The Foot Function Index with Verbal Rating Scales (FFI–5pt): A Clinimetric Evaluation and Comparison with the Original FFI

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ABSTRACT. ***Objective.*** To assess the clinimetric value of the Dutch version of the Foot Function Index (FFI) in comparison with the original FFI using verbal rating scales (FFI-5pt) rather than visual analog scales (VAS).

Methods. A prospective study was performed on 206 patients with nontraumatic forefoot complaints. Scoring, internal consistency, and construct validity of the FFI-5pt were compared with those of the original FFI, which rates all items on VAS. We also studied agreement between the scores at baseline and after one and 8 weeks and the scale scores with regard to sex, age, presence of osteoarthritis, limitation of mobility, bodily pain, and poor physical functioning (using SF-36).

Results. Some items were not applicable; removal of these items left 2 scales (Pain and Disability) with high internal consistency ($\alpha = 0.88$ to 0.94) and good agreement between both versions (intraclass correlation coefficient 0.64 to 0.79). Principal component analysis with varimax rotation using a forced 2 factor model fitted well (65% explained variance). Test-retest reliability was high (ICC 0.70 to 0.83), while the stability over 8 weeks was lower, but still good (ICC 0.63 to 0.71). Responsiveness to change was low to moderate. However, a small number of patients reported an overall change (19%). Scores of patients with limited mobility and poor physical health (SF-36) were higher than those of patients with fewer physical problems, indicating good concurrent validity.

Conclusion. The FFI-5pt is a suitable generic measure. Its clinimetric properties are comparable with those of the original FFI. Its administration and data entry are less time consuming. However, responsiveness has to be more exactly assessed in an intervention study. (J Rheumatol 2002;29:1023–8)

Key Indexing Terms:
FOOT FUNCTION PAIN
DISABILITY RELIABILITY RESPONSIVENESS TO CHANGE

Foot complaints are common in elderly people. The prevalence of foot pain complaints is roughly 6% in adults[1,2] and about 20% in the elderly (> 65 years)[3]. These complaints are mostly caused by problems like metatarsalgia, hallux valgus, abnormal position of toes, and arthritis[4,5]. Such foot problems can increase the risk of falls[6], which may in turn increase morbidity and mortality[7]. These problems are also associated with functional disability, immobility, and reduced well being. In 1991, the Foot Function Index (FFI) was developed to measure the effect of foot problems on function in terms of pain and disability[8]. The FFI is a self-administered index consisting of 23 items divided into 3 scales (Limitation, Pain, and Disability). All the items are rated on a visual analog scale (VAS) and have satisfactory clinimetric properties[8-10]. We wanted to use this measure because the effect of common foot complaints has not been investigated in general practice populations. As well, a generic Dutch measure to assess the effect of these complaints and to assess the effectiveness of interventions did not exist.

Since the FFI is in English, a forward and backward translation procedure[11] was performed by 2 bilingual persons, one layman and one professional, with permission of the authors (E. Budiman-Mak, personal communication).

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The first draft of this Dutch version was presented to a panel of specialists (orthopedic surgeon, lecturer on podiatry, general practitioner) who assessed that it had good face validity. However, administration, coding, and data entry of the VAS scores are time consuming. Because of this and since several studies have shown high correlation between scores using VAS and those using verbal rating scales (VRS)[12-14], the items in the present study were rated on a 5 point VRS, the FFI-5pt.

We examined the Dutch FFI-5pt with regard to scoring, internal consistency, and construct validity among patients with nontraumatic forefoot complaints lasting more than 4 weeks and compared it with the original FFI. We also describe the agreement between the scores of the FFI-5pt at baseline and after one and 8 weeks and the scale scores with regard to several aspects of physical functioning.

MATERIALS AND METHODS

Study design. A total of 250 patients ≥ 45 years of age with nontraumatic forefoot complaints lasting longer than 4 weeks were invited to participate in this prospective study. Patients were randomly selected from a population of 742 persons who had reported nontraumatic forefoot complaints on a screening questionnaire. That questionnaire had been sent to all patients ≥ 45 years of age registered in 5 general practices in the city of Apeldoorn (125,000 inhabitants), The Netherlands[5]. After patients had completed the questionnaire, they underwent a physical examination by physiotherapists (n = 2) (Time 0) in the regional hospital (Gelre Hospital, Apeldoorn, The Netherlands). They then completed 2 more questionnaires at home: one at Time 1 (one week after Time 0) and one at Time 8 (8 weeks after Time 0), while they were blinded to their previous scores.

Assessments. Age, sex, and type of insurance were noted. Osteoarthritis (OA) was diagnosed when the patient reported this disease in their feet or in any other joints in the previous 12 months. Mobility was assessed by asking the patient whether he/she was able to walk 400 m without stopping[15], with a cane if necessary (scored from 1 to 4; 1: mobile and 2 or more: limited mobility).

Physical functioning. Several aspects of physical functioning were measured using the Medical Outcomes Study Short-Form 36 Health Survey (SF-36)[16,17]: bodily pain, physical functioning, and role limitations due to physical functioning. The scale scores were calculated using the Medical Outcomes Study (MOS) scoring system and ranged from 0 (lowest well being) to 100 (highest well being)[18]; they were then dichotomized along the median.

Foot Function Index. As noted, the FFI measures pain and mobility limitation as the effect of foot complaints and problems of foot function[8]. It consists of 23 items divided into 3 scales: Limitation (5 items), Pain (9 items), and Disability (9 items). The items are rated on a VAS consisting of horizontal lines (10 cm) without subdivisions. The poles are labeled "never" and "always" (limitations), "no pain" and "intense pain" (pain), and "no difficulty" and "impossible" (disability). The respondent is asked to mark the horizontal line at the spot that best corresponds to the effect of the foot complaints in terms of limitation, pain, and disability. The minimum score is 0 and the maximum 9. If function loss is not a result of foot complaints, the patient is asked to indicate "NA," not applicable. That item is then omitted in further calculations. To calculate the definitive scale scores, the item scores are summed, divided by the maximum possible sum of the item scores, and then multiplied by 100. The total score is the mean of the scale scores. The scores range from 0 to 100; the higher the score, the more limitation/pain/disability is present. All patients completed the FFI at Time 0.

Foot Function Index-5pt. The items of the FFI-5pt are identical to those of the FFI, but are rated on a 5 point VRS, ranging from "never" (0) to "always" (4) on the Limitation scale, "no pain" (0) to "intense pain" (4) on the Pain scale, and "no difficulty" (0) to "impossible" (4) on the Disability scale. The score procedure is identical to the original version. Patients were asked to complete the FFI-5pt at Time 0, Time 1, and Time 8.

Improvement/deterioration of foot complaints. At Time 8 (8 weeks after Time 0), patients rated the overall change of their foot complaints on a scale ranging from "very much deterioration" (1) to "very much improvement" (7). The scores were categorized as follows: deterioration, 1–3; no change, 4; and improvement, 5-7.

Analysis. After item analysis, the internal consistency of the scales was evaluated for both versions of the FFI at Time 0 using Cronbach's α. The agreement between the scale scores obtained with the FFI-5pt and those obtained with the original FFI was calculated using the intraclass correlation coefficient (ICC; 95% CI). Construct validity was assessed for both versions by means of a principal component factor analysis with varimax rotation.

Test-retest reliability of the FFI-5pt was calculated by determining the agreement between the scale scores obtained at Time 0 and those obtained one week later (Time 1) using the ICC (95% CI). The stability of scores at Time 0 and Time 8 was also calculated using the ICC (95% CI). The responsiveness to change according to "improvement, "no change," and "deterioration" at Time 8 was assessed with graph/error bars (95% CI). Finally, the scale scores of the FFI-5pt were evaluated according to age, sex, the presence of OA, limited mobility, and poor physical functioning.

All analyses were performed with SPSS for Windows.

RESULTS

Patients. A total of 206 patients, mean age 61 years (SD 10 years), completed the measurements at Time 0 and Time 1 (response 82%). Two-thirds were female (67%) and two-thirds were insured by the Netherlands Health Insurance Fund (64%), which means that the portion of patients with relatively lower financial status is about the same as could be expected from national figures. Twenty-four percent had OA. One-third of the patients (35%) had limited mobility, about half of whom mentioned poor physical functioning (bodily pain, n = 106; physical functioning, n = 97; and role limitations due to physical functioning, n = 88). After 8 weeks (Time 8), 196 patients (78%) completed the FFI-5pt and 180 (72%) also completed the rating of the overall change.

Item and scale scores. The items on the limitation scale of both the FFI-5pt and the FFI proved poorly suitable for the study group. Nearly all respondents rated items 1 and 2 ("Use device indoors" and "outdoors," respectively) as "Not applicable," and 60% rated item 5 ("Limit activities") as "Not applicable" (Table 1). The 2 other items (items 3 and 4: "Stay inside all day" and "Stay in bed all day") were rated "Never" by nearly all respondents. Therefore, the Limitation scale was excluded from the FFI-5pt. Two items on the Pain scale ("Pain walking with orthotics" and "Pain standing with orthotics") and one on the Disability scale ("Difficulty walking fast") of both the FFI-5pt and the original FFI were also marked "Not applicable" by many patients. They were also deleted from the FFI-5pt. Further analysis, therefore, comprised a Pain scale with 7 items and a Disability scale with 8 items. On the whole, item scores of the FFI-5pt were

Table 1. The item and scale scores for the FFi-5pt and FFI (based on the Pain scale with 7 items and the Disability scale with 8 items) at Time 0. Data are mean (SD) (n = 206).

Item and Scale Scores	FFI-5pt Range 0–4			FFI Range 0–9		
	NA	Mean	(SD)	NA	Mean	(SD)
Limitation						
1 Use device indoors	197	1.6	(1.9)	198	2.9	(4.5)
2 Use device outdoors	197	2.9	(1.5)	198	6.4	(3.8)
3 Stay inside all day	7	0.2	(0.5)	3	0.2	(0.9)
4 Stay in bed all day	6	0.0	(0.0)	1	0.0	(0.3)
5 Limit activities	124	0.8	(1.1)	125	0.9	(1.8)
Pain						
1 Foot pain at worst	2	1.4	(0.9)	0	2.8	(2.4)
2 Foot pain in the morning	4	0.3	(0.6)	0	0.6	(1.3)
3 Pain walking barefoot	8	0.6	(0.8)	3	1.1	(1.8)
4 Pain standing barefoot	4	0.5	(0.8)	0	1.0	(1.8)
5 Pain walking with shoes	0	1.1	(0.8)	0	1.9	(1.0)
6 Pain standing with shoes	0	0.9	(0.8)	0	1.7	(1.0)
7 Pain standing with orthotics	135	0.9	(0.8)	141	1.3	(2.1)
8 Pain walking with orthotics	135	1.0	(0.8)	141	1.2	(2.4)
9 Foot pain end of the day	1	1.2	(0.9)	0	2.0	(2.5)
Disability						
1 Difficulty walking in house	0	0.3	(0.5)	1	0.6	(1.3)
2 Difficulty walking outside	9	0.9	(0.9)	6	1.9	(2.3)
3 Difficulty walking 4 blocks	10	0.6	(0.9)	8	1.3	(2.2)
4 Difficulty climbing stairs	7	0.5	(0.8)	20	0.9	(1.9)
5 Difficulty descending stairs	7	0.4	(0.8)	17	0.8	(1.9)
6 Difficulty standing on tiptoe	12	0.7	(1.0)	5	1.2	(2.1)
7 Difficulty getting up from chair	7	0.4	(0.7)	10	0.6	(1.6)
8 Difficulty climbing curbs	8	0.4	(0.7)	5	0.8	(1.8)
9 Difficulty walking fast	65	1.2	(1.3)	80	1.8	(2.8)
Pain scale score, 0–100		21.5	(15.6)		18.1	(17.0)
Disability scale score, 0–100		12.9	(16.6)		11.6	(17.7)
FFI total scale score, 0–100		17.2	(14.3)		14.8	(15.4)

NA: Not applicable.

about half those of the FFI (Table 1), which corresponds with the respective ranges of the scale scores (0–4 and 0–9). The item and scale scores (ranging from 0 to 100 in both versions) for the Pain subscale were higher than for the Disability subscale for both versions of the FFI (Table 1). The (scale) score(s) were generally slightly higher for the 5 point than for the VAS version, while the standard deviation was about the same for both, i.e., relatively large.

Internal consistency. The internal consistency of the scales was good for both versions (Table 2). The agreement between the FFI-5pt scores and the original FFI scores was also satisfactory, although the agreement for the Pain scale was lower than for the Disability scale.

Table 2. The international consistency (Cronbach's α) of the FFI-5pt and the FFI (n = 206) and the agreement between the scale scores of the 2 at time 0 using the intraclass correlation coefficient (ICC; 95% CI) (n = 206).

	Internal Consistency Cronbach's α		Agreement FFI-5pt/FFI
	FFI-5pt	FFI	ICC (95% CI)
Pain	0.88	0.89	0.64 (0.55 to 0.71)
Disability	0.92	0.94	0.79 (0.74 to 0.84)
FFI total	0.93	0.93	0.76 (0.69 to 0.81)

Construct validity. Using a default threshold eigenvalue of 1 (explained variance 67%), a first exploratory principal component analysis of the 15 items of the Pain and Disability scales of the FFI-5pt with varimax rotation produced 3 factors. All the Disability items loaded high on one factor (0.67 to 0.86), while the Pain items loaded on 2: items 1, 5, 6, and 9 loaded on factor 2 (with factor loadings ranging from 0.75 to 0.84) and the items 2, 3, and 4 on factor 3 (factor loadings 0.65 to 0.86). A forced 2 factor model, however, fitted well (explained variance 65%): all of the disability items loaded on factor 1, with factor loadings ranging from 0.67 to 0.87, and the pain items on factor 2 with factor loadings ranging from 0.49 to 0.81 (Table 3). The results of the original FFI version were very similar.

Reliability: test-retest and responsiveness to change. The test-retest reliability of the FFI-5pt was high (Table 4), although somewhat lower on the Pain scale than on the Disability scale. The stability of the scale scores over the 8

Table 3. The factor loadings of the items of the Pain and Disability scales of the FFI-5pt and the FFI (based on a principal components factor analysis with varimax rotation using a forced 2 factor model) (n = 206).

Items	FFI-5pt		FFI	
	1	2	1	2
1 Foot pain at worst	0.22	0.74	0.22	0.81
2 Foot pain in the morning	0.38	0.49	0.38	0.32
3 Pain walking barefoot	0.35	0.64	0.28	0.68
4 Pain standing barefoot	0.38	0.68	0.27	0.69
5 Pain walking with shoes	0.20	0.80	0.23	0.86
6 Pain standing with shoes	0.23	0.77	0.18	0.85
9 Foot pain end of day	0.24	0.81	0.17	0.81
1 Difficulty in walking in house	0.71	0.44	0.72	0.42
2 Difficulty in walking outside	0.71	0.37	0.62	0.53
3 Difficulty walking 4 blocks	0.75	0.26	0.76	0.35
4 Difficulty climbing stairs	0.87	0.22	0.91	0.22
5 Difficulty descending stairs	0.86	0.26	0.92	0.20
6 Difficulty standing on tiptoe	0.67	0.23	0.64	0.34
7 Difficulty getting up from chair	0.80	0.29	0.89	0.01
8 Difficulty climbing stairs	0.82	0.29	0.92	0.17
Variance explained, %	36	29	38	30

Table 4. The test-retest reliability between the scale scores of the FFI-5pt at Time 0 and Time 1 and the stability of the scale scores of the FFI-5pt at Time 0 and Time 8 using the intraclass correlation coefficient (ICC; 95% CI) (n = 206 and n = 196, respectively).

	Test/retest FFI-5pt T0/T1 ICC (95% CI)	Stability FFI-5pt T0/T8 ICC (95% CI)
Pain	0.70 (0.62 to 0.76)	0.63 (0.55 to 0.72)
Disability	0.83 (0.78 to 0.87)	0.71 (0.63 to 0.77)
Total	0.81 (0.76 to 0.85)	0.72 (0.64 to 0.78)

week period was somewhat lower (Table 4). The responsiveness to change, calculated by analyzing the changes in scores after 8 weeks, was low to moderate (Figure 1). It was better on the Pain scale for those respondents whose complaints deteriorated than for those whose complaints improved, but low to absent on the Disability scale.

Concurrent validity. The scores of the scales were higher for older patients, women, patients with OA, patients with limited mobility, and those with poor physical functioning (bodily pain, physical functioning, and role limitations due to physical functioning) than for the rest of the respondents (Table 5). The differences were most pronounced for the

Table 5. The FFI-5pt scale scores according to age, sex, osteoarthritis, mobility, bodily pain, physical functioning, and role limitations due to physical functioning. Mean (sd), difference of means (95% CI) (n = 206).

	Pain	Disability	Total FFI-5pt
Age			
45–64 yrs [n = 124]	20.9 (14.5)	10.0 (13.5)	15.5 (12.6)
> 75 [n = 82]	22.5 (17.2)	17.3 (19.8)	19.9 (16.2)
Diff (95% CI)	1.6 (–2.8 to 6.0)	7.3 (2.3 to 12.2)**	4.4 (0.2 to 8.6)*
Sex			
Men [n = 68]	17.5 (13.3)	9.0 (12.9)	13.2 (10.9)
Women [n = 138]	23.5 (16.3)	14.9 (17.9)	19.2 (15.3)
Diff (95% CI)	6.0 (1.8 to 10.2)**	5.8 (1.5 to 10.2)**	5.9 (2.2 to 9.6)**
Osteoarthritis			
No [n = 156]	19.8 (13.6)	10.2 (13.9)	15.0 (12.0)
Yes [n = 50]	26.7 (20.0)	21.4 (21.2)	24.0 (18.4)
Diff (95% CI)	6.8 (0.8 to 12.9)*	11.1 (4.7 to 17.5)**	9.0 (3.4 to 14.5)**
Mobility			
Good [n = 133]	18.2 (12.4)	5.7 (8.1)	12.0 (8.9)
Limited [n = 73]	27.4 (18.8)	26.1 (19.8)	26.8 (17.1)
Diff (95% CI)	9.2 (4.4 to 14.1)**	20.4 (15.6 to 25.2)**	14.8 (10.6 to 19.1)**
Bodily pain			
Low [n = 100]	14.9 (12.1)	5.9 (8.1)	10.3 (8.4)
High [n = 106]	27.9 (15.8)	19.5 (19.2)	23.7 (15.6)
Diff (95% CI)	13.2 (9.3 to 17.1)**	13.6 (9.4 to 17.8)**	13.4 (9.9 to 16.9)**
Physical functioning			
Well [n = 109]	17.1 (12.7)	4.7 (7.2)	10.8 (8.4)
Bad [n = 97]	26.6 (17.0)	22.2 (19.1)	24.4 (16.1)
Diff (95% CI)	9.5 (5.6 to 13.7)**	17.4 (13.5 to 23.3)**	13.5 (10.1 to 17.0)**
Role limitations due to physical functioning			
Low [n = 118]	17.2 (12.8)	6.6 (10.3)	11.9 (10.1)
High [n = 88]	27.2 (17.2)	21.4 (19.5)	24.3 (15.9)
Diff (95% CI)	10.1 (6.0 to 14.2)**	14.8 (10.7 to 19.0)**	12.4 (8.9 to 16.0)**

* $p < 0.05$, ** $p < 0.01$.

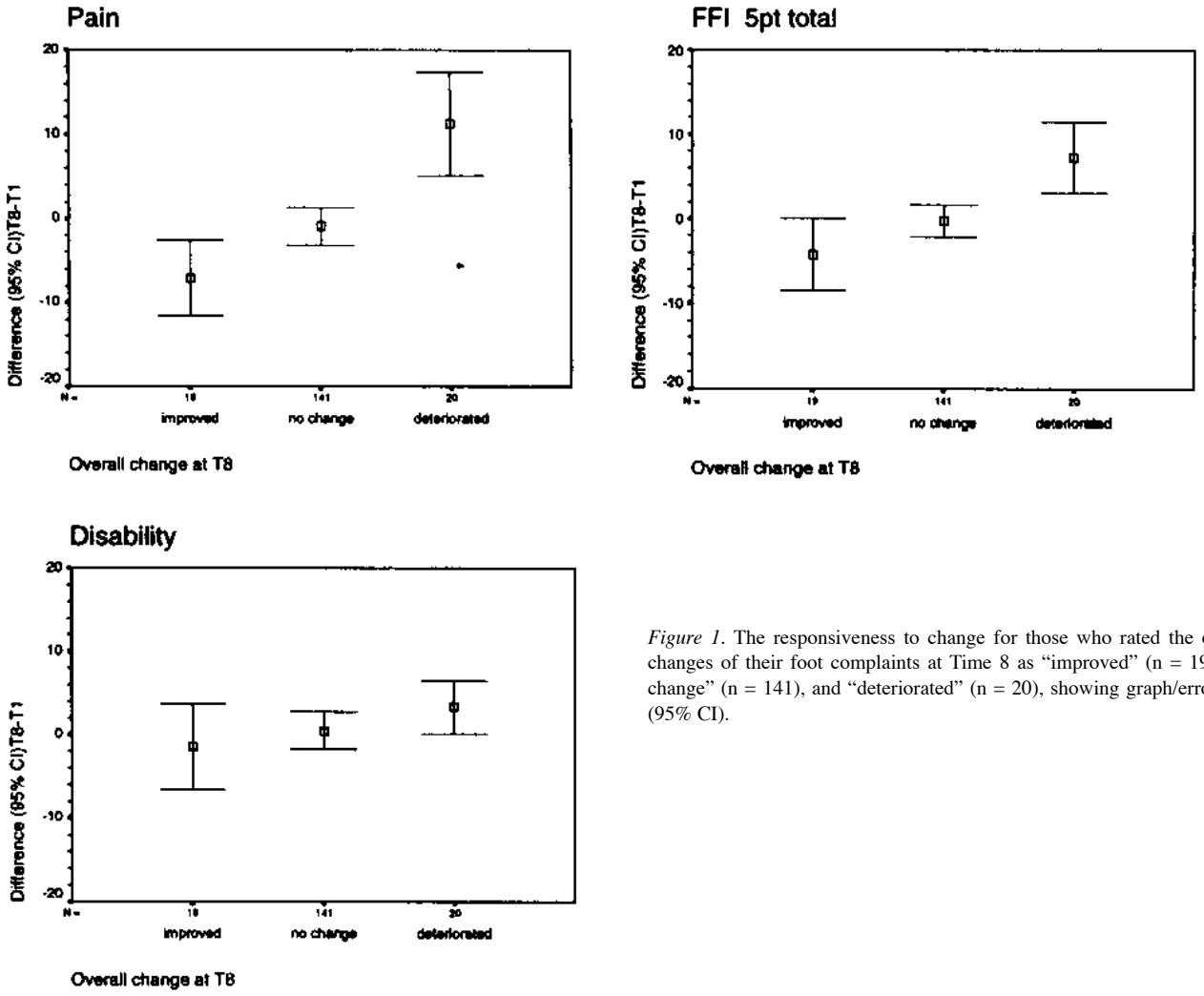

Figure 1. The responsiveness to change for those who rated the overall changes of their foot complaints at Time 8 as "improved" (n = 19), "no change" (n = 141), and "deteriorated" (n = 20), showing graph/error bars (95% CI).

Disability scores, particularly for the patients with/without limited mobility and those with higher/lower scale scores for physical functioning. In general, the differences were less for the Pain scores, being largest for patients with lower/higher scale scores for bodily pain.

DISCUSSION

The Dutch FFI-5pt appears to be a suitable generic self-administered measurement of the effect of foot complaints on foot function, with good test-retest reliability. Its clinimetric properties were comparable with those of the original VAS version[8], while its administration, coding, and data entry were less time consuming.

The final version of the FFI-5pt consisted of 15 items divided into 2 subscales: Pain and Disability. As stated, the Limitation scale did not apply to our patient group and was excluded. Comparable Pain and Disability scales were used by Domsic and Saltzman in their study assessing patients with ankle OA[10] and by Saag, *et al*[9] in their study of rheumatoid arthritis pain. Like Saag, *et al*, we deleted 2 items relating to the use of devices from the pain scale. We also deleted the item "Difficulty walking fast" and we assume this did not limit the content of the scale for this population with low prevalence of serious illness. The measure is appropriate to assess the effect of common foot complaints. Further studies might evaluate its suitability in populations with a higher prevalence of serious illness.

There was good agreement between the scores of the VRS of the FFI-5pt and those of the VAS. This result is in accord with other studies that examined the relationship between VRS and VAS[12-14]. There is some question, however, about the risk of a lower response when using VAS. Because of this and the relative ease of coding and data entry of VRS, the FFI-5pt is favorably comparable to the original FFI. Since we investigated patients with forefoot complaints who had been selected by screening a general population ≥ 45 years old, a wide variety of severity and much less severe cases could be expected. This is probably the reason why the item and scale scores were relatively lower compared to those of patients with rheumatoid arthritis, while the variance (SD) was as wide[8,19].

The responsiveness to change was low to moderate.

However, a small number of patients indicated that their foot complaints had changed between Time 0 and Time 8, and the changes were small in those who did report any change. A more precise assessment of responsiveness should be performed in future studies using an intervention with known effectiveness in reducing pain and disability of foot complaints. The concurrent validity of the FFI-5pt was satisfactory. The most pronounced score differences on the Disability scale were seen between patients with and those without limited mobility and between those with poor versus good physical functioning. As expected, the largest difference on the Pain scale was seen between patients with high and those with low bodily pain.

Another self-administered questionnaire was recently published by Garrow, *et al*, the Disabling Foot Pain Questionnaire (DFPQ)[20]. Although a comparative study is needed to rate the relative merits of both questionnaires (DFPQ and FFI-5pt), the FFI-5pt appears to have several advantages. First, the FFI measures the degree of pain and disability, which is important in assessing the effectiveness of interventions aimed at reducing pain and disability. In contrast, the DFPQ is aimed at measuring the number of problems and time intensity. Further, the FFI has fewer items (15 versus 19) and consists of 2 well defined components (Pain and Disability; explained variance 65%), both with high internal consistency. The DFPQ has 4 components, with less explained variance (57%). Finally, the FFI-5pt test-retest reliability is good, while that characteristic of the DFPQ is not yet known.

The 15 item FFI-5pt is a suitable questionnaire to measure the effect of foot complaints on foot function. It can be used in both population and intervention studies aimed at reducing pain and disability caused by foot morbidity. Further studies in populations with a relatively higher prevalence of serious illness and relating to responsiveness to change are recommended.

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