Development and Validation of the Ankle Fracture Outcome of Rehabilitation Measure (A-FORM)

Traumatic musculoskeletal injuries are a common problem and may result in short- or long-term disability. Ankle fractures are among the most common traumatic injuries requiring orthopaedic management. Despite their high incidence, ankle fractures have been the subject of less empirical research in comparison to other fracture types. Prior investigations among patients following ankle fractures have reported substantial variability in the prevalence of negative patient outcomes. Some studies have reported that up to 87% of patients experience good to excellent clinical recovery following ankle fracture, whereas other investigations have indicated that fewer than half of patients experience complete recovery and report ongoing problems with physical symptoms, psychological health, and performing social or recreational activities.

In addition to the uncertainty surrounding the frequency of poor outcomes for patients following ankle fracture, a Cochrane systematic review found limited available evidence to inform specific rehabilitation protocols for the management of ankle fracture. This review called for additional well-designed and appropriately powered research to document patient outcomes following ankle fracture and to evaluate interventions. Advancing this research agenda is important, given that insufficient or suboptimal rehabilitation has been cited as a potential cause of long-term disability following ankle fracture.

A limiting factor when evaluating the effectiveness of ankle fracture rehabilitation interventions is the absence of a suitable ankle fracture–specific, patient-
reported outcome measure with robust content foundation. The inclusion of patient-reported outcomes as primary measures has become increasingly common in investigations of people with musculoskeletal conditions. Most evident are measures of pain, physical function, and health-related quality of life. Patient-reported outcomes allow clinicians and researchers to better understand how a condition may impact various aspects of a patient's life from the perspective of the patient. This information can enhance patient-centered care by targeting interventions to priority problem areas indicated by the patient, and by evaluating whether these interventions have a meaningful impact from the perspective of the patient.

The aforementioned Cochrane review identified a range of patient-reported outcome measures that have been used in the context of ankle fracture rehabilitation. However, it has been suggested that these outcome measures lack a methodologically robust content foundation for use as ankle fracture-specific, patient-reported outcomes to evaluate quality-of-life impacts experienced by people recovering from this condition. It has also been found that existing measures lack empirical support for key elements of validity, reliability, and responsiveness, with the exception of the Lower Extremity Functional Scale (LEFS). Favorable clinimetric properties have been reported for the LEFS among individuals without ankle fracture and during the acute phase of ankle fracture recovery. However, a detrimental ceiling effect has been reported after the acute phase of ankle fracture recovery. Previous authors have recommended adding additional items to the LEFS to further improve the instrument. Perhaps the most important reason for the development of a patient-reported outcome to evaluate quality-of-life impacts following ankle fracture, despite the generally favorable performance of the LEFS, is the nature of the item content and purpose of the LEFS. The item scoring and content of the LEFS focus on physical task performance. Though this targeted focus may not be considered a weakness in an instrument designed to assess patients' ratings of their lower extremity physical function, it may not be suitable as an ankle fracture-specific outcome measure intended to capture broader quality-of-life impacts from the patient's perspective.

Perhaps the most widely used patient-reported outcome among people with ankle fractures to date has been the Olerud-Molander Ankle Score. In summary, the Olerud-Molander Ankle Score includes 9 parameters: walking, stiffness, swelling, stair climbing, running, jumping, squatting, physical supports, and work capacity. While this scale is quite practical, it has been criticized for lacking a methodologically robust content foundation and focusing solely on physical symptoms and performance. Additionally, the assignment of scores to the various response options was arbitrarily described by the instrument's authors, without justification for the values being evident.

Without a condition-specific, patient-reported outcome measure with content that is consistent with the life impacts reported by people who have experienced ankle fracture, the most pertinent aspects of the condition may not be evaluated (or addressed). A recent qualitative study has been published in preparation for the development of a condition-specific, patient-reported outcome measure known as the Ankle Fracture Outcome of Rehabilitation Measure (A-FORM) (APPENDIX). This investigation reported life impacts following ankle fractures and outlined a thematic framework suitable for developing potential content for an ankle fracture condition-specific outcome measure. The thematic framework from that investigation has been reproduced in TABLE 1.

This framework indicated that life impacts following ankle fractures commonly extend beyond short-term pain and physical discomfort into several overarching areas of life. A condition-specific, patient-reported outcome measure for use among patients with ankle fracture during their rehabilitation should capture the effects of rehabilitation that patients (rather than health professionals) consider most important. These effects must also be evaluated in a way that is valid, reliable, and responsive to change over the entire rehabilitation period.

The purpose of this study was to describe the process of developing the A-FORM, including the selection and refinement of items and response options, as well as to examine the psychometric properties of the A-FORM, including factor structure, reliability, and validity, by assessing item fit with the Rasch model. The A-FORM is intended to address a notable gap in the patient-reported outcome measures currently available for use in clinical and research settings with this clinical population. The A-FORM is designed to evaluate aspects of physical, social, and psychological recovery that are relevant to patients with ankle fractures, rather than purely measuring physical symptoms or other clinician-defined constructs. Appropriate development and validation of this measure will likely permit inclusion of the patient's perspective in rigorous and efficient evaluations of rehabilitation approaches for individuals with ankle fractures.

**METHODS**

**Design**

A 2-stage research design was implemented. First, a Delphi panel process was used for item development and wording refinement. Second, a cohort study was undertaken to permit a preliminary maximum-likelihood exploratory factor analysis, then Rasch analysis for items developed from stage 1.

**Delphi Panel Process**

The Delphi panel included 8 members and was facilitated by a member of the research team (T.P.H.). The Delphi panel
TABLE 1

Thematic Conceptual Framework of Life Impacts Following Ankle Fractures, Including Categories Represented Within Each Theme

<table>
<thead>
<tr>
<th>Physical</th>
<th>Psychological</th>
<th>Daily Living</th>
<th>Social</th>
<th>Occupational or Domestic</th>
<th>Financial</th>
<th>Aesthetic</th>
<th>Medication Taking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pain, ache, soreness, or discomfort</td>
<td>1. Feelings of anxiety</td>
<td>1. Reduced participation in preferred recreation or leisure activities</td>
<td>1. Negative impact on relationship with spouse or significant other</td>
<td>1. Difficulty participating in usual work activity</td>
<td>1. Reduced income</td>
<td>1. Changed physical appearance due to weight gain</td>
<td>1. Medication usage (including associated side effects)</td>
</tr>
<tr>
<td>2. Swelling</td>
<td>2. Feelings of depression</td>
<td>2. Reduced participation in health and fitness activities</td>
<td>2. Increased dependence on others in household</td>
<td>2. Difficulty completing household tasks</td>
<td>2. Use of savings</td>
<td>2. Now wear nonpreferred footwear</td>
<td></td>
</tr>
<tr>
<td>3. Decreased strength</td>
<td>3. Feelings of frustration</td>
<td>3. Difficulty participating in personal care activities (including showering and dressing)</td>
<td>3. Negative impact on personal relationships with family or friends</td>
<td>3. Reduced discretionary spending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Altered sensation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Difficulty walking (including flat surfaces, slopes, and steps)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where possible, phrasing used by study participants in the prior qualitative research was used in the stimulus wording of each category item. For example, the phrase “My ankle feels stiff when...” was used by patients reporting the impacts of restricted ankle movement on activities in their daily lives. This specific phrasing was used in the stimulus material for 1 of the items that intended to capture patient-perceived difficulty with ankle movement. In this way, a total of 50 stimulus items were provided to Delphi panel members, with item content covering the breadth of previously reported life impacts.

Most of these stimulus items included content primarily related to 1 of the 8 previously reported themes. However, some stimulus items included content with relevance to more than 1 theme; these items typically involved the description of a psychological impact (eg, anxiety or frustration) in relation to an impact from another category (eg, social or occupational and domestic impacts). For example, 1 stimulus item asked about anxiety in relation to difficulty completing usual work or household tasks. This intertheme item content generally occurred as a result of using common patient phrasing in the stimulus content.

Delphi panel participants received the list of potential items as stimulus via e-mail and were asked in each round to comment on the phrasing and scaling for participating in the Delphi panel process.
potential items that could be included in the A-FORM. Panel members discussed whether the content of the question was clear and unambiguous, suggested wording changes, commented on wording modifications suggested by others, and identified whether there were any other notable facets of ankle fracture life impacts that had not been adequately captured by the current item list. The Delphi panel took place via e-mails distributed to and from the central facilitator to ensure the anonymity of all participants. Three waves of Delphi panel feedback were discussed before consensus was attained on a total of 53 potential A-FORM items to be carried forward to the cohort phase of this investigation.

**Patient Cohort**

Cohort participants included a convenience sample of patients who had sustained an ankle fracture and received treatment at a tertiary (university) hospital facility. For inclusion in the study, patients had to be willing to complete the questionnaire on at least 1 of 2 possible occasions, although completion on both occasions was requested. The 2 occasions were prior to the first follow-up outpatient appointment, within 1 week following cast removal (approximately 6 to 8 weeks postfracture), and prior to a 6- to 8-week post–cast removal reassessment (approximately 12 to 16 weeks postfracture).

A total of 51 patients were invited to participate by a research assistant on the day of cast removal. Of these, 45 patients provided written informed consent, and their rights were protected throughout the investigation. The study protocol was approved by the Princess Alexandra Hospital Human Research Ethics Committee. The remainder indicated that they were not interested in taking part in the investigation (n = 4) or that they had already planned to receive subsequent care at another facility closer to their residence (n = 2).

Consenting patients were sent a written copy of the preliminary questionnaire, which included all 53 items, with instructions to complete the questionnaire no more than 1 week prior to the first follow-up appointment after cast removal. Similarly, patients were sent a written copy of the same questionnaire with instructions to complete the questionnaire no more than 1 week prior to their 6- to 8-week assessment. Thus the participants were asked to complete the questionnaire on 2 occasions, but were not excluded from the study if they were only able to complete the questionnaire on 1 occasion.

Participants who consented to completing the questionnaire but did not do so prior to their arrival at the clinic follow-up assessment were given an opportunity to complete the questionnaire in the clinic waiting area. Patients who completed the questionnaire but forgot to bring it to the clinic were provided with a stamped, addressed envelope by a member of the research team and were instructed to return the questionnaire via post. Patients who did not attend their clinic appointment at the scheduled time were mailed a return envelope with instructions to return the completed questionnaire via post.

**Analysis**

Data from completed questionnaires at both assessments were included in the analyses to ensure data representation of severe limitations (immediately following removal of cast) and less severe limitations (6 to 8 weeks following removal of cast). The A-FORM was refined with the intent of developing a parsimonious instrument that could be used in both research and clinical contexts as a condition-specific measure of recovery. As a deviation from standard approaches to scale refinement, the investigators decided to be tolerant of items that appeared to have floor effects (indicating that participants had not recovered), anticipating that a longitudinal cohort study with a follow-up beyond 16 weeks postinjury would more readily detect changes in these items among high-functioning patients.

It has previously been suggested that if less than 5% of the data are missing it is inconsequential to the analysis, but if more than 10% of the data are missing it may introduce bias. Therefore, the starting pool of potential A-FORM items was initially screened for items that had a missing-response rate of more than 10%, indicating that the items might not be broadly applicable or might cause confusion during completion.

An exploratory maximum-likelihood factor analysis was then pursued to examine whether a single-factor structure existed within the remaining items and to examine the relative contribution of each item. Items were sequentially removed on the basis of factor loading being less than 0.5. The internal consistency of items within the factors was then examined. Items were removed from factors on the basis of uniqueness values until a target Cronbach alpha of .90 was attained. This target value of .90 was considered ideal to ensure that the final instrument would likely be internally consistent, while minimizing the risk of item redundancy.

Rasch analysis was then used to further examine and refine the prevailing single-factor structure, construct validity, and internal consistency of the measure. The Rasch model is suitable for the analysis of ordered-response category data. In the Rasch model of analysis, the relationships between the participant responses and the items are explored. Regarding the potential A-FORM items, this model first tests the theory that the person with a more functional ankle was less likely to report a negative impact on their quality of life, and, second, the theory that the “easier” the item on the A-FORM, the less likely the person was to report an impact. For example, respondents may be less likely to report difficulty walking on a flat surface than difficulty jumping.

The Rasch model aligns a person’s perceived ability and item difficulty in logits, where the logit translates into a raw score. Higher logits represent increased item difficulty. Similarly, a person with
a higher (perceived) ability would have a higher logit value. This was visually represented with an item map (FIGURE). This alignment means that a person with a logit of 1.0 would have a 50% likelihood of reporting difficulty on an item with the same logit value of 1.0, while being more likely to be impacted by “harder” items (logits greater than 1.0) and less likely to be impacted by “easier” items (logits less than 1.0).

It has been reported that, for scale development with Rasch analysis, the use of a data set with between 64 and 100 responses indicates with 95% confidence that the items are stable at responses indicates with 95% confidence of a data set with between 64 and 100.

A well-formed questionnaire should give its ability to discriminate between participants. The separation index must exceed the residual and sensitivity to outliers. It has previously been suggested that mean-

The A-FORM data were fitted using the WINSTEPS Version 3.74.0 software (John Linacre, Winsteps.com, Beaverton, OR). While the model function and software allow for response scale analysis, the preliminary maximum-likelihood factor analysis was conducted to ensure unidimensional data suitable for analysis within the Rasch model. Once unidimensionality was established, 3 main parameters were assessed: the fit statistics, separation indices, and item targeting.

The 2 fit statistics commonly used within the Rasch model to assess the item fit included the infit and outfit. The infit is the weighted mean-square residual difference between the expected and observed responses, and the outfit statistic determines the unweighted mean-square residual and sensitivity to outliers. It has previously been suggested that mean-square infit and outfit statistics in the range of 0.5 to 1.5 are productive for measurement. Person or item responses that fall within this range can be retained within a questionnaire, having demonstrated favorable properties for inclusion in a unidimensional rating scale.

For items that fell slightly outside this range (1.5-2.0), the authors used discretion as to whether the item would be retained or discarded. This use of discretion for items that performed well enough to not degrade the instrument but did not fall into the ideal range ensured that potentially useful items would not be discarded prematurely. The choice of whether to retain or discard items in the discretionary range was primarily based on whether an item with similar content was already in the questionnaire (a disincentive to retain the discretionary item), and whether it was plausible that inclusion of data from more assessment time points would contribute to the item falling into the ideal range (0.5-1.5). Any items with infit or outfit greater than 2.0 were automatically discarded. The person separation index gives an indication of the reliability of a questionnaire and its ability to discriminate between participants. The separation index must exceed 2 to achieve a reliability of at least 0.8.

Differential item functioning (DIF) was also assessed to determine if participants responded differently to items over the 2 time points. The DIF was determined to be small or absent if the difference in logits was less than 0.50 logits, minimal (probably inconsequential) if the difference was 0.50 to 1.0 logits, and notable if the difference was greater than 1.0 logits. If notable DIF was found, it indicated that the scale performance differed between assessments, meaning that the scale would have been biased by the assessment time point.

Another key factor of the Rasch analysis is the targeting of item difficulty compared to the ability of the participants. A well-formed questionnaire should give a range of scores across a broad range of abilities, and Rasch analysis produces
a hierarchy of item scores and person ability. Ideally, for a well-targeted questionnaire, the mean of the person scores should be similar to the mean of the item scores. Scaling was also conducted to allow for conversion of raw scores from items falling within the target infit and outfit range to a linear measure suitable for parametric analysis. To demonstrate this, raw scores from the A-FORM Version 1.0 were converted into a linear score between 1 and 100.

RESULTS

Potential Items Following Delphi Panel

At the completion of the 3-round Delphi panel process, the 53 potential items carried forward to the cohort phase included content relating to the themes of physical impacts (16 items), psychological impacts (4 items), daily-living impacts (7 items), social impacts (3 items), occupational and domestic impacts (4 items), financial impacts (2 items), aesthetic impacts (2 items), medication-taking impacts (1 item), and content that addressed more than 1 of these themes within a single item (14 items). Items 1 through 11 included ordinal multiple-choice descriptive statements. The remainder of items had Likert-scale response options (5-point ordinal scale rating).

Ankle Fracture Cohort

Of the 45 consenting participants, 4 participants subsequently received follow-up orthopaedic care at another facility, did not return to the participating clinic, and did not complete the questionnaire at either assessment. The remaining 41 (91%) participants completed the questionnaire at 1 week post–cast removal and were included in the analyses. One of these participants was incarcerated at the time of the second assessment and did not attend the clinic or complete the questionnaire at the second assessment point. The remaining 40 (89%) participants completed the questionnaire at the second assessment. This resulted in a total of 81 completed questionnaires from the 2 time points for inclusion in the statistical analyses. Demographic details and fracture types present for the 41 participants who were included in the analyses are presented in Table 2.

Examination of cohort study data revealed 5 items with more than 10% missing data, and these items were eliminated from further analyses. Exploratory maximum-likelihood factor analysis with the remaining 46 items indicated a distinctive single-factor solution (factor 1 eigenvalue, 24.2, where eigenvalues are representative of the amount of variance in all items accounted for by the factor\(^{20}\)). Following this, there was a plateau of eigenvalues for subsequent factors. Items were further removed from the measure based on factor loadings and uniqueness values for the single-factor solution, resulting in a preliminary instrument of 15 items. The final instrument included 3 symptom items (pain, swelling, stiffness), 5 functional-limitation items (walking on flat surface, jumping off both feet, sprinting, getting to sleep, returning to sleep if woken), 1 participation-restriction item (personal activities of daily living), 2 general mental health symptoms (depressed, fatigued), 2 specific mental health symptoms (anxious about not being able to participate in your preferred health and fitness activities in the future, anxious about not being able to wear your preferred footwear), and 2 external impacts (the amount of extra work that others in your household have to do, relationships with your extended family and friends).

The 15 unidimensional items retained in the scale were analyzed for fit and separation. Table 3 displays the fit statistics of the 15 items, with 70 participant responses. One item (“Are you anxious about not being able to wear your preferred footwear?”) showed high outfit (mean square, 1.75) and was removed from subsequent analysis to examine whether this improved the properties of the measure. The person and separation indices before and after removal of this item (anxious about footwear) and the mean infit and outfit responses (69 responses remaining) are shown in Table 4. These values were favorable, demonstrating appropriate person and item reliability after (and before) removal of the “anxious about footwear” item, and acceptable infit and outfit statistics for the
other 14 items (range, 0.55-1.50). The person (and item) reliability and separation indices indicated that the measure was able to distinguish between persons (and items) in terms of their position on the latent variable. The high reliability of persons and items also indicated that the A-FORM was able to define each of the items (“difficulty”) and that there was an appropriate sample size and number of items within the A-FORM. Additionally, the small model error of measurements indicated that extreme scores were not common and was consistent with a favorable signal-to-noise ratio of true variance to observed variance. The DIF analysis indicated that notable DIF occurred between assessments for only the “anxious about footwear” item. In combination with the higher outfit for this item, this supported the removal of this question from subsequent analyses. The nonsignificant DIF for the other questions supported the use of the 2 time points to be used as a single data set.

The FIGURE displays a person ability and item map. This map gives a visual representation of the range of person abilities across all the items, with a range of difficulties. The person abilities were represented across the range of item difficulty, with no ceiling or floor effects noted. TABLE 5 displays a list of the raw scores (of the 14 items with acceptable infit and outfit statistics) converted to a scale of 1 to 100. This table demonstrates how, based on the analyses conducted, potential exists to convert the raw item scores to a single summary score (out of 100); however, the conversion process is not linear in nature.

DISCUSSION

Main Findings, Strengths, and Limitations

This 2-phase research investigation included the development and refinement of potential items for inclusion in an ankle fracture condition-specific outcome measure. The content of these potential items was founded on the previously described conceptual framework of life impacts that patients
reported as a result of an ankle fracture. Though all potential items included content that might have some relevance in clinical settings, only items that demonstrated favorable properties for inclusion in a patient-reported outcome measure were retained. The decision to retain items was informed by analyses of item response rates, factor structure, construct validity, and internal consistency.

At the end of these analyses, a decision was made as to whether to retain 14 or 15 items for inclusion in a parsimonious unidimensional outcome measure known as the A-FORM (Version 1.0). The item in question asked respondents to report whether they were anxious about not being able to wear their preferred footwear due to their ankle fracture. Despite a high outfit value and notable DIF for this item, no similar content was covered by the other remaining 14 items, which prompted the investigators to retain the item in the instrument pending further empirical investigations. However, the summary score for the A-FORM (Version 1.0) was derived from only the 14 items meeting the required parameters from the Rasch analysis, on account of the high outfit value and poor DIF for the footwear item.

Overall, data from this investigation were favorable, indicating that the A-FORM (Version 1.0) had high levels of internal consistency (also known as internal consistency reliability) and construct validity. This instrument is intended for self-completion by patients in clinical and research contexts. Among this sample, all patients were able to self-complete all 15 questions without the need for interviewer administration.

The findings from the A-FORM item data in this investigation are promising but must be considered with caveats, and further research is required. The nature of voluntary participation in the investigation of questionnaires may result in patients with lower levels of literacy or confidence in completing questionnaires self-electing not to participate in the study. Therefore, patients with the lowest levels of literacy may not be represented in this sample. This could have led to more favorable findings than those which might be observed among a complete cross-section of patients. Similarly, the sample included a higher percentage of males than females (Table 2), and only included participants up to 16 weeks post fixation of fracture, which might have impacted the external validity of these findings. However, this investigation had some protection against bias due to sampling on account of the high proportion of consenting participants in comparison to those invited to participate, and the high proportion of respondents who returned the questionnaire. The reasons provided for nonresponders were also rational (inability to return to

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**TABLE 5**

**Raw Score to Rasch Score Conversion of the Ankle Fracture Outcome of Rehabilitation Measure Version 1.0**

<table>
<thead>
<tr>
<th>Raw Score</th>
<th>Logits</th>
<th>Converted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-7.80E1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>-6.48</td>
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<tr>
<td>35</td>
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</tbody>
</table>

Table continues on page 496.
the participating facility for follow-up care or incarceration).

Clinical Implications

There are several important clinical implications from the findings of this research. These analyses have provided evidence of a latent trait (a single factor) being evaluated by the items retained in the instrument. This is desirable for a patient-reported outcome measure intended to generate a single summary score suitable for use in clinical practice and clinical trials. The authors are confident that the latent trait being evaluated by this instrument is patient-perceived impact (on the patient’s own quality of life) attributable to ankle fracture. The authors reached this conclusion after considering the content of the individual items and their derivation from qualitative reports of life impacts following ankle fracture.

The retained items include representation of each of the overarching themes presented in TABLE 1, with the exception of financial impacts and medication taking. It is perhaps not a coincidence that financial impacts and medication-taking impacts were among the least frequently identified impacts from the previous qualitative reports. It is plausible that financial and medication-taking impacts did not consistently affect patients with ankle fractures, or that other life circumstances not related to ankle fracture had a greater influence on these aspects of life. It is also noteworthy that financial or medication-related impacts that are attributable to an ankle fracture may be indirectly represented through other items with related content, such as items pertaining to the physical impacts associated with taking pain medication or difficulty completing usual employment-related activities.

The specific content in the retained items also has implications for use of the A-FORM in clinical practice (as well as clinical research). First, it is noteworthy that psychological constructs that have been associated with musculoskeletal pain conditions (eg, catastrophizing, pain-related fear, and fear avoidance) were not identified in the previous qualitative investigation or in this study. It is possible that these psychological constructs may not occur as frequently among people who have sustained ankle fractures compared to other painful conditions, such as persistent low back pain. Second, the A-FORM includes a mix of item difficulty levels, including “easy” (eg, being able to care for oneself or fall asleep) and “difficult” (eg, sprinting or jumping). The authors consider the mix of item difficulty present in the retained items suitable for general clinical use to minimize any potential ceiling and floor effects. Many patients, particularly among increasingly sedentary and aging populations, may not have been
able to sprint or jump before their ankle fracture, but some patients may want to return to sports in which high-level functioning is required. On the other hand, some of the easier items are perhaps more important to a large proportion of this clinical population who may have severe consequences if recovery does not occur (eg, not being able to walk or care for oneself). This mix of item difficulty is likely suitable for general clinical use, although it is plausible that it may have a ceiling effect if used among samples of elite or high-performing athletes recovering from ankle fractures.

The decision to retain the footwear item, at least until further investigations are undertaken, was not straightforward. On one hand, the item outfit was slightly higher than the target range and a notable DIF value was evident, suggesting that it was undesirable to retain the item in the summary score of this unidimensional measure, based on data of this investigation. On the other hand, the content of the item aligned with previous qualitative reports and was not directly duplicating content in other retained items. Therefore, a decision to retain the item pending further testing but not to include it in the summary score was reached. It is plausible that subsequent testing may provide more definitive findings indicating that the item should be removed entirely or that it performs sufficiently to be included in the summary score derived from the A-FORM.

Comparison to Prior Research and Future Research Priorities

The A-FORM (Version 1.0), developed by assessing item fit with the Rasch model, has a robust content foundation and demonstrated favorable single-factor structure, internal consistency reliability, and validity. This may be considered an advantage over the other instruments that have been previously used among people with ankle fractures, including the most widely used among these, the Olerud-Molander Ankle Score. There is currently a marked lack of empirical evidence reporting favorable psychometric and clinimetric properties for that scale.\[5,13,17\] However, further empirical examinations of the A-FORM and Olerud-Molander scales are warranted before firm conclusions can be drawn regarding the superiority in measurement properties of either instrument.

Further investigations of the A-FORM are warranted, given the promising findings of this investigation. It would be useful for future studies to investigate other elements of reliability and validity of the A-FORM, as well as sensitivity to change and minimal clinically important difference values. This may include examining the association between A-FORM responses and objective measures of symptoms and function that are known to be impacted by ankle fractures. Investigation of the performance of the A-FORM among a sample with a longer time since ankle fracture would be valuable. It would also be useful for a future study to conduct a head-to-head comparison between the performance of the A-FORM instrument and the Olerud-Molander Ankle Score, or perhaps the LEFS.

CONCLUSION

This investigation developed and refined content for the A-FORM instrument. The A-FORM items demonstrated favorable psychometric properties in this study and are suitable for conversion to a single summary score. Given the promising findings from this investigation, further studies utilizing the A-FORM instrument among people with ankle fractures are warranted. Future research should examine the association between A-FORM responses and measures of functioning and symptoms relevant to people recovering from ankle fractures, as well as sensitivity to change and the minimal clinically important difference for this measure.

KEY POINTS

FINDINGS: This investigation reported the development and validation of a new ankle fracture condition-specific, patient-reported outcome measure known as the A-FORM.

IMPLICATIONS: Findings from this research indicate that the 15-item A-FORM (Version 1.0) is suitable for use as a patient-reported outcome measure among people recovering from ankle fractures.

CAUTION: This investigation only included patients within the first 16 weeks postfixation; further research among patients in later stages of recovery is warranted.

REFERENCES


37. Ponzer S, Näsell H, Bergman B, Törnqvist H. Functional outcome and quality of life


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APPENDIX

The A-FORM© (Version 1.0)
Ankle Fracture Outcome of Rehabilitation Measure

The following questionnaire is presented in two parts.

In the first part, for each question please tick the box that applies to you the most. Tick only one box per question.

In the second part, there are short statements with five numbers beside them. Please circle the number that applies to you the most. There are words at the top of each section to help you to decide which number to circle.

PART ONE
(Please tick only the box that applies to you the most for each statement)

1) I feel pain in or around my ankle… (Pick one response only £)
- all of the time, even when I am laying down
- when I try to stand or walk on my leg for only a minute or two
- after I have been standing or walking on my leg for around 20 minutes
- after I have been standing or walking on my leg for an hour or more
- OR: I do not feel any pain in or around my ankle

2) There is swelling around my ankle… (Pick one response only £)
- all of the time, even if I put my legs up
- most of the time, but it goes down when I put my legs up
- occasionally, particularly if I have been standing on it for around 20 minutes
- occasionally, particularly if I have been standing on it for an hour or more
- OR: I do not have an swelling around my ankle

3) My ankle feels stiff… (Pick one response only £)
- all of the time
- most of the time, but will loosen up after I have used it for an hour or more
- occasionally, but will loosen up after I have used it for around 20 minutes
- occasionally, but will loosen up after I have used it for a minute or two
- OR: I do not have any stiffness around my ankle

For printable version, user guide (including instructions for scoring) and permission to use the A-FORM contact: Dr. Steven McPhail – steven.mcphail@gut.edu.au
### APPENDIX

#### PART TWO

*(Please circle one number on each line)*

<table>
<thead>
<tr>
<th></th>
<th>How difficult do you find it (or do you think you would find it) when...</th>
<th>Not at all</th>
<th>A little bit</th>
<th>Moderately</th>
<th>Very much</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a</td>
<td>...walking on a flat surface <em>(e.g., footpath)</em></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4b</td>
<td>...jumping off both feet</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4c</td>
<td>...sprinting (running at fast speed)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4d</td>
<td>...sleeping without waking up through the night</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4e</td>
<td>...getting back to sleep if you have woken up during the night</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5a</td>
<td>...trying to participate in activities that you need to complete to look after yourself <em>(e.g., showering, dressing, going to the toilet, preparing light meals)</em></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5b</td>
<td>...in general, are you currently feeling...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6a</td>
<td>...depressed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6b</td>
<td>...fatigued</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7a</td>
<td>...specifically, are you feeling...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8a</td>
<td>...is your ankle fracture currently impacting...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8b</td>
<td>...the amount of extra work that others in your household now have to do</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8c</td>
<td>...your relationships with your extended family and friends</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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