Patient-Reported Outcome Measures in Sports Medicine: A Concise Resource for Clinicians and Researchers

Kenneth C. Lam, ScD, ATC; Ashley N. Marshall, PhD, ATC; Alison R. Snyder Valier, PhD, ATC, FNATA

Department of Interdisciplinary Health Sciences, A.T. Still University, Mesa, AZ. Dr. Marshall is now in the Department of Health and Exercise Science, Appalachian State University, Boone, NC.

Background: Despite the importance of assessing patient outcomes during patient care, current evidence suggests relatively limited use of patient-reported outcome measures (PROMs) by athletic trainers (ATs). Major barriers to PROM use include lack of knowledge, navigating the intricate process of assessing a wide variety of PROMs, and selecting the most appropriate PROM to use for care. A concise resource for ATs to consult when selecting and implementing PROMs may help facilitate the use of PROMs in athletic health care.

Objective: To review the instrument essentials and clinical utility of PROMs used by ATs.

Methods: We studied 11 lower extremity region-specific, 10 upper extremity region-specific, 6 generic, and 3 single-item PROMs based on the endorsement of at least 10% of ATs who use PROMs, as reported in a recent investigation of PROM use in athletic training. A literature search was conducted for each included PROM that focused on identifying and extracting components of the instrument essentials (i.e., instrument development, reliability, validity, responsiveness, and interpretability, and precision) and clinical utility (i.e., acceptability, feasibility, and appropriateness). Through independent review and group consensus, we also classified each PROM question by International Classification of Functioning, Disability and Health domain and health-related quality-of-life dimensions.

Key Findings: The PROMs contained in this report generally possessed appropriate instrument essentials and clinical utility. Moreover, the PROMs generally emphasized body structure and function as well as the physical functioning of the patient. Athletic trainers aiming to assess patients via a whole-person approach may benefit from combining different PROMs for use in patient care to ensure broader attention to disabliable health domains and health-related quality-of-life dimensions.

Key Words: patient-centered care, whole-person care, clinical outcomes assessment, disablement, health-related quality of life

Although the importance of assessing patient outcomes and the use of PROMs is clear, current evidence suggests only 15% to 26% of ATs routinely use PROMs during patient care. When asked to identify barriers to the routine use of PROMs during patient care, ATs who did not use PROMs reported that the lack of education about and understanding of PROMs impeded their ability to successfully implement PROMs in their clinical practice. Recent findings indicated that the vast majority of ATs (68%–98%) were unfamiliar with PROMs that were frequently reported in the athletic training literature, including the Foot and Ankle Ability Measure (FAAM; 82.1% of the sample was unfamiliar), the Medical Outcomes Study 36-Item Short Form Health Survey (86.2% were unfamiliar), and the Patient-Specific Functional Scale (PSFS; 82.1% were unfamiliar), further underscoring this lack of knowledge. Although a general lack of knowledge of and experience with PROMs are not unique to the athletic training profession, these barriers can negatively affect the comprehensive implementation of PROMs during patient care, particularly during the intricate process of selecting the most appropriate instrument among the numerous available PROMs.
To help ATs evaluate the available PROMs and identify the most appropriate instruments for use in patient care, Snyder Valier and Lam\(^1\)\(^9\) provided a detailed summary of the major considerations related to PROM selection. In short, ATs should consider both the instrument essentials (ie, instrument development, reliability, validity, responsiveness and interpretability, and precision) and the clinical utility (ie, acceptability, feasibility, and appropriateness) of the instrument.\(^1\)\(^9\) Furthermore, when assessing the appropriateness of a PROM, ATs were advised\(^1\)\(^9\) to consider the health domains represented in disablement models\(^2\)\(^0\) and dimensions of health-related quality of life (HRQOL)\(^2\)\(^1\),\(^2\)\(^2\) captured by the instrument to ensure that the PROM can support patient-centered care. Because of busy athletic training clinicians’ lack of time and resources,\(^1\)\(^4\),\(^1\)\(^5\),\(^1\)\(^8\) gathering and evaluating all the information related to the instrument essentials and clinical utility for numerous PROMs is challenging. Although previous authors have reviewed the use of PROMs in the sports medicine community, these commentaries have generally reviewed PROMs from the perspectives of orthopaedic surgeons, whose patient population may not necessarily reflect the young and highly functional patient population for whom ATs usually provide care\(^2\)\(^3\)–\(^2\)\(^5\) or may not have reviewed a comprehensive list of PROMs reported by ATs who routinely use them.\(^2\)\(^6\) In addition, these researchers did not critically review instruments based on the health domains represented in disablement models or dimension of HRQOL, which are important components to patient-centered, whole-person care. Therefore, the purpose of our report was to critically review the instrument essentials and clinical utility of the PROMs reported by ATs who used PROMs to (1) provide a helpful and concise guide for ATs to refer to during the PROM selection process and (2) facilitate the use of PROMs in athletic training clinical practice.

**METHODS**

**Identification of PROMs**

To provide ATs with a concise guide to PROMs, we reviewed the instruments reported by ATs who used PROMs in routine practice. In a survey study by Lam et al.\(^1\)\(^5\) ATs who used PROMs on a routine basis were asked to identify the PROMs they used for patient care and research purposes. Based on the responses of 370 ATs who routinely used PROMs in care, 78 unique PROMs were endorsed and identified. We included PROMs in this report if at least 10% of the ATs endorsed their use in the study by Lam et al.\(^1\)\(^5\)

**Literature Search**

Using the list of PROMs, we conducted a 2-phase literature search. First, we searched the literature with a focus on instrument development and establishment of the psychometric properties of each PROM. We completed 4 searches for each PROM using its name and the following key words: development, validity, reliability, responsiveness. For example, we performed these searches for the FAAM: (1) Foot and Ankle Ability Measure AND development, (2) Foot and Ankle Ability Measure AND validity, (3) Foot and Ankle Ability Measure AND reliability, and (4) Foot and Ankle Ability Measure AND responsiveness. For the second phase, we searched the literature for the use of the PROM specifically among athletes. For this phase, we used the PROM name in combination with 1 of 2 key words (athlete*, sport) in separate searches: for instance, (1) Foot and Ankle Ability Measure* AND athlete* and (2) Foot and Ankle Ability Measure* AND sport. This process was repeated for each PROM.

**Data Extraction**

We extracted data from the available literature to summarize the instrument essentials (ie, instrument development, reliability, validity, responsiveness and interpretability, and precision) and clinical utility (ie, acceptability [number of items, time to complete, readability, comfort-level concerns], feasibility [ease of use, role of clinician, time to score, costs associated with use], and appropriateness [intended patient populations, demonstrated use for other patient populations, global purpose of use]) of each PROM included in this report.

For instrument acceptability, we also assessed the readability of each PROM. Readability is important for all patients but particularly for patients who are minors, such as secondary school and youth athletes, or nonnative English speakers.\(^2\)\(^7\),\(^2\)\(^8\) For this review, readability was represented by the Flesch-Kincaid reading grade level. To calculate the Flesch-Kincaid reading grade level, we used Word for Mac (version 16.15; Microsoft Corp, Redmond, WA). In short, each PROM was imported into Microsoft Word and its unformatted text was analyzed with the embedded formula to provide a reading grade level for the measure.

For instrument appropriateness, we also summarized the ICF health domains and HRQOL dimensions captured by each PROM using a consensus process described in a previous study.\(^2\)\(^9\) In brief, the consensus process required each research team member (n = 3, all of whom had expertise in clinical outcomes assessment [eg, teaching, presentation, and research experience in clinical outcomes assessment]) to review the included PROMs independently and classify each PROM question within 1 ICF health domain\(^2\)\(^0\) and 1 HRQOL dimension.\(^2\)\(^1\)\(^,\)\(^2\)\(^2\) After performing independent reviews of all PROMs and initial classification of questions according to ICF health domains and HRQOL dimensions, the raters met as a group to compare their classifications. Discrepancies in classifications were discussed, and a final classification was determined by group consensus.

Descriptions of the specific ICF health domains and HRQOL dimensions used for this study were detailed in a previous investigation.\(^2\)\(^9\) In brief, for the ICF health domains, raters classified each question in one of the following domains: health condition, body structure and function, activity, participation, environmental factors, or personal factors.\(^2\)\(^6\),\(^2\)\(^8\) When necessary, the raters were able to consult the ICF Web site (apps.who.int/classifications/ICFbrowser/) during the review process for guidance in categorizing ICF health domains. For the HRQOL dimensions, each item was classified in one of the following areas: physiological (ie, impairments such as pain and swelling), physical (ie, ability to perform activities...
and attributes such as mobility and performance), psychological (ie, emotional well-being, including happiness and sadness), spiritual (ie, value of religious beliefs and practices), social (ie, interactions with family and friends), or economic (ie, financial status and burden) functioning.21,22,29

**KEY FINDINGS**

Based on the findings of Lam et al,15 a total of 17 region-specific, 6 generic, and 3 single-item PROMs were endorsed by at least 10% of the ATs who used PROMs and thus were reviewed for this report. For region-specific PROMs, 11 lower extremity–specific (3 foot and ankle, 3 knee, 3 hip, 2 back) and 10 upper extremity–specific (3 shoulder-elbow, 3 wrist-hand, 1 neck, 3 head) instruments were studied (Table 1). Four PROMs were identified for use in multiple body regions: the Lower Extremity Functional Scale (knee and hip), Disabilities of the Arm, Shoulder and Hand (DASH; wrist-hand and shoulder-elbow), Quick-DASH (wrist-hand and shoulder-elbow), and Upper Extremity Functional Scale (wrist-hand and shoulder-elbow).

As a result, a total of 26 unique PROMs (10 lower extremity region specific, 7 upper extremity region specific, 6 generic, and 3 single item) were evaluated in this review. Consistent with Lam et al,15 we classified the PSFES as a single-item measure because it is neither a specific nor a generic measure. Table 1 provides a general summary of the instrument essentials and clinical utility of each included PROM for quick reference. More detailed summaries of the instrument essentials, including specific measurement property values, of lower extremity–specific, upper extremity–specific, and generic and single-item measures can be found in Tables 2, 3, and 4, respectively. Summaries of considerations for clinical utility can be found in Tables 5, 6, and 7.

**Region-Specific Measures**

**Instrument Essentials.** Of the 10 lower and 7 upper extremity region-specific PROMs, all (100.0%, 17 of 17) were associated with the appropriate instrument essentials, with a reported systematic development process and evidence of reliability and validity (Tables 2 and 3). In addition, responsiveness values were reported for almost all region-specific PROMs (88.2%, 15 of 17), with the exception of the American Academy of Orthopedic Surgeons Foot and Ankle Questionnaire and Abbreviated Profiles of Mood States. The precision of the PROMs varied within and among instruments, with response scales including some combination of binary, modified visual analog scale, 3- to 7-point adjectival, and 5-point Likert-scale responses.

**Clinical Utility.** In terms of clinical utility, the region-specific PROMs also generally demonstrated appropriate acceptability (Tables 5 and 6). Patient completion time was estimated as less than 10 minutes for almost all of the PROMs (15 of 17, 88.2%), with the expectation that many could be completed in 5 minutes or less (11 of 17, 64.7%). Readability of the measures ranged from fourth to 10th grade (Table 5) and third to sixth grade (Table 6) for the lower extremity and upper extremity PROMs, respectively. Most PROMs (13 of 17, 76.6%) had an estimated reading level of seventh grade or below. The region-specific PROMs also demonstrated good feasibility, with none requiring (1) special training to understand the administration process, (2) a clinician to complete the questions, or (3) clinician supervision of the patient during completion. Although 3 instruments (17.6%) required a user agreement, only 1 instrument, the Shortened Headache Impact Test, required paid access for use. In addition, the clinician burden was relatively low, with the time to score each measure estimated at ≤5 minutes. In terms of appropriateness, most appeared relevant to the types of conditions or areas of health effect that are important to athletes. Further, although the majority of the region-specific PROMs appeared to address items of importance to athletes, most were not developed specifically for high-functioning athletic populations (94.1%, 16 of 17). From an ICF health domain perspective, the region-specific PROMs generally captured the body structure and function (39.1%, 163 of 417 items) and activity (45.1%, 188 of 417 items) domains. Very few of the items on the region-specific instruments were related to the participation (13.2%, 55 of 417 items) or environmental factors (2.6%, 11 of 417 items) domain, and none included questions related to the health condition domain. From an HRQOL dimension perspective, the region-specific PROM instruments included questions that predominately evaluated the physical (54.7%, 228 of 417 items) and physiological (23.7%, 99 of 417 items) dimensions. The psychological (12.7%, 53 of 417) and social (8.9%, 37 of 417 items) dimensions were captured less frequently, and none of the region-specific measures addressed the spiritual or economic dimension.

**Generic Measures**

**Instrument Essentials.** We reviewed 6 generic PROMs. All were developed using a systematic process, had evidence of reliability and validity, and had established responsiveness values in some populations (Table 4). Similar to the region-specific PROMs, the precision of the generic PROMs varied within and among instruments, with questions requiring binary, 3- to 11-point adjectival, and 5- to 15-point Likert responses.

**Clinical Utility.** In general, most generic PROMs demonstrated good feasibility, with none requiring patient completion time (less than 5 minutes), no comfort-level concerns, and limited clinician burden associated with the Disableness in the Physically Active (DPA) scale, Pediatric Quality of Life, Medical Outcomes Study 36-Item Short Form Health Survey, and Short Form 12 (Table 7). Of note, the Musculoskeletal Function Assessment (MFA) and Short MFA both consist of more items (110 and 46, respectively) and, thus, require more time to complete (15 and 5–10 minutes, respectively) relative to the other generic PROMs. In addition, the MFA and Short MFA also include items with potential comfort-level items (ie, Have you experienced pain or discomfort? Do you have any limitations in physical activity?) for patients. The readability of the included generic PROMs ranged from second to 10th grade, with 77.8% (7 of 9) estimated at sixth grade or below (Table 7). From an ICF health domain perspective, the generic PROMs generally captured the body structure and function (35.0%, 85 of 243 items), activity (35.0%, 85 of 243 items),
Table 1. Concise Summary of Included Patient-Reported Outcome Measures

| Instrument Essentials | Clinical Utility |
|------------------------|-------------------|
|                        | Development | Reliability | Validity | Responsiveness | Acceptability | Feasibility | Appropriateness |
| Foot and ankle         |            |            |          |                |               |             |                |
| American Academy of Orthopaedic Surgeons Foot and Ankle Questionnaire | ✓         | ✓          | ✓        | X              | ✓             | ✓            | ✓              |
| Foot and Ankle Ability Measure | ✓         | ✓          | ✓        | ✓              | ✓             | ✓            | ✓              |
| Foot and Ankle Disability Index | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Knee                   |            |            |          |                |               |             |                |
| International Knee Documentation Committee Questionnaire | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Knee Injury and Osteoarthritis Outcome Score | ✓         | ✓          | ✓        | ✓              | ✓             | ✓            | ✓              |
| Lower Extremity Functional Scale | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Hip                    |            |            |          |                |               |             |                |
| Hip Disability and Osteoarthritis Outcome Score | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Hip Outcome Score      | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Lower Extremity Functional Scale | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Low back               |            |            |          |                |               |             |                |
| Low Back Outcome Score | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Oswestry Disability Index | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Wrist and hand         |            |            |          |                |               |             |                |
| Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH) | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| QuickDASH Questionnaire | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Upper Extremity Functional Instrument | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Shoulder and elbow     |            |            |          |                |               |             |                |
| DASH                   | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| QuickDASH              | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Upper Extremity Functional Instrument | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Neck                   |            |            |          |                |               |             |                |
| Neck Disability Instrument | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Head                   |            |            |          |                |               |             |                |
| Dizziness Handicap Index | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Shortened Headache Impact Test | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Abbreviated Profile of Mood States Questionnaire | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Generic outcome measures |            |            |          |                |               |             |                |
| Disabiliement of the Physically Active Scale | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Musculoskeletal Function Assessment | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Musculoskeletal Function Assessment–Short | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Pediatric Quality of Life Inventory | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Short Form 36          | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Short Form 12          | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Single-item outcome measures |            |            |          |                |               |             |                |
| Numeric Pain Rating Scale | X         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Global Rating of Change | X         | ✓          | ✓        |               | ✓             | ✓            | ✓              |
| Patient-Specific Functional Scale | ✓         | ✓          | ✓        |               | ✓             | ✓            | ✓              |

Symbols: X, no evidence found in current literature; ✓, available evidence in current literature; ?, available evidence in current literature but may not be appropriate for all settings.

- Responsiveness was not formally assessed in patients but was estimated based on comparison with data from the Western Ontario and McMaster Universities Osteoarthritis Index.
- Instrument was developed with athletes as the intended patient population.
| Region and Instrument | Development | Reliability | Validity | Responsiveness and Interpretability | Precision |
|-----------------------|-------------|-------------|----------|-------------------------------------|-----------|
| **Foot and Ankle**    | Content developed and refined with input from clinician focus groups; reliability, validity, and sensitivity testing<sup>30</sup> | Internal consistency: = .93  
(GLOBAL Foot and Ankle Scale)<sup>30</sup>  
Test-retest: R = 0.79 (GLOBAL Foot and Ankle Scale); R = 0.87  
(Shoe comfort Scale)<sup>30</sup> | Construct: r = 0.66 (SF-36 physical), r = 0.16 (SF-36 mental)<sup>30</sup>  
Criterion: = .79 (physician-rated ability)<sup>30</sup> | Not reported | Binary 5-point adjectival 7-point adjectival 6-point adjectival<sup>30</sup> |
| **Foot and Ankle Ability Measure** | Generation of potential items; initial item reduction; item response theory; final item reduction; reliability and validity testing<sup>31</sup> | Internal consistency: = .96–.98  
Test-retest: ICC (2,1) = 0.89 (ADL subscale), ICC (2,1) = 0.87 (Sport subscale)<sup>31</sup> | Construct: r = 0.78–0.84 (SF-36 physical), r = 0.11–0.18 (SF-36 mental)<sup>31</sup>  
MDC: 5.7 points (ADL), 12.3 points (Sports)<sup>31</sup>  
MCID: 8 points (ADL), 9 points (Sports)<sup>31</sup> | 5-point adjectival 4-point adjectival<sup>31</sup> |
| **Foot and Ankle Disability Index** | Generation of potential items; initial item reduction; item response theory; final item reduction; reliability and validity testing<sup>32</sup> | Test-retest: ICC (2,1) = 0.85–0.91  
(FADI), 0.67–0.92 (FADI Sport)<sup>32</sup> | Construct: lower scores on the involved versus uninvolved side<sup>32</sup> | 5-point adjectival<sup>32</sup> |
| **Knee**              | Instrument purposed; defined constructs; generation of potential items; pilot testing; item reduction; reliability and validity testing<sup>33</sup> | Internal consistency: = .77–.97  
Test-retest<sup>33</sup>: ICC (2,1) = 0.87–0.99 | Construct: r = 0.66 (SF-36 physical), r = 0.16 (SF-36 mental)<sup>33</sup>  
MCID: 11.5 points (ADL), 20.5 points (ADL and Sport)<sup>33</sup>  
MPCI: 8–10 points<sup>33,34</sup> | 5-point adjectival 5-point Likert Modified VAS<sup>33</sup> |
| **Knee Injury and Osteoarthritis Outcome Score (KOOS)** | Instrument purposed; generation of items through literature review and expert panel feedback; pilot testing; reliability, validity, and responsiveness testing<sup>34</sup> | Internal consistency: = .75–.96  
Test-retest<sup>34,35</sup>: ICC (2,1) = 0.75–0.93 | Content: >75% relevant items for symptoms, sports/recreational, and QOL subscales<sup>34</sup> | 5-point adjectival<sup>34</sup> |
| **Knee and Hip Lower Extremity Functional Scale** | Instrument purposed; generation of items by reviewing existing questionnaires, clinician and patient feedback, and consulting the WHO model of disability; pilot testing; item reduction; reliability, validity, and sensitivity testing<sup>35</sup> | Internal consistency: = .96  
Test-retest<sup>35</sup>: R = 0.86 | Construct: r = 0.64 (SF-36 physical), r = 0.30 (SF-36 mental)<sup>35</sup>  
MDC: 9 points<sup>35</sup>  
MCID: 9 points<sup>35</sup> | 5-point adjectival<sup>35</sup> |
| **Hip**               | Modification of the KOOS; pilot testing; item reduction; patient interviews; reliability and validity testing<sup>36</sup> | Internal consistency: = .77–.98  
Test-retest<sup>36,37</sup>: ICC = 0.75–0.97 | Construct: predetermined hypotheses confirmed<sup>11–43</sup>  
Content: patient input in scale development<sup>36,43</sup> | 5-point Likert 5-point adjectival<sup>43</sup> |
| **Hip Outcome Score** | Instrument purposed; generation of items through input from physicians and physical therapists; item response theory; reliability and validity testing<sup>38</sup> | Internal consistency: = .96  
(ADL), = 0.95 (Sport)<sup>38</sup>  
Test-retest: ICC (2,1) = 0.98 (ADL), ICC (2,1) = 0.92 (Sport)<sup>38</sup> | Construct: r = 0.72–0.76 (SF-36 physical), r = 0.11–0.18 (SF-36 mental)<sup>38</sup>  
MDC: 3 points (ADL and Sport)<sup>38</sup>  
MCID: 9 points (ADL), 6 points (Sport)<sup>38</sup> | 5-point adjectival 4-point adjectival<sup>38</sup> |
| **Low Back**          | Content developed and refined based on the practice of a single orthopaedic surgeon; constructs compared with similar patient-reported outcome measures; validity testing<sup>39</sup> | Internal consistency: = .85  
Test-retest<sup>39</sup>: r = 0.92 | Construct: r = 0.63–0.87 (other region-specific instruments)<sup>39</sup>  
MCID: 7.5 points<sup>39</sup> | 6-point adjectival 4-point adjectival<sup>39</sup> |
| **Oswestry Disability Index** | Instrument purposed; generation of items through an expert panel; reliability testing<sup>40</sup> | Internal consistency: = .71–.87  
Test-retest<sup>40,41</sup>: r = 0.83–0.99 | Construct: correlation with region-specific and generic instruments<sup>40</sup>  
MCID: 10 points<sup>40,52</sup> | 6-point adjectival 6-point Likert<sup>40</sup> |

Abbreviations: ADL, activities of daily living; FADI, Foot and Ankle Disability Index; ICC, intraclass correlation coefficient; MCID, minimal clinically important difference; MDC, minimal detectable change; MPCI, minimal perceptible clinical improvement; QOL, quality of life; SF-36, Short Form 36; VAS, visual analog scale; WHO, World Health Organization.  
<sup>a</sup> Responsiveness was not formally assessed in patients but estimated based on comparison with data from the Western Ontario and McMaster Universities Osteoarthritis Index.
| Region                  | Instrument                                    | Development                                                                 | Reliability                                      | Validity                                                                                      | Responsiveness and Interpretability | Precision |
|------------------------|-----------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------|-----------|
| Shoulder-elbow and wrist-hand | Disabilities of the Arm, Shoulder and Hand Questionnaire | Instrument purposed; defined constructs; pilot testing; reliability and validity testing | Internal consistency: $0.96$; Test-retest: $0.93-0.98$ | Content: significant ceiling effect in intercollegiate athletes$^a$ | SEM: $4.6$ points$^{75}$ | 5-point adjectival$^{73}$ |
|                        |                                               |                                                                              |                                                  | Construct: $>75\%$ hypotheses met$^{74}$ | MDC: $10.81-19.0$ points$^{4,5,23,26}$ |                      |
|                        |                                               |                                                                              |                                                  | Convergent: $r = 0.67-0.92$ | MIC: $6.7$ points$^{54}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{77}$ | MCID: $10.83$ points$^{56}$ |                      |
|                        |                                               |                                                                              |                                                  | Convergent: $r = 0.70-0.80$ | SCB: $40\%$ reduction in score$^{51}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MDC: $12.84-17.1$ points$^{56,60}$ | 5-point adjectival$^{72}$ |
|                        |                                               |                                                                              |                                                  | Convergent: $r = 0.54-0.57$ | MIC: $13.4$ |                      |
|                        |                                               |                                                                              |                                                  | Discriminant: able to discriminate among work status levels$^{66}$ | MID: $19$ points$^{54}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | MCID: $8-15.91$ points$^{56,65}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | SEM: $3.9-4.0$ points$^{65,66}$ | 5-point adjectival$^{75}$ |
|                        |                                               |                                                                              |                                                  |                                                            | MDC: $9.1-9.4$ points$^{65,66}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | MCID: $8$ points$^{56}$ |                      |
| Quick Disabilities of the Arm, Shoulder and Hand Questionnaire | 3 item-reduction approaches used to modify the original instrument; reliability and validity testing | Internal consistency: $0.90$; Test-retest: $0.90-0.94$ | Content: no reported floor or ceiling effects$^{73}$ | Convergent: $r = 0.67-0.92$ | SEM: $4.6$ points$^{75}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MDC: $10.81-19.0$ points$^{4,5,23,26}$ |                      |
|                        |                                               |                                                                              |                                                  | Convergent: $r = 0.70-0.80$ | MIC: $6.7$ points$^{54}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MCID: $10.83$ points$^{56}$ |                      |
|                        |                                               |                                                                              |                                                  | Convergent: $r = 0.54-0.57$ | SCB: $40\%$ reduction in score$^{51}$ |                      |
|                        |                                               |                                                                              |                                                  | Discriminant: able to discriminate among work status levels$^{66}$ | MDC: $12.84-17.1$ points$^{56,60}$ | 5-point adjectival$^{72}$ |
|                        |                                               |                                                                              |                                                  |                                                            | MID: $19$ points$^{54}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | MCID: $8-15.91$ points$^{56,65}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | SEM: $3.9-4.0$ points$^{65,66}$ | 5-point adjectival$^{75}$ |
|                        |                                               |                                                                              |                                                  |                                                            | MDC: $9.1-9.4$ points$^{65,66}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | MCID: $8$ points$^{56}$ |                      |
| Upper Extremity Functional Instrument | Based on the WHO model of impairment, disability, and handicap; identified original items through responses on the Patient-Specific Functional Scale, review of existing patient-reported outcome measures, and clinician feedback; 2-stage item-reduction process; reliability, validity, and sensitivity to change testing$^{52}$ | Internal consistency: $0.95$; Test-retest: $0.68-0.89$ | Content: no reported floor or ceiling effects$^{73}$ | Convergent: $r = 0.69-0.70$ (McGill Pain Questionnaire)$^{71}$ | SEM: $4.4$ points$^{73}$ | 5-point adjectival$^{77}$ |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MDC: $10.2$ points$^{59}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MCIC: $7$ points$^{69}$ |                      |
| Neck                  | Neck Disability Instrument                     | Developed through a modification of the Oswestry Disability Index and review of descriptive literature on whiplash and chronic neck pain; peer and patient review performed to confirm and modify questions; reliability and validity testing$^{57}$ | Internal consistency: $0.76-0.84$; Test-retest: $0.68-0.89$ | Content: through peer review and patient feedback$^{46}$ | SEM: $4.4$ points$^{73}$ | 6-point adjectival$^{77}$ |
|                        |                                               |                                                                              |                                                  | Concurrent: $r = 0.69-0.70$ (McGill Pain Questionnaire)$^{71}$ | MDC: $10.2$ points$^{59}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | MCIC: $7$ points$^{69}$ |                      |
| Head                  | Shortened Headache Impact Test                | Item generation and modification; item response theory; readability evaluation; reliability and validity testing$^{50}$ | Internal consistency: $0.87-0.89$; Test-retest: $0.80$ | Content: 1-factor scale with large factor loadings on the construct of disability$^{71}$ | SEM: $4.6$ points$^{75}$ | 5-point adjectival$^{72}$ |
|                        |                                               |                                                                              |                                                  | (0.57-0.86) | MDC: $2.5$ points$^{72}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: 1-factor scale with large factor loadings on the construct of disability$^{71}$ | MID: $6$ points$^{72}$ |                      |
|                        |                                               |                                                                              |                                                  | (0.57-0.86) | MCIC: $8$ points$^{73}$ |                      |
|                        |                                               |                                                                              |                                                  |                                                            | Not reported |                      |
|                        |                                               |                                                                              |                                                  |                                                            | 5-point adjectival$^{74}$ |                      |
| Abbreviated Profile of Mood States Questionnaire | Modification to the Short instrument to improve brevity and comprehensiveness for the athletic population; reliability and validity testing$^{58,59}$ | Internal consistency: $0.66-0.95$ | Content: able to discriminate between winners and losers$^{74}$ | Not reported | SEM: $6.23$ points$^{75}$ | 3-point adjectival$^{75}$ |
|                        |                                               |                                                                              |                                                  |                                                            | MDC: $18$ points$^{75}$ |                      |
| Dizziness Handicap Index | Developed empirically from case-history reports of patients with dizziness; pilot testing; item reduction; reliability and validity testing$^{53,55}$ | Internal consistency: $0.72-0.89$; Test-retest: $0.94-0.97$ | Content: no reported floor or ceiling effects$^{73}$ | Convergent: $r = 0.67-0.92$ | SEM: $4.6$ points$^{75}$ | 5-point adjectival$^{77}$ |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MDC: $10.81-19.0$ points$^{4,5,23,26}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MIC: $6.7$ points$^{54}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MCID: $10.83$ points$^{56}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | SCB: $40\%$ reduction in score$^{51}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MDC: $12.84-17.1$ points$^{56,60}$ | 5-point adjectival$^{72}$ |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MID: $19$ points$^{54}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MCID: $8-15.91$ points$^{56,65}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | SEM: $3.9-4.0$ points$^{65,66}$ | 5-point adjectival$^{75}$ |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MDC: $9.1-9.4$ points$^{65,66}$ |                      |
|                        |                                               |                                                                              |                                                  | Content: no reported floor or ceiling effects$^{73}$ | MCID: $8$ points$^{56}$ |                      |

Abbreviations: ICC, intraclass correlation coefficient; MCIC, minimal clinically important change; MCID, minimal clinically important difference; MDC, minimal detectable change; MIC, minimal important change; MID, minimal important difference; SCB, substantial clinical benefit; SEM, standard error of measurement; WHO, World Health Organization.

$^a$ Instrument was developed with athletes as the intended patient population.
| Region                              | Instrument                                                                 | Development                                                                                                                                           | Reliability                                                                 | Validity                                                                 | Responsiveness and Interpretability                                                                 |
|------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| **Generic**                        | Disabilment of the Physically Active Scale                                  | Instrument purpose; generation of items through a mixed-methods study (theoretical sampling); reliability, validity, and responsiveness testing    | Internal consistency<sup>97</sup>: = 0.89–0.91 Test-retest<sup>78</sup>: ICC (2, 1) = 0.94 | Content: no floor or ceiling effects<sup>78</sup> Concurrent: *r* = 0.75 (Global Function)<sup>78</sup> | MCID: 6–9 points<sup>78</sup> 5-point adjectival<sup>77</sup> |
| **Musculoskeletal Function**        | Assessment                                                                  | Instrument purpose; generation of items through interviews with patients and clinicians and a review of existing instruments; reliability and validity testing<sup>97</sup> | Internal consistency<sup>97</sup>: = 0.71–0.87 Test-retest<sup>78</sup>: % agreement = 78–100 | Face: adequacy and completeness of instrument reviewed by experts<sup>79</sup> Content: no floor or ceiling effects<sup>78</sup> Convergent<sup>69</sup> (SF-36): *r* = 0.40 Discriminant: demonstrated for a variety of known groups<sup>84</sup> | SRM<sup>80</sup>: 0.65–1.13 Binary 5-point adjectival<sup>79</sup> |
| **Musculoskeletal Function**        | Assessment—Short                                                             | Modification of the original instrument; systematic item reduction and addition of composite questions; pilot testing; reliability, validity, and responsiveness testing<sup>97</sup> | Internal consistency<sup>97,98</sup>: = 0.87–0.90 Test-retest<sup>80</sup>: ICC = 0.67–0.99 | Content: few ceiling effects (<5%), no floor effects<sup>90,91</sup> Convergent: *r* = 0.42–0.81 (pain scales), ≤0.40 (physicians’ rating)<sup>68,69</sup> Discriminant: demonstrated for a variety of known groups<sup>80</sup> | SRM (Dysfunction Index): –1.14 (condition deteriorated); 1.08 (condition improved)<sup>80,81</sup> SRM (Bother Index): –0.79 (condition deteriorated); 0.76 (condition improved)<sup>90</sup> |
| **Pediatric Quality of Life**       | Inventory                                                                   | Derived from the Pediatric Cancer Quality of Life Inventory; generation of items through an extensive literature review, patient and parent interviews, and consultation with health care professionals; pilot testing; item revision; readability assessed; reliability and validity testing<sup>92</sup> | Internal consistency<sup>92–96</sup>: = 0.69–0.91 | Content: healthy children scored higher than children with a chronic health condition<sup>82–84</sup> Discriminant: demonstrated for a variety of known groups<sup>98</sup> Convergent: small to medium positive intercorrelations, supporting the multidimensional measurement model<sup>92</sup> | MCID (total score): 4.4 5-point adjectival<sup>92</sup> |
| **Short Form 36**                  | Instrument purpose; defined constructs; generation of items through extensive literature review; pilot testing; validity testing<sup>97</sup> | Internal consistency<sup>98,99</sup>: = 0.76–0.93 Test-retest<sup>80</sup>: ICC = 0.63–0.89 | Criterion: decreasing scores with worsening self-rated general health<sup>98,99</sup> Disciminant: demonstrated for a variety of known groups<sup>89</sup> | Normative scores for each domain (PCS, MCS)<sup>91</sup> | 6-point adjectival 6-point adjectival 5-point adjectival 5-point Likert 3-point adjectival<sup>97</sup> 3-point adjectival<sup>92</sup> |
| **Short Form 12**                  | Modification of the SF-36; item reduction; pilot testing; reliability and validity testing<sup>97</sup> | Internal consistency: = 0.77 (PCS), 0.80 (MCS)<sup>89</sup> Test-retest: ICC = 0.87–0.89 (PCS), ICC = 0.76–0.77 (MCS)<sup>92</sup> | Construct: significant correlations with scales for well-being, back pain, back disability, depression<sup>99</sup> Relative validity<sup>85</sup> (SF-36): PCS = 0.43–0.93, MCS = 0.6–1.07 | MID (PCS): 6.5–7.3 points<sup>99</sup> SEM (PCS)<sup>100</sup>: 3.53–4.47 | 5-point adjectival 5-point adjectival<sup>98</sup> |
| **Single item**                    | Numeric Pain Rating Scale                                                    | Not reported                                                                                                                                          | Internal consistency<sup>a</sup>: = 0.86–0.90 Test-retest: ICC = 0.74–0.88 | Construct<sup>95–97</sup>: *r* = 0.94–0.96 Concurrent<sup>63</sup>: *r* = 0.80–0.88 | MCID: 1–3 points<sup>63,95,97,98</sup> 11-point adjectival<sup>95</sup> |
| **Global Rating of Change**        | Not reported                                                                 | Test-retest: ICC = 0.90 (11-point)<sup>100</sup>                                                                                                     | Face<sup>101,102</sup>: *r* = 0.72–0.90 | Convergent (VAS)<sup>99</sup>: *r* = 0.79–0.95 | MCID: 2 points (11-point scale)<sup>100</sup> 15-point Likert<sup>101</sup> |
| **Patient Specific Functional Scale** | Instrument purpose; pilot testing; reliability, validity, and sensitivity testing<sup>98</sup> | Test-retest<sup>102,103</sup>: ICC = 0.71 | Construct<sup>95–102,103,104</sup>: *r* = 0.34–0.83 Concurrent<sup>63</sup>: *r* = 0.66–0.83 | MDC: 0.45 points (11-point scale)<sup>100</sup> | MDC: 1–3 points<sup>102</sup> 11-point adjectival<sup>104</sup> |

Abbreviations: ICC, intraclass correlation coefficient; MCIC, minimal clinically important change; MCID, minimal clinically important difference; MCS, mental component summary; MDC, minimal detectable change; MID, minimal important difference; PCS, physical component summary; SEM, standard error of measurement; SF-36, Short Form 36; SRM, standardized response mean; VAS, visual analog scale.

<sup>a</sup> Instrument was developed with athletes as the intended patient population.
Single-Item Measures

Instrument Essentials. The Numeric Pain Rating Scale (NPRS), Global Rating of Change (GROC), and PSFS have established reliability, validity, and responsiveness in some populations; however, only the GROC involved a systematic development process (Table 4). The NPRS and PSFS use 10- and 5-point adjectival scales, respectively, whereas the GROC was developed as a 15-point Likert-type scale.

Clinical Utility. The single-item measures appear to have good acceptability and feasibility with short times for patient completion (<3 minutes) and low clinician burden (<1 minute; Table 7). The NPRS captures the body structure and function domain and the physiological HRQOL dimension, and the PSFS assesses the activity domain and physical HRQOL dimension; however, the ICF health domain and HRQOL dimension captured by the GROC vary, as they depend on how patients perceive their condition or injury and the subsequent frame of reference when reflecting on and answering the question.

COMMENTARY

To our knowledge, this is the first report to critically review and summarize the instrument essentials and clinical utility of generic, specific, and single-item PROMs that are used in athletic health care. In addition, we provided a summary of the ICF health domains and HRQOL dimensions that questions within each PROM addressed to offer insight into their use when delivering patient-centered care. Overall, we aimed to provide a helpful, concise resource for ATs to consult when selecting and implementing PROMs.

In general, the PROMs studied in this commentary demonstrated appropriate instrument essentials, with almost all having a systematic development process and acceptable psychometric properties including reliability, validity, and responsiveness. However, it is important to note that only a few of the instruments were specifically designed to evaluate aspects of disablement and health among highly functional patients, such as athletes. For example, of the instruments reviewed, only the DPA77,78 and the Abbreviated Profile of Mood States74 were developed with athletes as the intended population. Further, much of the research to date related to the instrument measurement properties of generic, specific, and single-item PROMs has been conducted in populations other than a highly functional patient population such as athletes. This finding is a concern when considering the validity of the instruments for use in athletic health care.

Other PROMs were designed for the athletic population, such as the Kerlan-Jobe Orthopaedic Clinic overhead athlete score,142 the Functional Arm Scale for Throwers,143,144 the Athlete Fear Avoidance Questionnaire,145 and the Swimmer's Functional Pain Scale.146 Yet previous research15 indicated that fewer than 10% of ATs routinely used these instruments. Thus, they were not included in this report. However, even though many of the included PROMs were developed for more general populations, these patients often presented with injuries similar to those sustained by athletes.35,53 Ideally, measurement properties such as reliability, validity, and responsiveness should be established for the intended population.19 Because evidence147–149 suggested that the HRQOL of highly functional patients is different than that of the general population, future work is needed to establish the validity, reliability, and responsiveness of the PROMs most commonly used in athletes.

The PROMs included in this report appear appropriate, acceptable, and feasible for use in athletic health care. Considering readability specifically, the general guidance was that the calculated reading grade level be 2 reading levels below a patient’s actual grade level.27,28 For example, a patient in the ninth grade should be administered a PROM with a reading level of seventh grade or lower. Of the reviewed PROMs, the vast majority (20 of 26, 76.2%) had an estimated reading level of seventh grade or lower. Of the reviewed PROMs, the vast majority (20 of 26, 76.2%) had an estimated reading level of seventh grade or lower, suggesting that they would likely be appropriate for adult and adolescent patients. However, it is important to note that a patient’s grade level may not necessarily align with his or her actual reading level (eg, students of English as a second language); clinicians should take this into account when selecting a PROM.

When we assessed the ICF health domains and HRQOL dimensions of health captured by the reviewed PROMs, it was not surprising that many of the instruments emphasized specific aspects of health. Most instruments include questions that evaluate the ICF health domains of body structure and function and the HRQOL dimensions of physiological and physical functioning. For example, the Lower Extremity Functional Scale and the FAAM are region-specific PROMs that focus solely on functional ability. Using PROMs that evaluate physical function in athletic health care is appropriate because highly functional patients often focus on maintaining or regaining high levels of physical function to perform activities in daily life and sports. For example, a common goal of athletes is to restore function to compete in their sports and fulfill their role as an athlete. Instruments that evaluate function allow ATs to better direct rehabilitation to meet these performance and role goals (ie, participation domain of the ICF). Even though regaining function is a common goal of athletes, other ICF health domains and HRQOL dimensions may warrant attention.19

Information related to body structures and functions, such as range of motion and strength, is helpful for clinicians to obtain a more complete understanding of the status of tissue healing, which may support treatment decisions to promote continued recovery.20 An equally important area of health to evaluate is participation. However, the participation domain was not a frequent component of the PROMs included in this review. Participation reflects the areas of health that many patients care most about because it relates to the ability to complete necessary or desired life roles, such as...
When selecting PROMs, ATs should consider whether the patient case warrants evaluation of the participation domain, particularly because athletes often have a strong identity grounded in being an athlete. The effect of identity loss due to injury and removal from sport may be an important focus when managing and coordinating care for a patient. In general, generic instruments include more questions that capture participation than specific instruments because they are designed to assess health on a more global level. However, some of the region-specific measures, such as the DASH,53 the Dizziness Handicap Inventory,75 and the Low Back Outcome Score,46 do contain several questions related to the participation domain and may be considered depending on the region of the patient’s injury.

Consider, for example, the care of a patient with an ankle sprain. The FAAM may be the PROM that a clinician identifies for use based on the fit of the instrument to the region of interest, instrument essentials, and patient friendliness. However, one consideration is that the FAAM is largely focused on functional ability.31 If the AT is approaching care from a patient-centered, whole-person perspective, coupling the FAAM with additional PROMs may be necessary, as the FAAM may evaluate only a limited scope of the HRQOL dimensions affected by an injury. A generic instrument (eg, Pediatric Quality of Life, DPA) could be considered depending on the HRQOL dimensions most relevant to the patient.

### Table 5. Lower Extremity (LE) Patient-Reported Outcome Measures: Considerations for Clinical Utility Extended on Next Page

| Aspect                  | American Academy of Orthopedic Surgeons Foot and Ankle Questionnaire | Foot and Ankle Ability Measure | Foot and Ankle Disability Index | International Knee Documentation Committee Questionnaire |
|-------------------------|------------------------------------------------------------------------|--------------------------------|---------------------------------|----------------------------------------------------------|
| Acceptability           | No. of items                                                          |                                |                                 |                                                          |
|                         | 20 (Global); 5 (Shoe Comfort)                                          | 21 (ADL); 8 (Sport)            | 26 (FADI); 8 (Sport)            | 19 items                                                  |
|                         | 0–100; % score = ↓ function                                           | 0–84 (ADL); 0–32 (Sport); ↑ score = ↑ function | 0–104 (FADI); 0–32 (FADI Sport); ↑ score = ↑ function | 0–100; % score = ↓ function |
|                         | 3–5 min20                                                              | <5 min21                       | 5 min23                        | 5–10 min25                                                |
|                         | 10                                                                  |                                | 9                              |                                                          |
|                         | None20                                                                |                                | None20                         | None20                                                    |
|                         |                                                                      |                                |                                |                                                          |
| Feasibility             | Ease of use                                                            |                                |                                 |                                                          |
|                         | No training or supervision; no training or supervision; easy to administer | No training or supervision; no questions for clinician; recall period = 1 wk | No training or supervision; easy to administer | No training or supervision; no questions for clinician; recall period = 4 wk |
|                         | 5 min20                                                               | 5 min21                        | 5 min23                        | 5 min25                                                   |
|                         |                                                                      |                                |                                |                                                          |
|                         | Costs                                                                 |                                |                                 |                                                          |
|                         | None20                                                                |                                | None20                         | None20                                                    |
|                         |                                                                      |                                |                                |                                                          |
|                         | Intended patient population                                           |                                |                                 |                                                          |
|                         | Musculoskeletal problems of the foot and ankle                        | Receiving PT for musculoskeletal disorders of the leg, foot, and ankle | Chronic ankle instability | Variety of knee injuries |
|                         |                                                                      |                                |                                |                                                          |
|                         | Other populations                                                      |                                |                                 |                                                          |
|                         | Tumor, synovitis, diabetes mellitus15111                              | Diabetes mellitus112           | Injury or surgery to ankle or foot1317 | Adolescents118                                           |
|                         |                                                                      |                                |                                |                                                          |
|                         | HRQOL dimension, No. items                                            |                                |                                 |                                                          |
|                         | Physiological                                                         |                                |                                 |                                                          |
|                         | 15                                                                   | 0                              | 5                              | 7                                                         |
|                         | Social                                                                | 2                              | 1                              | 1                                                         |
|                         | Spiritual                                                             | 0                              | 0                              | 0                                                         |
|                         | Physical                                                              | 8                              | 28                             | 27                                                        |
|                         | Economic                                                              | 0                              | 0                              | 0                                                         |
|                         | Psychological                                                         | 0                              | 0                              | 0                                                         |
|                         | ICF health domain, No. items                                           |                                |                                 |                                                          |
|                         | Health condition                                                      | 0                              | 0                              | 0                                                         |
|                         | Body structure and function                                            | 0                              | 0                              | 0                                                         |
|                         | Activity                                                              | 15                             | 28                             | 27                                                        |
|                         | Participation                                                         | 3                              | 28                             | 27                                                        |
|                         | Environmental and personal factors                                     | 2                              | 1                              | 1                                                         |
|                         | Global purpose of use                                                  | 0                              | 0                              | 0                                                         |
|                         | Evaluate patient perception of foot health and measure of surgical outcomes | Assess change in physical function of patients with leg, ankle, and foot musculoskeletal disorders | Assess functional limitations related to foot and ankle conditions | Measure symptoms and limitations in function and sports activity |

Abbreviations: ADL, activities of daily living; FADI, Foot and Ankle Disability Index; FAI, femoroacetabular impingement; HRQOL, health-related quality of life; ICF, International Classification of Functioning, Disability and Health; PT, physical therapy; PTOA, posttraumatic osteoarthritis.
Table 5. Extended From Previous Page

| Knee Injury and Osteoarthritis Outcome Score | Knee and Hip Lower Extremity Functional Scale | Hip Disability and Osteoarthritis Outcome Score | Hip Outcome Score | Low Back Outcome Score | Oswestry Disability Index |
|--------------------------------------------|---------------------------------------------|-----------------------------------------------|------------------|------------------------|--------------------------|
| 42 items<sup>27</sup>                      | 20 items<sup>30</sup>                       | 40 items<sup>60</sup>                         | 19 (ADL); 9 (Sport)<sup>44</sup> | 12 items<sup>51</sup> | 10 items<sup>51</sup> |
| 0–100; † scores = † function<sup>27</sup> | 0–80; † scores = † function<sup>39</sup> | 0–100; † scores = † function<sup>40</sup> | 0–68 (ADL); 0–36 (Sport); † scores = † function<sup>64</sup> | 0–75; † scores = † disability<sup>51</sup> | 0–100; † scores = † disability<sup>48</sup> |
| 10 min<sup>37</sup>                        | 2 min<sup>39</sup>                          | 10–15 min<sup>40</sup>                       | 5–10 min<sup>44</sup> | 5 min<sup>51</sup> | 5 min<sup>51</sup> |
| 4                                           | 4                                           | 9                                             | 4                | 4                      |

No training or supervision; easy to administer<sup>27</sup> No questions for clinician; recall period = 1 wk<sup>37</sup> No training or supervision; easy to administer<sup>39</sup> No questions for clinician; recall period = 1 wk<sup>39</sup> No training or supervision; easy to administer<sup>44</sup> No questions for clinician; recall period = 1 wk<sup>44</sup> No training or supervision; easy to administer<sup>48</sup> No questions for clinician; recall period = 1 d<sup>48</sup> No training or supervision; easy to administer<sup>51</sup> No questions for clinician; recall period = 1 wk<sup>51</sup> No training or supervision; easy to administer<sup>51</sup> No questions for clinician; recall period = 1 wk<sup>51</sup> No training or supervision; easy to administer<sup>51</sup> No questions for clinician; recall period = 1 wk<sup>51</sup> No training or supervision; easy to administer<sup>51</sup> No questions for clinician; recall period = 1 wk<sup>51</sup>

Young and middle-aged patients with ACL injury, meniscus injury, or PTOA<sup>37</sup> LE musculoskeletal dysfunction referred for PF<sup>39</sup> Adult population with hip disability with or without osteoarthritis<sup>60</sup> Patients receiving treatment for acetabular tears<sup>44</sup> Acute or chronic low back pain<sup>48</sup> Acute or chronic low back pain<sup>108</sup>

Patellofemoral pain, total knee replacement<sup>109,120</sup> Stroke<sup>121</sup> Total hip replacement, hip arthroscopic surgery<sup>41,122</sup> FAI, hip arthroplasty<sup>45,123</sup> Spine surgery<sup>124</sup> Spine surgery<sup>124</sup>

| Patellofemoral pain, total knee replacement<sup>109,120</sup> | Stroke<sup>121</sup> | Total hip replacement, hip arthroscopic surgery<sup>41,122</sup> | FAI, hip arthroplasty<sup>45,123</sup> | Spine surgery<sup>124</sup> | Spine surgery<sup>124</sup> |
|--------------------------------------------------------------|---------------------|---------------------------------------------------------------|-----------------|------------------------|--------------------------|
| 19                                                          | 0                   | 17                                                            | 0               | 5                      | 3                        |
| 2                                                           | 2                   | 1                                                             | 1               | 3                      | 1                        |
| 0                                                           | 0                   | 0                                                             | 0               | 0                      | 0                        |
| 22                                                          | 0                   | 0                                                             | 0               | 0                      | 0                        |
| 0                                                           | 0                   | 0                                                             | 0               | 0                      | 0                        |
| 1                                                           | 0                   | 0                                                             | 0               | 0                      | 0                        |
| 0                                                           | 0                   | 0                                                             | 0               | 0                      | 0                        |

Table 5 continued...
| Aspect                        | Shoulder-Elbow and Wrist-Hand | Neck | Upper Extremity Functional Instrument | Neck Disability Instrument | Shortened Headache Impact Test | Abbreviated Profile of Mood States Questionnaire | Dizziness Handicap Index |
|------------------------------|-------------------------------|------|--------------------------------------|----------------------------|-------------------------------|------------------------------------------|-------------------------|
| **Acceptability**            |                               |      |                                      |                            |                               |                                          |                         |
| No. of items                 | 30 (general), 4 (work), 4     | 10   | 20 items                             | 6                          | 40                            | 25                                       |                         |
|                             | (sports and performing arts) |      | (sports and performing arts)         |                            |                               |                                          |                         |
| Score range                  | 0–100; † scores = † disability |      | 0–80; † scores = † function          |                            | 36–78; † scores = † HRQOL     | 0–160; † scores on tension, depression, confusion and anger subscales = † negative affect; † scores on vigor and esteem subscales = † positive affect |                         |
| Time to complete             | 6 min                             |      | 3–5 min                             | 3                          | 1 min                         | 8 min                                   |                         |
| Readability, Flesch-Kincaid  | 5                                 |      | 3                                      |                            |                               | 3                                       |                         |
| grade level                  |                                |      |                                       |                            |                               |                                         |                         |
| Comfort issues               | 1 question regarding sexual activity |      | None                                  | None                       | None                          | None                                    |                         |
| Feasibility                  |                               |      |                                      |                            |                               |                                          |                         |
| Ease of use                  | No training or supervision, easy to administer |      | No training or supervision, easy to administer |                            |                               |                                          |                         |
| Role of clinician            | No questions for clinician to complete; recall period = 1 wk |      | No questions for clinician to complete; recall period = current day |                            |                               |                                          |                         |
| Time to score                | 3 min                          |      | 30 s                                 | 1 min                      | 3 min                         | 2 min                                   |                         |
| Costs                        | None, with user agreement      |      | None, with user agreement            | None                       | Paid access and licensing agreement |                                         |                         |
| Appropriateness              |                               |      |                                      |                            |                               |                                          |                         |
| Intended patient population  | UE musculoskeletal conditions   |      | Receiving PT for UE musculoskeletal disorders | Neck pain, particularly from whiplash injuries | Seeking care for a headache | Competitive athletes | Vestibular diseases or other conditions that produce dizziness |                         |
| Other populations            | UE amputees                     |      | Stroke, breast cancer surgery         | TMJ disorders              | Concussion                     | General population                       |                         |
| HRQOL dimension, No. items   |                               |      |                                       |                            |                               |                                          |                         |
| Physiological                | 9                              |      | 1                                     | 4                          | 2                             | 0                                       | 7                       |
| Social                       | 7                              |      | 3                                     | 3                          | 3                             | 0                                       | 4                       |
| Spiritual                    | 0                              |      | 0                                     | 0                          | 0                             | 0                                       | 6                       |
| Physical                     | 20                             |      | 17                                    | 3                          | 0                             | 0                                       | 6                       |
| Economic                     | 0                              |      | 0                                     | 0                          | 0                             | 0                                       | 0                       |
| Psychological                | 2                              |      | 2                                     | 0                          | 1                             | 40                                      | 8                       |
| Aspect | Quick Disabilities of the Arm, Shoulder and Hand Questionnaire | Upper Extremity Functional Instrument | Neck Disability Instrument | Shortened Headache Impact Test | Abbreviated Profile of Mood States Questionnaire | Dizziness Handicap Index |
|--------|---------------------------------------------------------------|--------------------------------------|---------------------------|-------------------------------|-----------------------------------------------|--------------------------|
| ICF health domain, No. items | 0 | 0 | 0 | 0 | 0 | 0 |
| Health condition | 7 | 0 | 4 | 3 | 3 | 3 |
| Body structure and function | 15 | 11 | 2 | 3 | 3 | 3 |
| Activity | 16 | 5 | 17 | 0 | 0 | 0 |
| Participation | 15 | 11 | 2 | 3 | 3 | 3 |
| Environmental and personal factors | 0 | 3 | 0 | 0 | 0 | 0 |

**Table 6. Continued From Previous Page**

| Aspect | Hand Questionnaire | Hand Questionnaire | Hand Questionnaire | Hand Questionnaire | Hand Questionnaire | Hand Questionnaire |
|--------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Abbreviations: HRQOL, health-related quality of life; ICF, International Classification of Functioning, Disability and Health; PT, physical therapy; TMJ, temporomandibular joint.
support athletic health care and are commonly used in practice, there are likely other instruments with which ATs should be familiar. Furthermore, the landscape of PROM use in athletic training is ever changing. Thus, newer instruments developed in recent years may not have been reviewed in this report. Despite these limitations, we believe that our concise summary of PROMs used by ATs is a helpful resource for the profession as a whole, given ATs’ relatively low use of and general lack of knowledge regarding PROMs, which appear to hinder the overall use of PROMs in athletic health care.

**CONCLUSIONS**

In general, the PROMs included in this report possess established and appropriate instrument essentials and clinical utility, supporting their use in patient care. With respect to the ICF health domains and HRQOL dimensions of health, the included PROMs generally focus on body structure and function as well as the physical functioning of the patient. Although that focus is not surprising and is typically helpful in caring for athletes, a sole focus on these components does not comprehensively capture the patient from a whole-person perspective. Thus, ATs with the primary goal of evaluating each patient as a whole person...
to support patient-centered care should consider a collection of PROMs as opposed to a single instrument. Efforts to make the use of PROMs in athletic training more routine will likely result in the development of new PROMs that are designed specifically for highly functional patients. As a result, in addition to considering the PROMs included in this report, ATs should stay abreast of newly developed PROMs.

REFERENCES

1. Washington EA, Lipstein SH. The Patient-Centered Outcomes Research Institute: promoting better information, decisions, and health. N Engl J Med. 2011;365(15):e31.

2. Guyatt GH, Ferrans CE, Halyard MY, et al. Exploration of the value of health-related quality-of-life information from clinical research and into clinical practice. Mayo Clin Proc. 2007;82(10):1229–1239.

3. Testa MA, Simonson DC. Assessment of quality-of-life outcomes. N Engl J Med. 1996;334(13):835–840.

4. Watts JH, Clement DG, Casanova JS. Perspectives on outcomes research and practice collaboration. J Rehabil Outcome Meas. 1999;3(4):22–32.

5. DeLise DC, Leasure AR. Benchmarking: measuring the outcomes of evidence-based practice. Outcomes Manag Nurs Pract. 2001;5(2):70–74.

6. Snyder AR, Parsons JT, Valovich McLeod TC, Bay RC, Michener LA, Sauers EL. Using disablement models and clinical outcomes

Table 7. Extended From Previous Page

| Generic | Single Item |
|---------|-------------|
| Short Form 36 | Short Form 12 | Numeric Pain Rating Scale | Global Rating of Change | Patient Specific Functional Scale |
| 36 items\(^{87}\) | 12 items\(^{92}\) | 3–6: current pain, best pain, worst pain in the past 24 h\(^{99}\) | 1 item\(^{101}\) | 3–5 items\(^{104}\) |
| Each scale 0–100; \(\uparrow \) scores = \(\uparrow \) function\(^{87}\) | Each scale 0–100; \(\uparrow \) scores = \(\uparrow \) function\(^{92}\) | Each item 0–10; \(\uparrow \) scores = \(\uparrow \) pain\(^{99}\) | Each item 0–10; \(\uparrow \) scores = \(\uparrow \) function\(^{104}\) |
| 5–10 min\(^{87}\) | 2 min or less\(^{92}\) | 30 s\(^{99}\) | 30 s\(^{101}\) | 1 min\(^{104}\) |
| 6 | 6 | 6 | 3 | 10 |
| None\(^{87}\) | None\(^{92}\) | None\(^{99}\) | None\(^{101}\) | None\(^{104}\) |
| No training or supervision, easy to administer\(^{87}\) | No training or supervision, easy to administer\(^{92}\) | No training or supervision, easy to administer\(^{99}\) | No training or supervision, easy to administer\(^{101}\) | No training or supervision, easy to administer\(^{104}\) |
| No questions for clinician to complete; recall period = 1 mo\(^{87}\) | No questions for clinician to complete; recall period = 1 mo\(^{92}\) | No questions for clinician to complete; recall period = 1 d\(^{99}\) | No questions for clinician to complete; recall period not reported\(^{101}\) | No questions for clinician to complete; recall period not reported\(^{104}\) |
| 3–5 min\(^{87}\) | 1 min\(^{92}\) | <30 s\(^{99}\) | <30 s\(^{101}\) | <1 min\(^{104}\) |
| Paid access and licensing agreement\(^{87}\) | Paid access and licensing agreement\(^{92}\) | None\(^{99}\) | None\(^{101}\) | None\(^{104}\) |
| Diverse patients—not specific to age, disease, or treatment\(^{87}\) | Diverse patients—not specific to age, disease, or treatment\(^{92}\) | Patients presenting with pain\(^{99}\) | Patients presenting with a health condition and are seen by a clinician on more than 1 occasion\(^{101}\) | Musculoskeletal disorders\(^{104,134}\) |
| NA | NA | NA | NA | Cardiopulmonary, neurologic, and orthopaedic conditions\(^{134}\) |
| 15 | 1 | 3 | Varies | 0 |
| 10 | 6 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 10 | 2 | 0 | 0 | 0 |
| 0 | 3 | 0 | 0 | 0 |
| 0 | 30 | 0 | 0 | 0 |
| 16 | 4 | 0 | 0 | 0 |
| 8 | 2 | 0 | 0 | 0 |
| 12 | 6 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 3–5 min\(^{15}\) | Varies | 3–5 (all activities identified) | 0 | 0 |
| 3–5 (all activities identified) | 0 | 0 | 0 | 0 |

2. Guyatt GH, Ferrans CE, Halyard MY, et al. Exploration of the value of health-related quality-of-life information from clinical research and into clinical practice. Mayo Clin Proc. 2007;82(10):1229–1239.

3. Testa MA, Simonson DC. Assessment of quality-of-life outcomes. N Engl J Med. 1996;334(13):835–840.

4. Watts JH, Clement DG, Casanova JS. Perspectives on outcomes research and practice collaboration. J Rehabil Outcome Meas. 1999;3(4):22–32.

5. DeLise DC, Leasure AR. Benchmarking: measuring the outcomes of evidence-based practice. Outcomes Manag Nurs Pract. 2001;5(2):70–74.

6. Snyder AR, Parsons JT, Valovich McLeod TC, Bay RC, Michener LA, Sauer EL. Using disablement models and clinical outcomes
assessments to enable evidence-based athletic training practice, part I: disablement models. *J Athl Train*. 2008;43(4):428–436.

7. Evans TA, Lam KC. Clinical outcomes assessment in sport rehabilitation. *J Sport Rehabil*. 2011;20(1):8–16.

8. Valovich McLeod TC, Snyder AR, Parsons JT, Bay RC, Michener LA, Sayers EL. Using disablement models and clinical outcomes assessment to enable evidence-based athletic training practice, part II: clinical outcomes assessment. *J Athl Train*. 2008;43(4):437–445.

9. National Athletic Trainers’ Association. *Athletic Training Education Competencies*. 5th ed. Dallas, TX: National Athletic Trainers’ Association; 2011.

10. Johnson SB. *The 2009 Athletic Trainer Role Delineation Study*. 6th ed. Omaha, NE: Board of Certification; 2010.

11. Commission on Accreditation of Athletic Training Education. *2020 Standards for Accreditation of Professional Athletic Training Programs*. Austin, TX: Commission on Accreditation of Athletic Training Education; 2018.

12. Nottingham S, Meyer C, Blackstone B. ICF model: a framework for athletic training practice. National Athletic Trainers’ Association Web site. https://www.nata.org/blog/beth-sitzler/icf-model-framework-athletic-training-practice. Published 2016. Accessed February 18, 2019.

13. Jette AM. Outcomes research: shifting the dominant research paradigm in physical therapy. *Phys Ther*. 1995;75(11):965–970.

14. Snyder Valier AR, Jennings AL, Parsons JT, Vela LI. Benefits of and barriers to using patient-rated outcome measures in athletic training. *J Athl Train*. 2014;49(5):674–683.

15. Lam KC, Harrington KM, Cameron KL, Snyder Valier AR. Use of patient-reported outcome measures in athletic training: common measures, selection considerations, and practical barriers. *J Athl Train*. 2019;54(4):449–458.

16. Coulombe BJ, Games KE, Eberman LE. The use of patient-reported outcome measures: secondary school athletic trainers’ perceptions, practices, and barriers. *J Athl Train*. 2019;54(2):142–151.

17. Hankemeier DS, Manspeaker SA. Athletic trainers’ perception of interprofessional and collaborative practice. *Athl Train Sports Health Care*. 2017;9(5):203–216.

18. Foster A, Croft L, Brazier J, Harris J, O’Cathain A. The facilitators and barriers to implementing patient reported outcome measures in organisations delivering health related services: a systematic review of reviews. *J Patient Rep Outcomes*. 2018;2:46.

19. Snyder Valier AR, Lam KC. Beyond the basics of clinical outcomes assessment: selecting appropriate patient-rated outcomes instruments for patient care. *Athl Train Educ J*. 2015;10(1):91–100.

20. International Classification of Functioning, Disability and Health (ICF). World Health Organization Web site. https://www.who.int/classifications/icf/en/. Published 2018. Accessed February 18, 2019.

21. Irrgang JJ, Anderson AE. Development and validation of health-related quality of life measures for the knee. *Clin Orthop Relat Res*. 2002;402:95–109.

22. Spilker B. Taxonomy of quality of life. In: Spilker B, Revicki D, eds. *Quality of Life and Pharmacoeconomics in Clinical Trials*. 2nd ed. Philadelphia, PA: Lippincott-Raven; 1996:1–10.

23. Suryavanshi J, Goto R, Jivanelli B, et al. Age-appropriate pediatric sports patient-reported outcome measures and their psychometric properties: a systematic review [published online ahead of print January 16, 2019]. *Am J Sports Med*. doi:10.1177/0363546518818822.

24. Collins NJ, Misra D, Felson DT, Crossley KM, Roos EM. Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). *Arthritis Care Res (Hoboken)*. 2011;63(suppl 11):S208–S228.

25. Schmidt S, Ferrer M, Gonzalez M, et al. Evaluation of shoulder-specific patient-reported outcome measures: a systematic and standardized comparison of available evidence. *J Shoulder Elbow Surg*. 2014;23(3):434–444.

26. Denegar CR, Vela LI, Evans TA. Evidence-based sports medicine: outcomes instruments for active populations. *Clin Sports Med*. 2008;27(3):339–351, vii.

27. Communicating with patients who have limited literacy skills: report of the National Work Group on Literacy and Health. *J Fam Prac*. 1998;46(2):158–176.

28. Weiss BD, Coyne C. Communicating with patients who cannot read. *N Engl J Med*. 1997;337(4):272–274.

29. Snyder Valier AR, Welch Bacon CE, Lam KC. Disablement model and health-related quality of life classification for Patient-Reported Outcomes Measurement Information System (PROMIS) instruments. *J Athl Train*. 2018;53(12):1206–1213.

30. Johnson NA, Liang MH, Daltroy L, Rudicel S, Richmond J. American Academy of Orthopaedic Surgeons lower limb outcomes assessment instruments: reliability, validity, and sensitivity to change. *J Bone Joint Surg Am*. 2004;86(5):902–909.

31. Martin RL, Irrgang JJ, Burdett RG, Conti SF, Van Swearingen JM. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). *Foot Ankle Int*. 2005;26(11):968–983.

32. Ecclestone C, Vaes P, Van Schaepdt L, Asman S, Duquet W. The clinimetric qualities of patient-assessed instruments for measuring chronic ankle instability: a systematic review. *BMC Musculoskeletal Disord*. 2007;8:6.

33. Martin RL, Burdett RG, Irrgang JJ. Development of the Foot and Ankle Disability Index (FADI). *J Orthop Sports Phys Ther*. 1999;29(A32–A33).

34. Hale SA, Hertel J. Reliability and sensitivity of the Foot and Ankle Disability Index in subjects with chronic ankle instability. *J Athl Train*. 2005;40(1):35–40.

35. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the International Knee Documentation Committee Subjective Knee Form. *Am J Sports Med*. 2001;29(5):600–613.

36. Irrgang JJ, Anderson AF, Boland AL, et al. Responsiveness of the International Knee Documentation Committee Subjective Knee Form. *Am J Sports Med*. 2006;34(10):1567–1573.

37. Roos EM, Roos HP, Lohmander LS, Ek达尔 C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS): development of a self-administered outcome measure. *J Orthop Sports Phys Ther*. 1998;28(2):88–96.

38. Salavati M, Akhbari B, Mohammadi F, Mazaheri M, Khorrami M. Knee Injury and Osteoarthritis Outcome Score (KOOS); reliability and validity in competitive athletes after anterior cruciate ligament reconstruction. *Osteoarthritis Cartilage*. 2011(19):406–410.

39. Binkley JM, Stratford PW, Lott SA, Riddle DL. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application: North American Orthopaedic Rehabilitation Network. *Phys Ther*. 1999;79(4):371–383.

40. Klassbo M, Larsson E, Mannevik E. Hip Disability and Osteoarthritis Outcome Score: an extension of the Western Ontario and McMaster Universities Osteoarthritis Index. *Scand J Rheumatol*. 2003;32(1):46–51.
41. Nilsdotter AK, Lohmander LS, Klaasbo M, Roos EM. Hip Disability and Osteoarthritis Outcome Score (HOOS): validity and responsiveness in total hip replacement. *BMC Musculoskelet Disord.* 2003;4:10.

42. De Groot IB, Reijman M, Terwee CB, et al. Validation of the Dutch version of the Hip Disability and Osteoarthritis Outcome Score. *Osteoarthritis Cartilage.* 2007;15(1):104–109.

43. Ornetti P, Parratte S, Gossec L, et al. Cross-cultural adaptation and validation of the French version of the Hip Disability and Osteoarthritis Outcome Score (HOOS) in hip osteoarthritis patients. *Osteoarthritis Cartilage.* 2010;18(4):522–529.

44. Martin RL, Kelly BT, Philippon MJ. Evidence of validity for the Hip Outcome Score. *Arthroscopy.* 2006;22(12):1304–1311.

45. Martin RL, Philippon MJ. Evidence of reliability and responsiveness for the Hip Outcome Score. *Arthroscopy.* 2008;24(6):676–682.

46. Greenough CG, Fraser RD. Assessment of outcome in patients with low-back pain. *Spine (Phila Pa 1976).* 1992;17(1):36–41.

47. Holt AE, Shaw NJ, Shetty A, Greenough CG. The reliability of the Low Back Outcome Score for back pain. *Spine (Phila Pa 1976).* 2002;27(2):206–210.

48. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976).* 2000;25(22):2940–2952.

49. Roland M, Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. *Spine (Phila Pa 1976).* 2000;25(24):3115–3124.

50. Davidson M, Keating JL. A comparison of five low back disability questionnaires: reliability and responsiveness. *Phys Ther.* 2002;82(1):8–24.

51. Muller U, Duetz MS, Roeder C, Greenough CG. Condition-specific outcome measures for low back pain: part I. Validation. *Eur Spine J.* 2004;13(4):301–313.

52. Davidson M, Keating J. Oswestry Disability Questionnaire (ODQ). *Aust J Physiother.* 2005;51(4):270.

53. Hudak P, Amadio PC, Bombardier C; Upper Extremity Collaborative Group (UECG). Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder, and head). *Am J Ind Med.* 1996;29(6):602–608.

54. Mahabier KC, den Hartog D, Theyskens N, Verhofstad MHJ, Van Lieshout EMM; HUMMER Trial Investigators. Reliability, validity, responsiveness, and minimal important change of the Disabilities of the Arm, Shoulder and Hand and Constant-Murley scores in patients with a humeral shaft fracture. *J Shoulder Elbow Surg.* 2001;10(5):602–608.

55. Beaton DE, Katz JN, Fossel AH, Wright JG, Tarasuk V, Bombardier C. Measuring the whole or the parts? Validity, reliability, and the responsiveness of the Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity. *J Hand Ther.* 2001;14(2):128–146.

56. Franchignoni F, Vercelli S, Giordano A, Sartorio F, Bravini E, Ferriero G. Minimal clinically important difference of the Disabilities of the Arm, Shoulder and Hand outcome measure (DASH) and its shortened version (QuickDASH). *J Orthop Sports Phys Ther.* 2014;44(1):30–39.

57. Gummesson C, Ward MM, Atroshi I. The shortened Disabilities of the Arm, Shoulder and Hand Questionnaire (QuickDASH): validity and reliability based on responses within the full-length DASH. *BMC Musculoskelet Disord.* 2006;7:44.

58. Hsu JE, Nacke E, Park MJ, Sennett BJ, Huffman GR. The Disabilities of the Arm, Shoulder, and Hand questionnaire in intercollegiate athletes: validity limited by ceiling effect. *J Shoulder Elbow Surg.* 2010;19(3):349–354.

59. Schmitt JS, Di Fabio RP. Reliable change and minimum important difference (MID) proportions facilitated group responsiveness comparisons using individual threshold criteria. *J Clin Epidemiol.* 2004;57(10):1008–1018.

60. van Kampen DA, Willems WJ, van Beers LW, Castelein RM, Scholtes VA, Terwee CB. Determination and comparison of the smallest detectable change (SDC) and the minimal important change (MIC) of four shoulder-patient-reported outcome measures (PROMs). *J Orthop Surg Res.* 2013;8:40.

61. Michener LA, Snyder Valier AR, McClure PW. Defining substantial clinical benefit for patient-rated outcome tools for shoulder impingement syndrome. *Arch Phys Med Rehab.* 2013;94(4):725–730.

62. Beaton DE, Wright JG, Katz JN; Upper Extremity Collaborative Group. Development of the QuickDASH: comparison of three item-reduction approaches. *J Bone Joint Surg Am.* 2005;87(5):1038–1046.

63. Mintken PE, Glynn P, Cleland JA. Psychometric properties of the shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire (QuickDASH) and Numeric Pain Rating Scale in patients with shoulder pain. *J Shoulder Elbow Surg.* 2009;18(6):920–926.

64. Polson K, Reid D, McNair PJ, Larmer P. Responsiveness, minimal important difference and minimal detectable change scores of the shortened Disability Arm Shoulder Hand (QuickDASH) questionnaire. *Man Ther.* 2010;15(4):404–407.

65. Stratford PW, Binkley JM, Stratford DM. Development and initial validation of the Upper Extremity Functional Index. *Physiother Can.* 2001;52:259–267.

66. Chesworth BM, Hamilton CB, Walton DM, et al. Reliability and validity of two versions of the Upper Extremity Functional Index. *Physiother Can.* 2014;66(3):243–253.

67. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. *J Manipulative Physiol Ther.* 1991;14(7):409–415.

68. Westaway MD, Stratford PW, Binkley JM. The Patient-Specific Functional Scale: validation of its use in persons with neck dysfunction. *J Orthop Sports Phys Ther.* 1998;27(5):331–338.

69. Cleland JA, Fritz JM, Whitman JM, Palmer JA. The reliability and construct validity of the Neck Disability Index and Patient Specific Functional Scale in patients with cervical radiculopathy. *Spine (Phila Pa 1976).* 2006;31(5):598–602.

70. Kosinski M, Bayliss MS, Bjoner J, et al. A six-item short-form survey for measuring headache effect: the HIT-6. *Qual Life Res.* 2003;12(8):963–974.

71. Kawata AK, Coeytaux RR, DeVellis RF, Finkel AG, Mann JD, Kahn K. Psychometric properties of the HIT-6 among patients in a headache-specialty practice. *Headache.* 2005;45(6):638–643.

72. Smelt AF, Assendelft WJ, Terwee CB, Ferrari MD, Blom JW. What is a clinically relevant change on the HIT-6 questionnaire? An estimation in a primary-care population of migraine patients. *Cephalalgia.* 2014;34(1):29–36.

73. Casten RF, Blankenstein AH, Windt DA, Dekker J. Minimal clinically important change on the Headache Impact Test-6 questionnaire in patients with chronic tension-type headache. *Cephalalgia.* 2012;32(9):710–714.

74. Grove JR, Pravapessis H. Preliminary evidence for the reliability and validity of an Abbreviated Profile of Mood States. *Int J Sport Psychol.* 1992;23(2):93–109.

75. Jacobson GP, Newman CW. The development of the Dizziness Handicap Inventory. *Arch Otolaryngol Head Neck Surg.* 1990;116(4):424–427.

76. Enloe LJ, Shields RK. Evaluation of health-related quality of life in individuals with vestibular disease using disease-specific and general outcome measures. *Phys Ther.* 1997;77(9):890–903.

77. Vela LI, Denegar CR. Transient disbalance in the physically active with musculoskeletal injuries, part I: a descriptive model. *J Athl Train.* 2010;45(6):615–629.
78. Vela LI, Denegar CR. The Disablement in the Physically Active Scale, part II: the psychometric properties of an outcomes scale for musculoskeletal injuries. J Athl Train. 2010;45(6):630–641.

79. Martin DP, Engelberg R, Agel J, Snapp D, Swiontkowski MF. Development of a musculoskeletal extremity health status instrument: the Musculoskeletal Function Assessment instrument. J Orthop Res. 1996(14):173–181.

80. Bouffard J, Bertrand-Charette M, Roy JS. Psychometric properties of the Musculoskeletal Function Assessment and the Short Musculoskeletal Function Assessment: a systematic review. Clin Rehabil. 2016;30(4):393–409.

81. Swiontkowski MF, Engelberg R, Martin DP, Agel J. Short Musculoskeletal Function Assessment questionnaire: validity, reliability, and responsiveness. J Bone Joint Surg Am. 1999;81(9):1245–1260.

82. Varni JW, Seid M, Rode CA. The PedsQL: measurement model for the Pediatric Quality of Life Inventory. Med Care. 1999;37(2):126–139.

83. Varni JW, Seid M, Kurtin PS. PedsQL 4.0: reliability and validity of the Pediatric Quality of Life Inventory version 4.0 generic core scales in healthy and patient populations. Med Care. 2001;39(8):800–812.

84. Varni JW, Burwinkle TM, Seid M, Skarr D. The PedsQL 4.0 as a pediatric population health measure: feasibility, reliability, and validity. Ambul Pediatr. 2003;3(6):329–341.

85. Varni JW, Burwinkle TM, Seid M. The PedsQL as a pediatric patient-reported outcome: validity and reliability of the PedsQL Measurement Model in 25,000 children. Expert Rev Pharmacoecon Outcomes Res. 2005;5(6):705–719.

86. Varni JW, Burwinkle TM, Seid M. The PedsQL 4.0 as a school population health measure: feasibility, reliability, and validity. Qual Life Res. 2006;15(2):203–215.

87. Ware JE Jr, Sherbourne CD. The MOS 36-item Short-Form Health Survey (SF-36). I: conceptual framework and item selection. Med Care. 1992;30(6):473–483.

88. Ware JE Jr, Snow KK, Kosinski M, Gandek B. SF-36 Health Survey: Manual and Interpretation Guide. Boston, MA: Health Institute, New England Medical Center; 1993.

89. McHorney CA, Ware JE Jr, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care. 1993;31(3):247–263.

90. Jenkinson C, Coulter A, Wright L. Short Form 36 (SF-36) health survey questionnaire: normative data for adults of working age. BMJ. 1993;306(6890):1437–1440.

91. Jenkinson C, Wright L, Coulter A. Criterion validity and reliability of the SF-36 in a population sample. Qual Life Res. 1994;3(1):7–12.

92. Ware JE, Kosinski M, Keller SD. A 12-item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Med Care. 1996;34(3):220–233.

93. Luo X, George ML, Kakouras I, et al. Reliability, validity, and responsiveness of the Short Form 12-Item Survey (SF-12) in patients with back pain. Spine (Phila Pa 1976). 2003;28(15):1739–1745.

94. Herr KA, Spratt K, Mohily PR, Richardson G. Pain intensity assessment in older adults: use of experimental pain to compare psychometric properties and usability of selected pain scales with younger adults. Clin J Pain. 2004;20(4):207–219.

95. Bijur PE, Latimer CT, Gallagher EJ. Validation of a verbally administered numerical rating scale of acute pain for use in the emergency department. Acad Emerg Med. 2003;10(4):390–392.

96. Kahl C, Cleland JA. Visual analogue scale, numeric pain rating scale and the McGill Pain Questionnaire: an overview of psychometric properties. Phys Ther. 2013;102(2):123–128.

97. Spadoni GF, Stratford PW, Solomon PE, Wishart LR. The evaluation of change in pain intensity: a comparison of the P4 and single-item numeric pain rating scales. J Orthop Sports Phys Ther. 2004;34(4):187–193.

98. Michener LA. Patient- and clinician-rated outcome measures for clinical decision making in rehabilitation. J Sport Rehabil. 2011;20(1):37–45.

99. Downie WW, Leatham PA, Rhind VM, Wright V, Branco JA, Anderson JA. Studies with pain rating scales. Ann Rheum Dis. 1978;37(4):378–781.

100. Camper SI, Maher CG, Mackay G. Global rating of change scales: a review of strengths and weaknesses and considerations for design. J Man Manip Ther. 2009;17(3):163–170.

101. Jaeschke R, Singer J, Guyatt GH. Measurement of health status: ascertaining the minimal clinically important difference. Control Clin Trials. 1989;10(4):407–415.

102. Stratford PW, Binkley J, Solomon P, Gill C, Finch E. Assessing change over time in patients with low back pain. Phys Ther. 1994;74(6):528–533.

103. Watson CJ, Propps M, Ratner J, Zeigler DL, Horton P, Smith SS. Reliability and responsiveness of the Lower Extremity Functional Scale and Anterior Knee Pain Scale in patients with anterior knee pain. J Orthop Sports Phys Ther. 2005;35(3):136–146.

104. Stratford P, Gill C, Westaway M, Binkley J. Assessing disability and change on individual patients: a report of a patient specific measure. Physiother Can. 1995;47(4):258–263.

105. Hefford C, Abbott JH, Arnold R, Baxter GD. The Patient-Specific Functional Scale: validity, reliability, and responsiveness in patients with upper extremity musculoskeletal problems. J Orthop Sports Phys Ther. 2012;42(2):56–65.

106. Chatman AB, Hyams SP, Neel JM, et al. The Patient-Specific Functional Scale: measurement properties in patients with knee dysfunction. Phys Ther. 1997;77(8):820–829.

107. Riskowski JL, Hagedorn TJ, Haman MT. Measures of foot function, foot health, and foot pain: American Academy of Orthopedic Surgeons Lower Limb Outcomes Assessment: Foot and Ankle Module (AAOS-FAM), Bristol Foot Score (BFS), Revised Foot Function Index (FFI-R), Foot Health Status Questionnaire (FHSQ), Manchester Foot Pain and Disability Index (MFPI), Podiatric Health Questionnaire (PHQ), and Rowan Foot Pain Assessment (ROFPAQ). Arthritis Care Res (Hoboken). 2011;63(suppl 11):S229–S239.

108. Vianin M. Psychometric properties and clinical usefulness of the Oswestry Disability Index. J Chiropr Med. 2008;7(4):161–163.

109. Nilssdotter A, Bremander A. Measures of hip function and symptoms: Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Oxford Hip Score (OHS), Lequesne Index of Severity for Osteoarthritis of the Hip (LISOH), and American Academy of Orthopedic Surgeons (AAOS) Hip and Knee Questionnaire. Arthritis Care Res (Hoboken). 2011;63(suppl 11):S200–S207.

110. Stevenson JD, Jaiswal A, Gregory JJ, Mangham DC, Cribb G, Cool P. Diffuse pigmented villonodular synovitis (diffuse-type giant cell tumour) of the foot and ankle. Bone Joint J. 2013;95-B(3):384–390.

111. Kahraman M, Misir A, Kizkapan TB, Ozcamdalli M, Uzun E, Mutlu M. The long-term outcomes following the application of intralesional epidermal growth factor in patients with diabetic foot ulcers. J Foot Ankle Surg. 2019;58(2):282–287.
athletes versus general, healthy adolescent individuals. *J Athl Train.* 2013;48(2):233–241.

148. McAllister DR, Motamedi AR, Hame SL, Shapiro MS, Dorey FJ. Quality of life assessment in elite collegiate athletes. *Am J Sports Med.* 2001;29(6):806–810.

149. Snyder Valier AR, Martinez JC, Bay RC, Parsons JT, Sauers EL, Valovich McLeod TC. Health-related quality of life differs between adolescent athletes and adolescent nonathletes. *J Sport Rehabil.* 2010;19(3):237–248.

150. Fraser JJ, Hertel J. Preinjury to postinjury disablement and recovery after a lateral ankle sprain: a case report. *J Athl Train.* 2018;53(8):776–781.

151. Ferreira ML, Ferreira PH, Latimer J, et al. Comparison of general exercise, motor control exercise and spinal manipulative therapy for chronic low back pain: a randomized trial. *Pain.* 2007;131(1–2):31–37.

152. Crossley KM, Bennell KL, Cowan SM, Green S. Analysis of outcome measures for persons with patellofemoral pain: which are reliable and valid? *Arch Phys Med Rehabil.* 2004;85(5):815–822.

Address correspondence to Kenneth C. Lam, ScD, ATC, Department of Interdisciplinary Health Sciences, A.T. Still University, 5850 East Still Circle, Mesa, AZ 85206. Address e-mail to klam@atsu.edu.