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Reliability and validity of the Persian version of Foot and Ankle Ability Measure (FAAM) to measure functional limitations in patients with foot and ankle disorders

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Objective: To translate the Foot and Ankle Ability Measure (FAAM) into Persian and to evaluate the psychometric properties of the Persian version of FAAM.
Methods: 93 patients with a range of foot and ankle disorders, completed the Persian version of the FAAM and Short-Form 36 Health Survey (SF-36) in the test session. With an interval of 2–6 days, 60 patients filled out the FAAM in the retest session. The FAAM is composed of two subscales including activities of daily living (ADL) and SPORTS. Internal consistency was assessed using Cronbach's alpha, test–retest reliability using intraclass correlation coefficient (ICC) and standard error of measurement (S.E.M.), item internal consistency and discriminant validity using Spearman's correlation coefficient and construct validity using Spearman's correlation coefficient and Independent *t*-test.
Results: Cronbach's alpha coefficient of 0.97 and 0.94 was obtained for ADL and SPORTS subscales, respectively. The ICC and S.E.M. were 0.98 and 3.13 for ADL and 0.98 and 3.53 for SPORTS subscale. Items were stronger measures of their hypothesized subscale than of other subscale. The ADL and SPORTS subscales had stronger correlation with SF-36 physical function ($r = 0.60, 0.53$) and physical health summary measure ($r = 0.61, 0.48$) than with SF-36 mental health ($r = 0.21, 0.10$) and mental health summary measure ($r = 0.36, 0.27$). A high correlation was found between FAAM scores and global scale of functional status for SPORTS ($r = 0.73$) but not for ADL ($r = 0.42$). FAAM scores were greater in individuals who rated their function as normal or nearly normal compared with those who rated as abnormal or severely abnormal for SPORTS ($P = 0.04$) but not for ADL ($P = 0.15$).
Conclusion: The Persian version of FAAM is a reliable and valid measure to quantify physical functioning in patients with foot and ankle disorders.

Introduction

Different self-report outcome instruments have been developed by researchers to provide information about functional limitations and disabilities experienced by individuals with foot and ankle disorders[1,2]. The appropriate selection of instruments for outcome measurement depends on many factors including the type and psychometric properties of instrument and the characteristics of subjects among whom the instrument is intended to be used[1,2].

Based on these criteria, Eachaute *et al.*[2] in a systematic review of the literature identified Foot and Ankle Disability Index (FADI) and Foot and Ankle Ability Measure (FAAM) as the most appropriate outcome instruments to quantify functional limitations in patients with varying leg, foot and ankle disorders. FADI is the former version of FAAM. The FAAM received the highest ratings for its

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clinimetric qualities including content validity, reliability, construct validity, responsiveness, and interpretability. In a separate review, Martin and Irrgang[1] found FAAM as one of five instruments which had evidence for its usefulness for evaluative purposes, that is, being able to measure changes over time[3]. Despite its primarily evaluative function, FAAM as a self-report, region-specific instrument has also shown ability to distinguish individuals with different levels of functional performance[4,5]. Evidence of content validity, construct validity, reliability and responsiveness has been provided for the FAAM to be used in a population with general orthopedic conditions, including pain, sprain and strain, fractures, plantar fasciitis, bunion and Achilles rupture[3]. In addition, construct validity of the FAAM has been verified in athletes with chronic ankle instability[4] and individuals with diabetes mellitus[5]. Reports on its psychometric properties are available for original American–English[3] and German versions[6].

Although the FAAM has been shown to have a good evidence of psychometric properties, its additional validation in other cultures is needed in order to compare and contrast assessments made in different countries[7]. Therefore, the purpose of the study was to cross-culturally adapt and validate the Persian version of FAAM in a group of patients with foot and ankle disorders.

Materials and methods

Translation process

Cross-cultural translation guidelines recommended by International Quality of Life Assessment project[8] were used to translate the FAAM from the original source in English to Persian, which is spoken in Iran, Afghanistan and Tajikistan. At the first step, translators 1 and 2 who were native Persian speakers and were not familiar with the FAAM independently translated the source English version into Persian and then agreed on a common translation in a meeting with the investigators. One of the translators had experience in translating medical textbooks. Translator 3 who was native Persian speaker with extensive knowledge of the English language and with no medical background rated the quality of forward translation from the aspects of clarity, common language use and conceptual equivalence. Quality rating was used to modify the forward translation as needed. Translator 4 who was native American–English speaker translated the forward version back into English with further modification as needed. She was unaware of the concepts underlying the material. The back translation was submitted to the developer to test the equivalence of back-translated version with original version. Finally a pilot was conducted with 20 subjects (age range of 16–48; 14 males, six female) with different foot and ankle pathologies of averagely 6 months duration. They were asked to complete the Persian version of FAAM to find any difficult, upsetting and confusing items. No difficulties encountered by the respondents were noted in the pilot study.

Participants

During a 1-year period, a consecutive sample of native Persian speaking outpatients with a range of foot and ankle disorders referred to 1 Orthopedic and 4 Physical Therapy clinics in Tehran, the capital of Iran, and Isfahan, the third largest city of Iran, participated in the study. Multicenter character of the study minimizes any possible bias due to different cultural, semantic and demographic factors[9]. Patients were included in the study if the cause of their foot and ankle disorder was musculoskeletal in origin. Patients with a history of knee, hip or back pain during the last 3 months, systematic inflammatory rheumatic disease, neurological or vascular conditions, cancer, diabetes mellitus, alcohol abuse and psychiatric disorders were excluded from the study. Of 93 patients who were identified as eligible to participate in the study, all patients agreed to participate and completed the questionnaires. Most of the patients (78.5%) were diagnosed as having lateral ankle sprain. Demographic and clinical characteristics of subjects are shown in Table I. All patients received a region-specific questionnaire, FAAM, and a generic one, Short-Form 36 Health Survey (SF-36), in the first visit. The questionnaires were completed in the clinic waiting room. To evaluate test–retest reliability, a sample of 60 subjects completed the FAAM 2–6 days after the first visit in the same location. To ensure that the health status remained stable between repeated measurements, all patients were explicitly asked by telephone contact that "Has your status changed over the last days since you filled out this questionnaire?". Three possible responses were: (1) No; (2) Yes changed for the better and (3) Yes changed for the worse. Sixty out of ninety-three patients responded "no" to the question. All subjects signed an informed consent form approved by the Ethics Committee at University of Social Welfare and Rehabilitation Sciences.

Instruments

The FAAM is a 29-item questionnaire divided into two subscales: activities of daily living (ADL) with 21 items and SPORTS with 8 items[3]. Each item is scored on a 5-point Likert scale representing different levels of difficulty (no difficulty at all, slight difficulty, moderate difficulty, extreme difficulty and unable to do). The ADL and SPORTS subscales have a total score of 84 and 32, respectively. The scores are transformed to percentage with higher scores indicating a higher level of functional status for each

Table I
Demographic and clinical characteristics of participants completing the FAAM ($N = 93$)

	N (%) unless stated
Demographic data	
Age (year), mean (SD)	27.58 (8.83)
Height (m), mean (SD)	1.75 (7.88)
Weight (kg), mean (SD)	74.25 (11.30)
Body mass index (kg/m^2) mean (SD)	24.36 (3.43)
Sex	
Male	74 (79.6)
Female	19 (20.4)
Years of education	
6–8	5 (5.4)
9–12	35 (37.6)
>12	45 (48.4)
Marital status	
Single	57 (61.3)
Couple	36 (38.7)
Clinical data	
Diagnosis	
Lateral ankle sprain	73 (78.5)
Fracture	11 (11.9)
Plantar fasciitis	4 (4.4)
Others	4 (4.4)
Side of involved leg	
Right	58 (62.4)
Left	33 (35.4)
Both	2 (2.2)
Duration of disease (month), mean (SD)	4.92 (9.92)

Fractures included lateral malleolus ($n = 10$) and metatarsal ($n = 1$) fractures.
Other diagnoses were calcaneal spur ($n = 1$) and ankle joint pain ($n = 3$).
Number (%) of missing values for years of education and diagnosis were 8 (8.6) and 1 (1.1), respectively.

subscale. The FAAM also includes three additional global scales of functional status. Two separate scales for each FAAM subscale required subjects to rate their current level of function during ADL and SPORTS tasks on a 0–100% level with 0% indicating an inability to perform any task and 100% indicating the level function before injury. Another scale asked subjects to rate their current level of overall function with responses categorized as normal, nearly normal, abnormal and severely abnormal.

The SF-36 is a 36-item widely used instrument which measures health status. It consists of eight subscales, namely, physical function (PF), role-physical, bodily pain, general health, vitality, social functioning, role-emotional and mental health (MH) and two distinct higher-ordered factors, namely, physical health summary measures (PHSM) and mental health summary measure (MHSM)[10]. These eight subscales are scored from 0 to 100 with higher scores indicating better health status. Evidence indicates that SF-36 may be a suitable outcome measure in lower limb dysfunctions[11]. In a study to assess the reliability and validity of Persian version of the SF-36, it was administered to a general population of 4163 healthy individuals[12]. Minimum Cronbach's alpha of 0.70 was exceeded by all but one of the subscales, ranging from 0.71 to 0.90. The correlation between each item and its hypothesized subscale was higher than 0.40, ranging from 0.58 to 0.95. Also, the SF-36 had the ability to discriminate between subgroups of people who differed in age and gender. While specific instruments are more sensitive to detect changes in health status resulting from a specific condition, generic instruments like SF-36 evaluate multiple dimensions of disablement that are often neglected when specific measures are used[13]. Generic measures allow comparisons to be made between people with a wide variety of diagnosis.

Assessment of psychometric properties

Data obtained from the first administration of FAAM were used to evaluate internal consistency, item internal consistency and discriminant validity, and construct validity. Internal consistency or the degree of inter-item correlation within a subscale was assessed using Cronbach's alpha while test–retest reliability using two-way random effects model of intraclass correlation coefficient ($ICC_{2,1}$). Cronbach's alpha ≥ 0.70 and ICC ≥ 0.70 were considered satisfactory for internal consistency and test–retest reliability, respectively[14,15]. To verify systematic change, the FAAM mean scores at the test and retest sessions were compared using Paired *t*-test[16]. To estimate measurement precision associated with repeated measurements, standard error of measurements (S.E.M.) was calculated as the square root of the mean square error term derived from analysis of variance table[16]. S.E.M. is useful for computing the minimal detectable change (MDC) or change that could be different between two or more measurements[16]. MDC was defined as 95% confidence interval (CI) of the S.E.M. ($\pm 1.96 \times \sqrt{2} \times$ S.E.M.)[16].

Item internal consistency was assessed using item-subscale correlation corrected for overlap. Spearman's correlation coefficient ≥ 0.40 was considered acceptable[14]. In addition, item discriminant validity was tested using the correlation between each item and the other subscale. Clearly, the correlation between each item and its hypothesized subscale must be significantly greater than the correlation between the same item and its competing subscale[14]. Two standard errors were used as the significance level for comparing two correlations. The standard error was calculated by dividing 1 by the square root of the sample size[17].

Three hypotheses were developed and tested to determine construct validity:

1. The FAAM subscales would have strong correlations with the SF-36 PF and PHSM and weak correlations with the SF-36 MH and MHSM. Spearman's correlation coefficient was used to measure the relationships. According to the literature, correlation coefficients > 0.50 are considered as strong, 0.35–0.50 as moderate and <0.35 as weak[18].
2. The FAAM scores would be strongly related to the scores obtained from global scales of functional status. Spearman's correlation coefficient assessed the relationship.
3. The FAAM would have the ability to distinguish individuals who rate their overall level of function as normal or nearly normal and those who rate their level of function as abnormal or severely abnormal. Independent *t*-test was used to analyze the difference between two groups. Effect size (ES) was determined by dividing the mean difference between groups by the pooled standard deviation (SD). Value greater than 0.5 is large, 0.3–0.5 is moderate and 0.1–0.3 is small[19]. Alpha level of 0.05 was considered for all statistical analyses.

Results

Table II provides the mean, SD, range and the proportion of patients receiving the lowest possible score (floor effect) and the highest possible score (ceiling effect) for the FAAM. Patients reporting a score of 0% or 100% were absent or minimal for both subscales. Only 23 of 2697 (93 × 29) items (0.85%) were missing for the FAAM data. Also, 12 of 3276 (91 × 36) items (0.36%) were missing for the SF-36 data. If the number of missing values were one or two for a subscale, they were substituted with the mean value. More than two missing values for a subscale were considered invalid.

Internal consistency was acceptable with Cronbach's alpha coefficient of 0.97 and 0.94 for ADL and SPORTS subscales, respectively. ADL and SPORTS subscales had mean (SD) score of 68.69 (23.79) and 38.15 (25.64) for the test session and mean (SD) score of 68.83 (23.04) and 38.70 (25.45) for the retest session, respectively. No significant difference between test and retest mean scores was obtained, indicating absence of any systematic change. The ICC (95% CI) for the ADL subscale was 0.98 (0.97–0.99) with a S.E.M. of 3.13, resulting in MDC of 8.67. The ICC (95% CI) for the SPORTS subscale was 0.98 (0.97–0.99) with a S.E.M. of 3.53, resulting in MDC of 9.78.

The evidence on item internal consistency and discriminant validity is provided in Table III. The Spearman's correlation coefficient was higher than 0.57 for ADL items and 0.66 for SPORTS items with their respective subscales. Also, the correlation between each item and its hypothesized subscale was stronger than the correlation between the same item and its competing subscale. The differences between these correlations were significant for 14 items of ADL subscale and 6 items of SPORTS subscale.

Table IV displays the correlation between FAAM and SF-36 subscales. As expected, the FAAM subscales had strong correlations with concurrent measures of PF (that is, SF-36 PF and PHSM) and weak correlations with concurrent measures of mental function (that is, SF-36 MF and MHSM). The correlation between SPORTS subscale and PHSM was marginally below 0.50 (0.48) and the correlation between ADL subscale and MHSM was marginally

Table II
Descriptive statistics and number (%) of patients reporting the worst possible score (floor effect) and the best possible score (ceiling effect) for the subscales of FAAM ($N = 93$)

FAAM subscales	Mean	SD	Range	Floor effect	Ceiling effect
				n (% of patients)	n (% of patients)
ADL	69.19	21.97	4.74–100	0	2 (2.2)
SPORTS	41.67	25.13	0–93.75	7 (7.5)	0

Table III
Correlation matrix showing the relationship of each item to its hypothesized subscale corrected for overlap (item internal consistency) and to the other subscale (item discriminant validity) ($N = 93$)

Item content	FAAM subscales	
	ADL	SPORTS
ADL		
Standing	0.74***	0.42
Walking on even ground	0.77***	0.50
Walking on uneven ground without shoes	0.78***	0.40
Walking up hills	0.82***	0.50
Walking down hills	0.80***	0.53
Going up stairs	0.80***	0.53
Going down stairs	0.79	0.65
Walking on uneven ground	0.81**	0.63
Stepping up and down curbs	0.67	0.63
Squatting	0.70	0.67
Coming up on your toes	0.57	0.54
Walking initially	0.70***	0.37
Walking 5 min or less	0.71***	0.43
Walking approximately 10 min	0.71	0.60
Walking 15 min or greater	0.77**	0.60
Home responsibilities	0.74***	0.51
ADL	0.80***	0.52
Personal care	0.68***	0.48
Light to moderate work (standing and walking)	0.70**	0.51
Heavy work (push/pulling, climbing, carrying)	0.76	0.67
Recreational activities	0.57	0.49
SPORTS		
Running	0.67	0.79
Jumping	0.61	0.83***
Landing	0.60	0.85***
Starting and stopping quickly	0.55	0.86***
Cutting/lateral movements	0.51	0.79***
Low impact activities	0.62	0.69
Ability to perform activity with your normal technique	0.50	0.66**
Ability to participate in your desired sport as long as you would like	0.55	0.74**

All correlations were statistically significant ($P < 0.01$).
Two or more than two standard errors were used as the significance level for comparing each item-subscale correlation with its hypothesized subscale and competing subscale.
*** Item-subscale correlation was significantly higher for hypothesized subscale than for competing subscale at $P < 0.01$.
** Item-subscale correlation was significantly higher for hypothesized subscale than for competing subscale at $P < 0.05$.

above 0.35 (0.36). A moderate correlation ($r = 0.42$, $P < 0.01$) between the ADL subscale and ADL global scale of functional status and a high correlation ($r = 0.73$, $P < 0.01$) between SPORTS subscale and SPORTS global scale of functional status were also observed. Computation of mean difference with 95% CI showed that the SPORTS scores (mean ± SD) were significantly greater in individuals ($n = 48$) who rated their functional status as normal or nearly normal (46.64 ± 25.49) compared with those ($n = 44$) who rated as abnormal or severely abnormal (36.12 ± 23.78) ($t = 2.05$, $P = 0.04$, ES = 0.43). For the ADL subscale, the FAAM was not able to distinguish between individuals who rated their function as normal or nearly normal (72.27 ± 22.37) compared with those who rated as abnormal or severely abnormal (65.75 ± 21.23) ($t = 1.44$, $P = 0.15$).

Table IV
Spearman's rank correlation coefficient of the FAAM and SF-36 subscales ($N = 91$)

SF-36 subscales	FAAM subscales	
	ADL	SPORTS
PF	0.60	0.53
PHSM	0.61	0.48
MH	0.21	0.10
MHSM	0.36	0.27

All correlation coefficients were significant at $P \leq 0.05$ with the exception of correlation between SF-36 MH and FAAM SPORTS subscales.

Discussion

The results of the present study provided evidences for psychometric properties (floor and ceiling effects, internal consistency, test–retest reliability, item internal consistency and discriminant validity, and construct validity) of the Persian version of FAAM to be used as an outcome measure in patients with a variety of foot and ankle conditions, including lateral ankle sprain, fracture, plantar fasciitis and other diagnoses.

In general, the obtained results for the psychometric performance of the FAAM in the present study is similar to its original, American–English, version[3]. In an attempt to develop and validate an outcome instrument for measuring physical function, Martin *et al.*[3] studied the FAAM in 243 patients with varied diagnosis of foot and ankle musculoskeletal disorders, similar to the present study, including joint or limb pain, sprain or strain, fracture, plantar fasciitis, bunion, Achilles rupture and other diagnoses. For internal consistency, Cronbach's alpha coefficient of 0.96–0.98 was found for ADL and SPORTS subscales in different subgroups, comparable to the coefficients (0.97 for ADL and 0.94 for SPORTS subscale) obtained in the present study. For test–retest reliability, an ICC, S.E.M. and MDC level of 0.89, 2.1 and 5.7 points for ADL and 0.87, 4.5 and 12.3 points for SPORTS subscale was found, close to the values (0.98, 3.13 and 8.67 points for ADL and 0.98, 3.53 and 9.78 for SPORTS subscale) observed in the present study. It must be noted that although the generally accepted Cronbach's alpha level of 0.70 indicates the homogeneity of items in each subscale[14], according to Eachaute *et al.*[2], very high level of Cronbach's alpha (above 0.90) for ADL and SPORTS subscales raises the possibility that there may be some redundancy among items within the FAAM subscales. However, this needs further investigation.

For construct validity, our findings were comparable to those in the original version. In the American–English version[3], the ADL and SPORTS subscales had greater correlations with the SF-36 PF ($r = 0.84$, 0.78) and PHSM ($r = 0.84$, 0.80) than with SF-36 MH ($r = 0.18$, 0.11) and MHSM ($r = 0.05$, −0.02), similar to the correlations obtained in the present study. The significant difference of SPORTS scores between the two groups in the present study implies that subjects with foot and ankle disorders have more difficulties in sports activities rather than ADL. The inability of ADL subscale to discriminate between groups may be related to the high level of functioning in the young study participants with an average age of 28. Based on item-response theory analysis, Martin *et al.*[3] demonstrated that ADL subscale provides information regarding physical functioning in the lower range of ability while SPORTS subscale is able to collect information in the higher range of ability. Although the FAAM SPORTS subscale was able to distinguish between individuals with different levels of functional status, the clinician must remember that the FAAM has been primarily developed for evaluative, but not discriminative, purposes[3].

A potential disadvantage of the FAAM is that the FAAM does not quantify outcome at the level of quality of life. Therefore, clinicians can decide to use another instruments like Foot and Ankle Outcome Score[20] in conjunction with the FAAM to be able to measure quality of life in people with foot and ankle disorders.

The values of internal consistency obtained in this study must be interpreted with caution because it has been shown that the same Cronbach's alpha can be achieved in data sets with different structures[21]. Therefore, Cronbach's alpha does not measure the unidimensionality of an instrument[22]. While the unidimensionality of each instrument needs to be measured by performing factor analysis, the sample size of the present study was not sufficient enough to do such analysis. Another limitation of this study may be the short length of time (i.e., 2–6 days) between two measurements for test–retest reliability which increases the memory effects of first administration of instrument on the performance of subsequent administration. Furthermore, the design of the present study did not allow us to assess its sensitivity to change. Future research shall assess the responsiveness of the Persian version of FAAM to examine its ability to detect important change in physical functioning over time following a conservative or surgical intervention. The results of the present study must be generalized cautiously, because the population represented a sample with young age, with a prevalence of males and with a dominant diagnosis of lateral ankle sprain.

In conclusion, the results reported in this study confirm the reliability and validity of the Persian version of FAAM in patients with a variety of foot and ankle musculoskeletal conditions, especially those with lateral ankle sprain who constituted the majority of included participants.

Conflict of interest

None of the authors have any financial or other interests related to the manuscript to be submitted for publication in Osteoarthritis and Cartilage.

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