Defining disabling foot pain in older adults: further examination of the Manchester Foot Pain and Disability Index

Edward Roddy¹, Sara Muller¹ and Elaine Thomas¹

Objective. To identify a practical definition of disabling foot pain in older adults for clinical and research use, using the Manchester Foot Pain and Disability Index (FPDI).

Methods. Adults aged ≥ 50 years registered with three general practices were mailed a two-stage cross-sectional survey. A total of 1342 respondents who reported foot pain in the previous 12 months and completed the FPDI and 58 participants in a test–retest repeatability study were included.

Results. Confirmatory factor analysis verified the three-construct FPDI structure (pain intensity, functional limitation and appearance). Internal consistency for the three constructs was good (Cronbach’s α 0.74, 0.92 and 0.77, respectively). A total of 1320 (98.4%) of those persons with foot pain reported disability (at least one of the 17 FPDI items experienced on at least some days—Definition A). After restricting this definition to problems experienced on most/every day(s) (Definition B), 996 (74.2%) of those with foot pain reported disability (percentage difference 24.2%; 95% CI 21.9, 26.5%). For each of the three constructs, the prevalence of disability among persons with foot pain was significantly higher under Definition A than under Definition B. Test–retest repeatability for the individual constructs ranged from fair to substantial. Physical function, measured by the SF-36 physical function sub-scale, was poorer in those who reported problems within the function construct compared with those with problems in pain and/or appearance constructs only.

Conclusion. A practical definition of disabling foot pain [at least one of the 10 FPDI function items experienced on most/every day(s)] is proposed, which appears valid, repeatable and suitable for use in older adults.

Key words: Foot pain, Older adults, Validity, Disability, Physical function, Repeatability.

Introduction

Foot pain and foot-related disability are prevalent in community-dwelling older adults. Foot pain, swelling and/or stiffness affect 18% of the adults aged ≥5 years [1]. Prevalence estimates for foot pain range from 20 to 42% in the ≥65 years age group [2–5]. Several studies have shown that foot pain contributes to locomotor disability [1–9] although most have relied upon generic measures of functional status such as the Medical Outcomes Study Short-Form 36 physical functioning sub-scale (PF-10) [10], or objective measures of physical function such as the timed ‘up and go’ [11], rather than foot-specific self-report instruments.

A barrier to epidemiological research into foot pain has been the lack of such a validated foot-specific outcome measure to assess self-reported foot pain and related disability. An exception is the Manchester Foot Pain and Disability Index (FPDI), a 19-item self-administered questionnaire that assesses foot-related problems across four constructs: pain intensity (five items), functional limitation (10 items), personal appearance (two items) and limitation in work or leisure activities (two items) [12]. Each item is assessed as occurring ‘none of the time’, ‘on some days’ or ‘on most/every day(s)’. Using this tool, previous studies have defined disabling foot pain as the occurrence of a problem on at least one of the 17 items (excluding the two items relating to work/leisure) on at least some days in the last month [7, 13–15]. A study of 3417 community-dwelling 18- to 80-year olds reported prevalences of 11% in women and 8% in men for disabling foot pain [7]. A further study of 682 subjects with foot pain nested within this population found that nearly 50% reported disabling foot pain [13]. Two smaller studies used the same definition in older adults but did not report prevalence [14, 15]. These four studies demonstrate the potential of the FPDI to assess foot-related disability in epidemiological studies. However, important practical questions remain concerning how best to use the FPDI to sub-group people with foot pain according to their degree of foot-related disability. As acknowledged by Garrow et al. [7], the classification of disabling foot pain as a minimum of one item experienced only on ‘some days’ will include some people with relatively mild problems. In populations such as older adults, where disability is highly prevalent, the proportion of people with foot pain fulfilling this definition might be so high as not to discriminate. Moreover, persons are classified as having disabling foot pain even if they report a problem only with pain intensity or appearance but not function, which suggests potential for over-reporting of disabling foot pain.

This study was undertaken in order to address the practical issue of how best to use the FPDI to characterize and classify significant foot-related disability. The specific objectives were to (i) determine whether the FPDI provides a useful means of differentiating disabling and non-disabling foot pain in older adults, (ii) examine whether disabling foot pain is more usefully defined in older adults using a more conservative cut-off than recommended previously [7], namely functional problems occurring on most/every day(s), and (iii) examine the validity and repeatability of the individual FPDI constructs as measures of disabling foot pain.

Participants and methods

The study design was two cross-sectional postal questionnaire surveys of older adult populations.

Data collection

Two sources of data were used in this examination of the Manchester FPDI. First, the FPDI was included in a two-stage cross-sectional postal survey of an older adult population using self-complete questionnaires [16]—the main study. Second, the FPDI was completed by participants in a pilot for the main study that had incorporated a repeatability component—the repeatability study. Ethical approval for all stages of both studies
was obtained from the North Staffordshire Local Research Ethics Committee.

Main study
Details of the main study protocol and data collection have been published previously [16]. In summary, the sampling frame consisted of all adults aged ≥50 years registered with three general practices from the North Staffordshire Primary Care Research Consortium (n = 11 309). Practice registers were examined by the general practitioners for exclusions (e.g. severe psychiatric illness or terminal illness).

The design of the study was a two-stage cross-sectional postal survey of an older adult population sample using self-complete questionnaires. Briefly, Stage 1 consisted of a Health Survey questionnaire. Responders to this questionnaire who reported foot pain in the last 12 months were then sent Stage 2, a Regional Pains Survey questionnaire, which gathered more detailed information on their foot problems.

Study questionnaires
Stage 1—the Health Survey questionnaire. The Stage 1 questionnaire included a screening question regarding the presence of foot pain in the last 12 months and survey responders who answered positively to the screening question and gave permission for re-contact were mailed the Stage 2 questionnaire. The Stage 1 questionnaire also collected information on demographic factors, and on physical function using scores from the 10-item physical function (PF-10) scale of the Medical Outcomes Study Short-Form 36 [10]—scores range from 0 to 100 with 100 representing best possible physical function. As reported previously, an adjusted response of 71.3% (n = 7878) to the Stage 1 Health Survey questionnaire was achieved [17].

Stage 2—the Regional Pains Survey questionnaire. Participants were asked to confirm the presence of foot pain in the last 12 months and to complete the FPDI [12].

Repeatability study
The main study was preceded by a pilot study in which a random sample of 1000 adults aged ≥50 years was drawn from the population registered with one general practice from the North Staffordshire Primary Care Research Consortium. The methodology for mailing Health Survey and Regional Pains Survey questionnaires in this repeatability study replicated that used in the main survey described above [16] with an additional stage in which a second identical Regional Pains Survey questionnaire was mailed 4 weeks after the first one to assess the test–retest repeatability of the FPDI.

Analysis
Analysis was restricted to those individuals who reported foot pain in both the Health Survey questionnaire and the Regional Pains Survey questionnaire and completed all 17 FPDI items (excluding the two items relating to work/leisure). These two items were excluded as suggested in previous studies [7, 12–14].

Factor structure of the FPDI
The exploratory factor analyses (EFAs) undertaken by Garrow et al. [12] and Menz et al. [14] identified two different four-factor structures, whereas a further analysis by Cook et al. [13] identified a two-factor structure with one of the 17 items (my feet are worse in the mornings) removed from the scale. Garrow et al. identified two factors related to pain, which the authors suggested could be combined to a single pain intensity construct (five items), and also one construct relating to function (10 items) and one to appearance (two items) [12]. In contrast, the model of Menz et al. proposed two constructs relating to function [termed functional limitation (seven items) and activity restriction (two items)] in addition to constructs pertaining to pain intensity (six items) and appearance (two items) [14]. Cook et al. suggested that their two constructs could be termed foot and ankle function (nine items) and pain and appearance (seven items) [13].

To compare the suitability of the structures proposed by Garrow et al. [12], Menz et al. [14] and Cook et al. [13] in a sample of older adults with foot pain, confirmatory factor analysis (CFA) was applied. CFA is a method in which a proposed structure for the data is specified and then tested to assess whether the data fit the structure [18]. This is in contrast to EFA where the structure is arrived at by having assessed what is the best structure for the data. Following the principles suggested by Terwee et al. [19], CFA was chosen here, rather than EFA, as the aim was to assess which of the three proposed structures was the most appropriate for the data, rather than to create a new structure. The suitability of the three structures proposed by Garrow et al. [12], Menz et al. [14] and Cook et al. [13] was assessed using three routinely used goodness of fit test statistics for each factor structure; root mean square error of approximation (RMSEA), comparative fit index (CFI), and normed fit index (NFI) [18]. For the RMSEA, values <0.05 are considered to be a good fit and values between 0.05 and 0.08 an acceptable fit. Values that indicate a model fits well are greater than 0.95 for CFI and greater than 0.90 for NFI [18]. CFA was carried out using the software package AMOS 7.0.0 [20]. The factor structure with the superior fit according to these three statistics was chosen to define the constructs underlying our data in further analyses.

Internal consistency of the FPDI
The individual constructs within the chosen factor structure were then examined in more detail. The internal consistency of each individual construct was assessed in the main study data through the calculation of the Cronbach’s α statistic [21]. Values of Cronbach’s α between 0.70 and 0.95 have been suggested to represent good internal consistency for health status questionnaires [19].

Definition of disabling foot pain
Two definitions for disabling foot pain were used throughout the analyses:
Definition A—at least one item scored at ‘some days’ or ‘most/every day(s)’ [7]; Definition B—at least one item scored at ‘most/every day(s)’.

The above two definitions for disabling foot pain were applied to all 17 items of the FPDI [12] in the main study to compare the prevalence of disability among persons with foot pain obtained using each definition. The percentage difference between these two prevalence estimates was calculated with a corresponding 95% CI for a paired sample.

Test–retest repeatability
Test–retest repeatability for each individual construct under Definitions A and B was then undertaken using data collected in the repeatability study. Analysis was restricted to those individuals who reported foot pain in the Health Survey questionnaire and reported foot pain and completed all 17 FPDI items in both the test and retest Regional Pains Survey questionnaires. Disabling foot pain (yes/no) within each construct was determined, using both Definitions A and B, on both the test and retest questionnaires. Cross-tabulations were carried out separately for each construct and test–retest repeatability was measured in terms of percentage agreement and a κ-statistic with a corresponding 95% CI. The κ-statistic was interpreted
Prevalence and overlap of constructs

The analysis described above was repeated within each of the constructs first to define prevalence estimates for disabling foot pain using each of the constructs under Definitions A and B, and secondly to determine the percentage difference, with 95% CIs, between these two definitions.

To examine the overlap in the constructs, participants were classified according to the possible combinations of the individual constructs in which they reported a problem, under Definitions A and B. The number and percentage of participants within each combination (including those who did not report problems within any of the constructs) were calculated under Definitions A and B separately.

Construct validity

Building on the concept that ‘disability’ may relate more consistently and specifically to function than to either pain intensity or appearance, the median PF-10 scores and associated interquartile ranges were calculated for each of the construct combinations under Definitions A and B to examine the construct validity of the FPDI. It was hypothesized that scores on the PF-10 would be lower (i.e. worse physical function) in the groups that reported problems within function constructs.

Results

Samples

Main study. Among responders to the Stage 1 Health Survey questionnaire, 3020 respondents reported that they had experienced foot pain in the previous year, giving an estimated prevalence of foot pain in this general population sample of people aged ≥50 years of 39.5%. A total of 2126 of these provided consent for further contact and were mailed a Regional Pains Survey questionnaire, and 1858 completed questionnaires were received: 1518 confirmed that they had experienced foot pain in the previous year and 1342 of these completed all 17 items of interest in the FPDI. These 1342 people formed the population for the analysis of the main study, representing 44.4% of all those who reported foot pain in the Health Survey and 63.1% of all those who received a Regional Pains Survey questionnaire. Of those, 823 were females (61.3%). The mean age was 67.7 (s.d. 8.8) years and 62% were females.

Factor structure of the FPDI

CFA suggested that the data fitted the three-factor structure (pain intensity, function and appearance) proposed by Garrow et al. [12] better than the four-factor structure (pain intensity, functional limitation, activity restriction and appearance) proposed by Menz et al. [14] or the two-factor structure proposed by Cook et al. [13], with all three of the goodness of fit statistics from the CFA closer to the ideal when a model is a good fit to the data under the Garrow et al. [12] structure than under the other structures (Table 1). Hence, the three-factor structure proposed by Garrow et al. [12] was used for subsequent analyses.

Internal consistency of the FPDI

Cronbach’s α was 0.74 for the pain intensity construct, 0.92 for the function construct and 0.77 for the appearance construct, indicating good internal consistency for all three constructs.

Definition of disabling foot pain

Using Definition A across all 17 FPDI items, disabling foot pain was reported by 1320 people (98.4%) in this population with foot pain. Using Definition B, the prevalence was 74.2% (percentage difference 24.2%; 95% CI 21.9%, 26.5%) (Table 2).

Test–retest repeatability

Using Definition A, test–retest repeatability was fair for pain intensity, moderate for function and substantial for appearance. Using Definition B, repeatability was moderate for pain intensity, substantial for function and fair for appearance (Table 3).

Prevalence and overlap of constructs

Among persons with foot pain, the prevalence of disability using Definitions A and B within the three constructs of pain intensity, function and appearance is shown in Table 2. Within all three constructs, the prevalence of disability among persons with foot pain was significantly higher using Definition A.

Data regarding the possible combinations of the eight constructs within which foot problems were reported are shown in Table 3.

| TABLE 1. CFA [18] of the models proposed by Garrow et al. [12], Menz et al. [14] and Cook et al. [13] |
|---------------|------------------------------------------|---------------------------------------|-------------------------------------|
| RMSEA         | 0.065 (95% CI 0.061, 0.069) | 0.087 (95% CI 0.084, 0.091) | 0.078 (95% CI 0.075, 0.082) |
| CFI           | 0.949                                    | 0.908                                 | 0.930                               |
| NFI           | 0.943                                    | 0.903                                 | 0.925                               |

<p>| TABLE 2. Prevalence of disability among people with foot pain, overall and within individual constructs, under Definitions A and B |
| Prevalence of disability among people with foot pain |</p>
<table>
<thead>
<tr>
<th>Definition A, n (%)</th>
<th>Definition B, n (%)</th>
<th>Percentage difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All constructs</td>
<td>1320 (98.4)</td>
<td>996 (74.2)</td>
</tr>
<tr>
<td>Pain intensity</td>
<td>1298 (96.7)</td>
<td>722 (53.8)</td>
</tr>
<tr>
<td>Function construct</td>
<td>1258 (93.7)</td>
<td>859 (64.0)</td>
</tr>
<tr>
<td>Appearance construct</td>
<td>623 (46.4)</td>
<td>275 (20.5)</td>
</tr>
</tbody>
</table>

Definition A: at least one FPDI item scored at ‘some days’ or ‘most/every day(s)’ [7]; Definition B: at least one FPDI item scored at ‘most/every day(s)’. 

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in Table 4. Using Definition A of disabling foot pain, the two most prevalent combinations were represented by persons who reported problems in the pain intensity and function constructs but no problems in the appearance construct \( (n = 624, 46.5\%) \) and those who reported problems within all three constructs \( (n = 613, 45.7\%) \) (Table 4). Each of the other six combinations was seen in fewer than 4% of people. Using Definition B of disabling foot pain, the two most common patterns were pain intensity and function \( (n = 368, 27.4\%) \) and function only \( (n = 230, 17.1\%) \), although 225 \( (16.8\%) \) reported items in all three constructs (Table 4).

**Construct validity**

Median PF-10 scores were lowest for the group reporting problems in all three constructs under both Definitions A and B. Under Definition B, PF-10 scores were lower in the groups who reported problems within the FPDI function construct than in those whose problems were restricted to pain intensity and/or appearance, under Definition B.

The implication of these results is that in older adults, Definition A provides little additional information beyond asking about the presence of foot pain because it identifies virtually all people with foot pain. In contrast, Definition B seems to provide a more useful distinction between disabling and non-disabling foot pain. Furthermore, under Definition B, the pain intensity and appearance constructs relate less strongly to problems with physical function, measured by the PF-10, than the function construct suggesting that the inclusion of the pain intensity and appearance constructs of the FPDI in a definition of disabling foot pain could lead to over-reporting. If a definition of disabling foot pain is required to reflect physical function, we suggest that disabling foot pain should be defined by applying the more conservative Definition B to the 10 FPDI items contained within Garrow’s function construct [12]. This definition of disabling foot pain was found here to be both valid and repeatable. However, we acknowledge that the assumption that a definition of ‘disability’ should relate more consistently and specifically to function than to either pain or appearance contrasts with the approach of many existing severity scales, such as the Chronic Pain Grade [23], which incorporate both pain severity and functional severity.

The prevalence estimates obtained for foot pain and for disability among people with foot pain in this study differ from previous work with the FPDI. In our population of adults aged \( \geq 50 \) years, the prevalence of foot pain in the last year was 39.5%. This contrasts with a study of community dwelling 18- to 80-year olds in which 24% of women and 20% of men reported foot pain during the past month lasting at least 1 day [7], whilst asking about pain in the last year as opposed to the past month might not influence the prevalence estimate greatly, the age difference between the populations studied is likely to explain a substantial proportion of the difference in prevalence estimates obtained. Age-specific foot pain prevalence was not provided by this previous study [7], hence we cannot directly compare data from the same age groups. The prevalence of disability among people with foot pain also differs between the studies. In our study, the prevalence of disability among older people with foot pain in the last year was 98.4% (defined using Definition A). In Garrow’s study, 45.8% of women and 40% of men with foot pain reported current disabling foot pain by Definition A [7]. In a study nested within Garrow’s population [7], Cook et al. found that nearly 50% of 682 people with foot pain reported disability [13]. However, the definition of disability used in these studies had the additional requirement of foot pain present on the day the questionnaire was completed which is likely to have reduced the prevalence estimates obtained for disability among people with foot pain further. Two further studies have used the FPDI to define disabling foot pain in older adults but do not describe the prevalence of disability among people with foot pain [14, 15].

Limitations of our study merit acknowledgement. Based on the findings of CFA, we chose Garrow’s three-factor structure [12].

### Table 3. Test–retest repeatability over a 4-week period in the three constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Agreement (%)</th>
<th>(-/-)</th>
<th>(+/-)</th>
<th>(\chi (95% CI))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain intensity</td>
<td>52 (90)</td>
<td>3 (5)</td>
<td>3 (5)</td>
<td>0.34 (–0.06, 0.75)</td>
</tr>
<tr>
<td>Function</td>
<td>52 (90)</td>
<td>3 (5)</td>
<td>3 (5)</td>
<td>0.57 (0.25, 0.88)</td>
</tr>
<tr>
<td>Appearance</td>
<td>48 (83)</td>
<td>6 (10)</td>
<td>4 (7)</td>
<td>0.61 (0.39, 0.83)</td>
</tr>
<tr>
<td><strong>Definition B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain intensity</td>
<td>45 (78)</td>
<td>5 (9)</td>
<td>8 (14)</td>
<td>0.55 (0.33, 0.76)</td>
</tr>
<tr>
<td>Function</td>
<td>50 (86)</td>
<td>3 (5)</td>
<td>5 (9)</td>
<td>0.72 (0.54, 0.90)</td>
</tr>
<tr>
<td>Appearance</td>
<td>48 (83)</td>
<td>5 (9)</td>
<td>5 (9)</td>
<td>0.34 (0.02, 0.66)</td>
</tr>
</tbody>
</table>

Values are given as n (%). Data from 58 repeatability study participants who reported foot pain and completed all 17 FPDI items in both Regional Pain Survey questionnaires. \(-/-\): Not disabled at test, disabled at retest; \(+/-\): Disabled at test, not disabled at retest.

### Table 4. Physical function scores by the combination of constructs in which problems were reported

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Definition A</th>
<th>Definition B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency, n (%)</td>
<td>PF-10, median (IQR)*</td>
</tr>
<tr>
<td>None</td>
<td>22 (1.6)</td>
<td>90 (73–100)</td>
</tr>
<tr>
<td>Function only</td>
<td>20 (1.5)</td>
<td>85 (55–95)</td>
</tr>
<tr>
<td>Pain only</td>
<td>53 (3.9)</td>
<td>90 (85–90)</td>
</tr>
<tr>
<td>Appearance only</td>
<td>1 (0.1)</td>
<td>75</td>
</tr>
<tr>
<td>Pain and function only</td>
<td>624 (46.5)</td>
<td>69 (30–80)</td>
</tr>
<tr>
<td>Function and appearance only</td>
<td>1 (0.1)</td>
<td>95</td>
</tr>
<tr>
<td>Pain and appearance only</td>
<td>8 (0.6)</td>
<td>90 (71–95)</td>
</tr>
<tr>
<td>Pain, function and appearance</td>
<td>613 (45.7)</td>
<td>35 (10–65)</td>
</tr>
</tbody>
</table>

IQR: interquartile range. *Subject to missing data.
rather than the four-factor structure identified by Menz et al. [14] or the two-factor structure of Cook et al. [13]. We acknowledge that caution is necessary when making indirect comparisons between the results of CFA from different models within the same dataset [18]. Due to the skewed distribution of disability, particularly under Definition A, the χ2-statistic for test–retest repeatability might be unexpectedly low because chance agreement is more likely [24]. However, percentage agreement was high for both Definitions A and B and for each of the three constructs. The study sample was derived from a single geographical region in which ethnic minorities are under-represented, which may limit the generalizability of our findings to other more diverse populations. Although the response rate to the Health Survey questionnaire in our main study was high, there was inevitably subsequent attrition arising from participants’ refusal of consent for further postal contact and either lack of response to the Regional Pain Survey questionnaire or incomplete/inconsistent data reported within. Differences in the age and gender structure of Health Survey questionnaire responders and non-responders have been reported previously [17]. These differences might have led to a biased estimate of the prevalence of foot pain but would have been less likely to have biased the reporting of disability among people with foot pain which was the main subject of this analysis. The poorer response rate to the second Regional Pain Survey questionnaire in the pilot study, which provided data for test–retest repeatability, was particularly conspicuous but not unexpected as the repeat copy of the Regional Pain Survey was the third questionnaire that participants had been sent in a period of only a few weeks.

In summary, the existing method of defining disabling foot pain using the FPDI (Definition A) does not appear to distinguish between disabling and non-disabling foot pain in older adults. Modification of the existing definition to require foot problems to be reported on most/every day(s) (Definition B) rather than some days appears to provide a more meaningful differentiation in this age group. However, using this definition, foot problems were more likely to be restricted to the pain intensity and/or appearance constructs, which relate less strongly with physical function, risking over-reporting of disabling foot pain. We therefore propose a new definition of disabling foot pain based upon the 10 items within the FPDI function construct only that appears to be both valid and repeatable and may be more suitable for use in populations of older adults.

Rheumatology key messages

- Foot problems are so common that their occurrence alone is impractical for defining disabling pain.
- The 10-item FPDI function domain provides a practical measure of disabling foot pain in older adults.

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