more means the presence of ankle instability, and 10 or less means no instability. TV_IdFAI can be successfully used by professionals working in sports medicine in Turkey.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Hacettepe University (GO 14/601-26).

Informed Consent: Written informed consent was obtained from the participants.

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Conflict of Interest: The authors have no conflicts of interest to declare.

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Appendix. Fonksiyonel Ayak Bileği İnstabilitesi Tanımlaması (FABİT)**FONKSİYONEL AYAK BİLEĞİ İNSTABİLİTESİ TANIMLAMASI (FABİT)**

Açıklamalar: Bu form, ayak bileği durumunuzu kategorize etmek için kullanılacaktır. Sağ ve sol ayak bilekleri için ayrı birer form kullanılmalıdır. Lütfen formun tamamını doldurunuz ve bir sorunuz olursa lütfen ilgiliye sorunuz. Katılımınız için teşekkür ederiz.

Aşağıdaki bildirim lütfen dikkatlice okuyunuz:

“İnstabilite” eklemlerimizdeki bağların zayıflığı, gevşemesi veya yaralanması sonucu eklemden oluşan aşırı hareket hali ve dengesizliğidir.

“Boşalma Hissi” birinin ayak bileğindeki geçici kontrolsüz instabilite ya da dönme hissidir.

Bu formu SAĞ/SOL ayağım (hangisiyse daire içine alın) için dolduruyorum.

1.) Yaklaşık olarak ayağınızı kaç kere burkmuşsunuzdur? _____

2.) Ayak bileğinizi en son ne zaman burktunuz?

() Asla () > 2 yıl () 1-2 yıl () 6-12 ay () 1-6 ay () < 1 ay

3.) Bir spor fizyoterapistine, doktora ya da sağlık uzmanına görünmüşseniz, en ciddi ayak bileği burkulmanız nasıl kategorize edilmiştir?

() Birine gösterilmedi () Hafif (Derece I) () Orta (Derece II) () Ciddi (Derece III)

4.) Ayak bileği burkulması sonucunda koltuk değneği ya da diğer bir gereç kullanmışsanız, süresi nedir?

() Kullanmadım () 1-3 gün () 4-7 gün () 1-2 hafta () 2-3 hafta () >3 hafta

5.) En son ne zaman ayak bileğinizde “boşalma hissi” ortaya çıktı?

() Asla () > 2 yıl () 1-2 yıl () 6-12 ay () 1-6 ay () < 1 ay

6.) Ne sıklıkta ayak bileğinizde “boşalma hissi” ortaya çıkar?

() Asla () Yılda bir () Ayda bir () Haftada bir () Günde bir

7.) Tipik olarak ayak bileğiniz dönmeye (veya burkulmaya) başladığında kontrol edebildiniz mi?

() Hiç dönmedi () Hemen () Bazen () Kontrol edilemedi

8.) Tipik olarak ayak bileğinizin dönmesi sonrasında ne kadar süre sonra ‘normale’ döndü?

() Hiç dönmedi () Hemen () < 1 gün () 1-2 gün () > 2 gün

9.) ‘Günlük yaşam aktiviteleri’ sırasında ne sıklıkta bileğinizde İNSTABİLİTE hissedersiniz?

() Asla () Yılda bir () Ayda bir () Haftada bir () Günde bir

10.) “Spor ya da eğlence aktivitelerinde” ne sıklıkta bileğinizde İNSTABİLİTE hissedersiniz?

() Asla () Yılda bir () Ayda bir () Haftada bir () Günde bir