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Patient-Reported Outcome Measures for Pediatric Patients With Sport-Related Injuries: A Systematic Review

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Despite a call to incorporate patient-reported outcome measures (PROMs) into all aspects of health care, little is known about which instruments are best suited for a pediatric patient population with sport-related injury. The objective of this article was to perform a systematic review of the currently available evidence to determine which PROMs were used for pediatric patients with sport-related injuries and identify the associated psychometric properties and considerations for clinical utility. We conducted a literature search for articles on PROMs used in the pediatric population through electronic databases and a manual search of reference lists and authors between from inception to 2020. Articles were grouped based on the PROM(s) included, and considerations for clinical utility and psychometric properties were extracted from each article. Thirty-nine articles were included in this review, from which 22 PROMs were identified: 12 PROMs were developed specifically for the pediatric population, 4 were modified versions of an adult scale, and 6 were adult measures used in a pediatric population. Of the PROMs included in this review, the Oxford Ankle Foot Questionnaire for Children and the Pediatric Quality of Life Inventory were the most comprehensive in their development and assessment. Several outcome measures used for pediatric patients had missing or inadequate measurement properties and considerations for clinical utility, particularly in regard to readability, responsiveness, and interpretability. Clinicians and researchers should consider a measure's feasibility, acceptability, appropriateness, and psychometric properties when selecting a PROM for use with the pediatric population.

Key Words: health-related quality of life, children, adolescents, athletic injuries

Participation in pediatric (ie, youth and adolescent) athletics is thriving. In 2019, over 46 million children between the ages of 6 and 18 years regularly participated in organized athletics,[1] more than double the total population of Florida.[2] In fact, in 2020 (before the COVID-19 pandemic), children in 40% of families played their primary sport at least 4 days per week.[1] Due to these levels of participation, sport has been deemed the leading cause of injury in youths and adolescents.[3,4] An estimated 35 injuries occur for every 100 participants each year,[5,6] and up to 40% of pediatric athletes quit sports due to injury.[7] Although athletic injuries are thought to primarily affect physical functioning, previous investigators[8–10] indicated that athletes reported deficits in emotional and mental health functioning after injury. Because of these deficits, athletic trainers (ATs) have been encouraged to view athletes from a whole-person perspective[11,12] and assess patient outcomes to better understand how injuries affect patients from their own viewpoints.[13,14]

To capture the patient's perspective, efforts have been made to encourage the use of *patient-reported outcome measures* (PROMs), which are self-report measures that assess different health domains related to health-related quality of life (HRQOL), different levels of disablement,[13] or both. Thus, the use of PROMs helps clinicians provide patient-centered care as opposed to only focusing on disease-oriented outcomes (eg, range of motion, strength, edema).[13] Further, when used effectively, patient outcomes provide a systematic approach to incorporating patient values and needs into patient care. Despite the importance of PROMs in providing patient-centered care, they remain underused by ATs, physical therapists, and other clinicians.[15,16]

Barriers to the implementation of PROMs into patient care have been documented in athletic training.[15] For example, the process of selecting a PROM for use can be challenging for practicing clinicians due to the time needed to evaluate the available PROMs and the technical knowledge needed to critically review each instrument. This process is further complicated when the population consists of pediatric patients.[17] For instance, pediatric patients, with different cognitive abilities, often have difficulty with the readability,[18] comprehensibility,[19] and appropriateness[19,20] of PROMs initially developed for adults. Therefore, clinicians and researchers should select

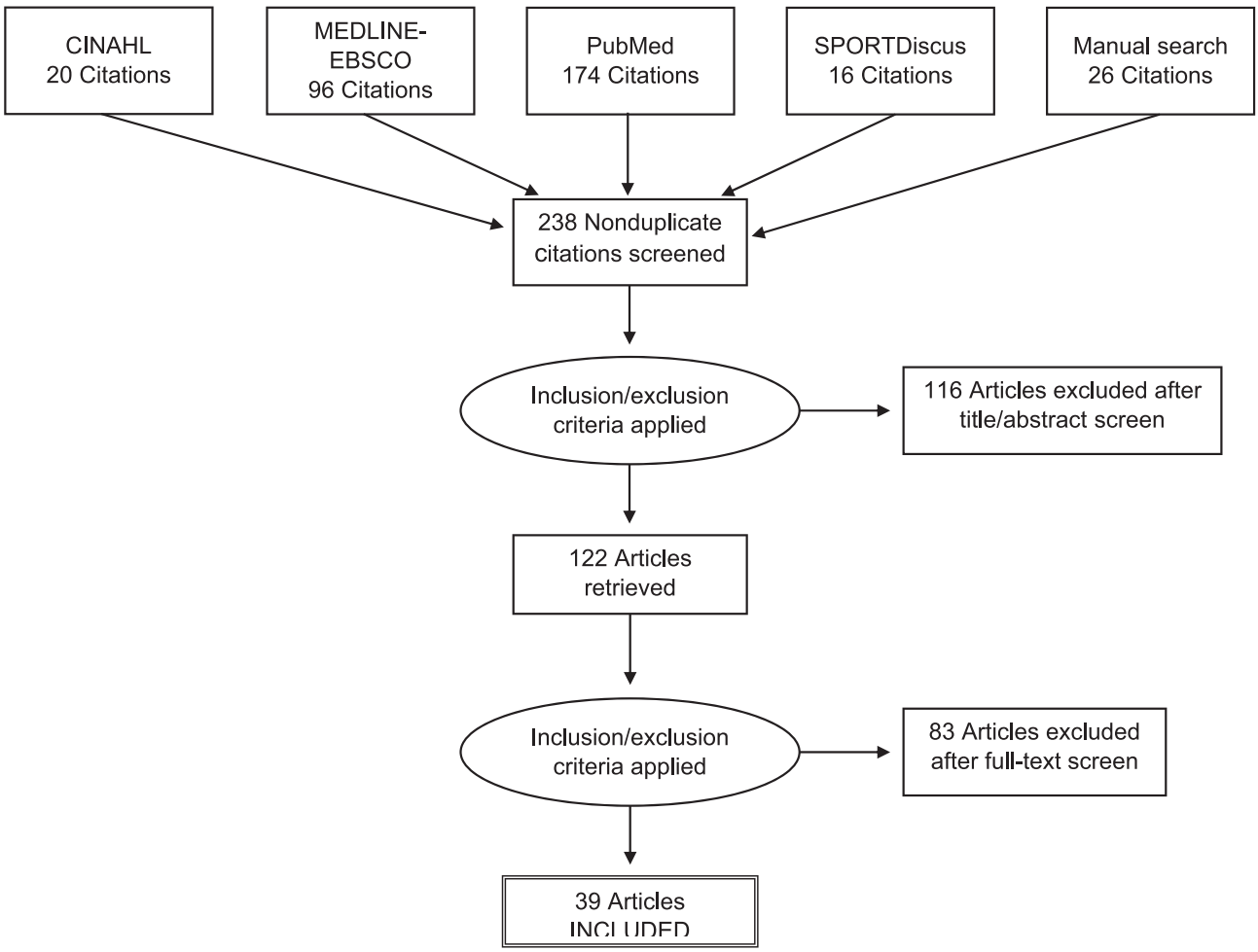

Figure 1. Search strategy and selection process.

instruments that have been evaluated in a youth or adolescent population, are appropriate for the condition or injury being managed, and have demonstrated suitable psychometric properties to ensure that the data are reliable and valid.

Recently, Lam et al[21] reviewed and evaluated PROMs that are commonly used in athletic training to provide clinicians and researchers with information in support of the selection process. In that review, only 1 PROM was specifically designed for use in the pediatric patient population. With many ATs providing care to pediatric patients, a similar review and evaluation of PROMs for pediatric patients may be helpful to ATs. Thus, the purpose of our study was to review the literature to (1) determine which PROMs were being used for youth or adolescent patients with sport-related injuries, (2) identify the associated psychometric properties and considerations for clinical utility, and (3) determine the health domains and levels of disablement assessed by each PROM.

METHODS

Data Sources

We conducted a computerized search of CINAHL, EBSCO, SPORTDiscus, and PubMed from inception to 2020 using the terms (*sport-related* OR *sport* OR *athletic* OR *orthopedic* OR *orthopaedic*) AND (*youth* OR *adolescent* OR *child* OR *pediatric*) AND (*patient reported outcome* OR *patient rated outcome* OR *patient oriented outcome* OR *patient centered outcome*) AND (*instrument* OR *measure* OR *scale* OR *tool*) for peer-reviewed articles. In addition to the computerized search, we contributed relevant articles and performed a manual search of reference lists and authors in the articles screened for inclusion to find relevant articles not identified in the initial search.

Study Selection

Duplicate articles were removed, and a 2-step process was used to identify relevant articles for this study (Figure 1). The titles and abstracts of all articles were screened by each author independently, using the inclusion and exclusion criteria. After the screening, a meeting was held to discuss articles that lacked consensus. We reviewed the full text of the remaining articles and met again to discuss any articles that did not receive a consensus.

Articles were included if they (1) were original research, (2) were written in English, (3) incorporated a PROM for sport-related injuries, and (4) involved participants $\leq$18 years of age. Studies were excluded if (1) the authors incorporated parent-generated responses or proxy reports on PROMs, (2) the authors focused on conditions outside of sport-related or orthopaedic injury, or (3) they were

Table 1. Considerations for Clinical Utility: Acceptability

Region	Instrument	No. of Items	Score Range (Interpretation)	Time to Complete, min	Readability (Reading Ease; Reading Grade Level)
Upper extremity	Pediatric/Adolescent Shoulder Survey (PASS)	13	0–100	NR	85.0; 4.4
	Pediatric and Adolescent Shoulder and Elbow Survey (Pedi-ASES)	39	0–84 (↑ Score = better function)	NR	85.0; 4.2
	Quick Disabilities of the Arm, Shoulder and Hand outcome measure (QuickDASH)	11	0–100 (↑ Score = better function)	2	65.9; 7.9
	Youth Throwing Scale	18	18–90 (↑ Score = less pain or effect on HRQOL)	NR	73.1; 5.4
Lower extremity	International Knee Documentation Committee Subjective Knee Evaluation Form (IKDC)	10	0–100 (↑ Score = better function)	10	59.6; 9.5
	Knee Injury and Osteoarthritis Outcome Score for Children (KOOS-Child)	46	0–100 (↑ Score = fewer knee problems)	NR	82.8; 3.8
	Micheli Functional Scale	5	0–100 (↓ Score = less disability)	5–10	57.6; 9.5
	Oxford Ankle Foot Questionnaire for Children (OxAFQ-C)	14	0–100 (↑ Score = better function)	NR	74.3; 6.2
	Pediatric International Knee Documentation Committee Subjective Knee Evaluation Form (Pedi-IKDC)	10	0–100 (↑ Score = better function)	NR	90.3; 2.2
Generic	Child Health Questionnaire (CHQ)	87	0–100 (↑ Score = better health)	5–15	78.4; 4.4
	Multidimensional Fatigue Scale	18	0–100 (↑ Score = fewer fatigue symptoms and better HRQOL)	10–15	89.1; 3.0
	Pediatric Quality of Life Inventory (PedsQL)	23	0–100 (↑ Score = better HRQOL)	NR	93.9; 2.1
	Pediatric Outcomes Data Collection Instruments (PODCI)	83	0–100 (↑ Score = better HRQOL)	10–20	75.0; 4.3
Single item	Global Rating of Change (GROC)	1	0–9	NR	63.7; 7.0
	Global Rating of Athletic Activity	1	0–6	NR	55.3; 8.3
	Global Rating of Daily Activity	1	0–6	NR	59.0; 7.8
	Single Assessment Numerical Evaluation (SANE)	1	0–100 (↑ Score = better function)	NR	64.4; 8.3
Activity	Activities Scale for Kids (ASK)	30	0–100 (↑ Score = better function)	NR	91.2; 3.3
	Hospital for Special Surgery Pediatric Functional Activity Brief Scale (HSS Pedi-FABS)	8	1–30	NR	50.3; 7.9
	Marx Activity Scale	4	0–16 (↑ Score = higher level of activity)	NR	60.8; 8.3
	Physical Activity Questionnaire for Older Children (PAQ-C)	9	9–45 (↑ Score = higher level of activity)	20	76.8; 5.5
	Physical Activity Questionnaire for Adolescents (PAQ-A)	9	9–45 (↑ Score = higher level of activity)	10–15	77.3; 5.5

Abbreviations: HRQOL, health-related quality of life; NR, not reported.

editorials, commentaries, case studies, guidelines, conference proceedings, or review articles. If the research involved participants <18 years old or proxy reports and we could feasibly separate the data and psychometrics of the instrument for the pediatric population, the study was included.

Data Extraction

Articles were grouped according to the PROM(s) used, and instruments were then organized based on the region of focus: upper extremity, lower extremity, generic, single item, or activity. Considerations for clinical utility extracted from articles were acceptability (number of items, score range, time to complete, and readability; Table 1), feasibility (recall period, response format, grading, time to score, and anticipated costs; Table 2), and appropriateness (intended patient population and demonstrated use; Table 3).

Readability, including both the Flesch-Kincaid Reading Ease and Reading Grade Level formulas, was calculated for the unformatted text of each instrument using Word for Mac software (version 16.15; Microsoft Corp). *Health-related quality of life* is a global multidimensional concept that references an individual's unique life experiences and values and how they ultimately affect health and can be summarized through health domains and International Classification of Functioning (ICF) disablement levels.[11] Health domains (ie, physiological, physical, psychological, spiritual, social, economic) and ICF disablement levels (ie, body structure and function, activity, participation, environmental, personal) were determined based on a consensus method,[11] in which researchers with expertise in clinical outcomes assessment independently reviewed and rated each question in the included instruments to determine the primary health domain[11] and disablement level.[22] A more detailed description of these domains and disablement

Table 2. Considerations for Clinical Utility: Feasibility

Region	Instrument	Recall Period	Response Format	Grading	Time to Score	Anticipated Costs
Upper extremity	Pediatric/Adolescent Shoulder Survey (PASS)	NR	Patient or parent fills out	Computer	NR	Free
	Pediatric and Adolescent Shoulder and Elbow Survey (Pedi-ASES)	7 d	Patient fills out	By hand	NR	Free
	Quick Disabilities of the Arm, Shoulder and Hand outcome measure (QuickDASH)	NR	By patient on computerized device with comprehension clarification as needed	By hand	8 min	Free
	Youth Throwing Scale	NR	Patient fills out	By hand	NR	Free
Lower extremity	International Knee Documentation Committee Subjective Knee Evaluation Form (IKDC)	4 wk	Patient fills out	By hand	5 min	Free
	Knee Injury and Osteoarthritis Outcome Score for Children (KOOS-Child)	7 d	Patient fills out	By hand or Excel[a]	NR	Free
	Micheli Functional Scale	NR	Patient fills out	By hand	NR	Free
	Oxford Ankle Foot Questionnaire for Children (OxAFQ-C)	NR	Patient fills out	Computer	NR	License
	Pediatric International Knee Documentation Committee Subjective Knee Evaluation Form (Pedi-IKDC)	4 wk	Patient fills out	By hand	NR	Free
Generic	Child Health Questionnaire (CHQ)	4 wk and 1 y	Patient fills out; parental proxy section	NR	NR	License
	Multidimensional Fatigue Scale	NR	Scale read aloud to children $\leq$7 and to those too fatigued or ill to complete the instrument themselves	By hand	NR	Under copyright
	Pediatric Quality of Life Inventory (PedsQL)	NR	Patient fills out (ages 5–18); parental proxy section (ages 2–18)	By hand	NR	Free
	Pediatric Outcomes Data Collection Instruments (PODCI)	NR	Patient fills out	By hand	NR	Free
Single item	Global Rating of Change (GROC)	NR	Patient fills out	By hand	NR	Free
	Global Rating of Athletic Activity	NR	Patient fills out	By hand	NR	Free
	Global Rating of Daily Activity	NR	Patient fills out	By hand	NR	Free
	Single Assessment Numerical Evaluation (SANE)	NR	Patient verbally responds	By hand	NR	Free
Activity	Activities Scale for Kids (ASK)	NR	Patient self-report (children $<$9 could have parents read the questions to them)	By hand	NR	Free
	Hospital for Special Surgery Pediatric Functional Activity Brief Scale (HSS Pedi-FABS)	NR	Patient self-report	By hand	NR	Free
	Marx Activity Scale	1 y	Patient self-report (parents can assist with question interpretation)	By hand	NR	Free
	Physical Activity Questionnaire for Older Children (PAQ-C)	7 d	Patient self-report	By hand	NR	Free
	Physical Activity Questionnaire for Adolescents (PAQ-A)	7 d	Patient self-report	By hand	NR	Free

Abbreviation: NR, not reported.

[a] Microsoft Corp.

levels can be found in a previous investigation.[11] After the independent review, we convened to compare our individual ratings and agree on the final classification (Table 3).

Psychometric properties extracted from the articles were reliability (internal consistency, test-retest, interrater, intrarater), validity (face, criterion, construct, content, concurrent, discriminant, convergent or divergent), floor and ceiling effects (using a 15% threshold), responsiveness (effect size, minimal detectable change, standard error of measurement), interpretability (minimal clinically important difference, minimal important difference), and precision (type of score: binary, adjectival, visual analogue scale; Table 4).

RESULTS

The literature search resulted in 332 potential articles (Figure 1). After identifying and removing 94 duplicates, we screened the remaining 238 articles according to the inclusion and exclusion criteria. After the title and abstract review, 116 articles were removed, resulting in 122 articles

Table 3. Considerations for Clinical Utility: Appropriateness

Region	Instrument	Intended Patient Population	Demonstrated Use	Health Domains	International Classification of Functioning Disablement Levels
Upper extremity	Pediatric/Adolescent Shoulder Survey (PASS)	<18 y	Shoulder-specific conditions	Physiological, social, physical	Body structure and function, activity, participation
	Pediatric and Adolescent Shoulder and Elbow Survey (Pedi-ASES)	10–18 y	Shoulder or elbow conditions	Physiological, physical	Body structure and function, activity, participation
	Quick Disabilities of the Arm, Shoulder and Hand outcome measure (QuickDASH)	8–18 y	Upper extremity function relative to ability to perform activities of daily living	Physiological, social, physical, psychological	Body structure and function, activity, participation
	Youth Throwing Scale	10–18 y	Male overhead throwers	Physiological	Body structure and function
Lower extremity	International Knee Documentation Committee Subjective Knee Evaluation Form (IKDC)	Adults	Knee conditions for ages 6+ y	Physiological, social, physical	Body structure and function, activity, participation
	Knee Injury and Osteoarthritis Outcome Score for Children (KOOS-Child)	10–18 y	Knee conditions	Physiological, social, physical	Body structure and function, activity, participation
	Micheli Functional Scale	12 y to adult	Back pain	Physiological, physical	Body structure and function, activity
	Oxford Ankle Foot Questionnaire for Children (OxAFQ-C)	5–16 y	Variety of lower extremity deformities and conditions	Physiological, social, physical, psychological	Body structure and function, activity, participation, environmental and personal factors
	Pediatric International Knee Documentation Committee Subjective Knee Evaluation Form (Pedi-IKDC)	10–18 y	Knee conditions	Physiological, physical	Body structure and function, activity
Generic	Child Health Questionnaire (CHQ)	5–18 y	Generic health-related quality of life	Physiological, social, physical, psychological	Body structure and function, activity, participation
	Multidimensional Fatigue Scale	2–18 y	Chronic diseases and subjective experiences of fatigue	Physiological, physical	Body structure and function, activity
	Pediatric Quality of Life Inventory (PedsQL)	2–18 y	Languages other than English; acute and chronic health conditions	Physiological, social, physical, psychological	Body structure and function, activity, participation
	Pediatric Outcomes Data Collection Instruments (PODCI)	11–18 y	Languages other than English; broad range of musculoskeletal conditions	Physiological, social, physical	Body structure and function, activity, participation
Single item	Global Rating of Change (GROC)	Any age	Varies based on condition		
	Global Rating of Athletic Activity	Any age	Varies based on condition		
	Global Rating of Daily Activity	Any age	Varies based on condition		
	Single Assessment Numerical Evaluation (SANE)	Any age	Broad range of musculoskeletal conditions	Physical	Activity
Activity	Activities Scale for Kids (ASK)	5–15 y	Broad range of musculoskeletal conditions	Physical	Activity, participation
	Hospital for Special Surgery Pediatric Functional Activity Brief Scale (HSS Pedi-FABS)	10–18 y	Activity rating for athletically active	Physical	Activity, participation
	Marx Activity Scale	8 y to adult	Languages other than English; knee conditions	Physical	Activity
	Physical Activity Questionnaire for Older Children (PAQ-C)	8–14 y	Athletically active youth	Physical	Activity, participation
	Physical Activity Questionnaire for Adolescents (PAQ-A)	14–20 y	Athletically active youth	Physical	Activity, participation

Table 4. Psychometric Properties Continued on Next Page

Region	Instrument	Reliability	Validity	Floor and Ceiling Effects	Responsiveness	Interpretability	Precision
Upper extremity	Pediatric/Adolescent Shoulder Survey (PASS)	Internal consistency[23]: Cronbach $\alpha = 0.86$ Item-total correlations[23]: $P = .37–.72$ Test-retest[23]: ICC = 0.75	Concurrent[23]: correlation with QuickDASH, $r = 0.65–0.79$ Discriminant[23]: Between acute injuries and diminished clinical examinations ($P < .05$); duration of symptoms and scores: $r = 0.23$, $P < .05$	None[23]	NR	NR	Adjectival, VAS
	Pediatric and Adolescent Shoulder and Elbow Survey (Pedi-ASES)	NR	Face[24]: qualitative analysis of scale comprehensibility compared with ASES and QuickDASH	NR	NR	NR	Binary, adjectival
	Quick Disabilities of the Arm, Shoulder and Hand outcome measure (QuickDASH)	Internal consistency[28]: Cronbach $\alpha = 0.91$ Item-item correlations[28]: $P = .24–.68$	Construct[28]: predictor of PedsQL, $R^2 = 0.45–0.61$	None[28]	NR	NR	Adjectival
	Youth Throwing Scale (YTS)	Test-retest[25]: ICC = 0.90 Internal consistency[25]: Cronbach $\alpha = 0.93$	Content[25]: floor and ceiling effects <30% Criterion[25]: correlation between YTS and existing validated evaluation methods Construct[25]: between healthy and injured players Concurrent[25]: correlation with DASH Sports Module, $r = 0.71$; Kerlan-Jobe Orthopaedic Clinic score, $r = 0.62$; QuickDASH, $r = 0.31$; PODCI, $r = 0.31–0.76$	None[25]	MDC[25]: 9.4 points	NR	Binary, adjectival
Lower extremity	International Knee Documentation Committee Subjective Knee Evaluation Form (IKDC)	Internal consistency[30]: Cronbach $\alpha = 0.91$	Construct[30]: 2 items below value of $r = 0.50$ Concurrent[30]: correlation with PedsQL, $r = 0.79–0.84$	NR	NR	NR	Binary, adjectival, VAS
	Knee Injury and Osteoarthritis Outcome Score for Children (KOOS-Child)	Internal consistency (subscales)[39]: Cronbach $\alpha = 0.59–0.90$ Test-retest[39]: ICC = 0.78–0.91	Content[20]: confirmed through cognitive interviews Construct[20]: >75% relevant items	None	SEM[39]: 5.28–8.14 points; SDC (group)[39]: 1.73–2.66	NR	Adjectival
	Micheli Functional Scale	Internal consistency[32]: Cronbach $\alpha = 0.79$	Concurrent[32]: correlation with Oswestry Disability Index, $r_s = 0.82$	Floor effect at follow up[32]: 21.6% of respondents	NR	NR	Adjectival, VAS

Table 4. Continued From Previous Page

Region	Instrument	Reliability	Validity	Floor and Ceiling Effects	Responsiveness	Interpretability	Precision
	Oxford Ankle Foot Questionnaire for Children (OxAFQ-C)	Test-retest[35]: ICC = 0.78–0.95 Internal consistency (subscales)[35]: Cronbach $\alpha = 0.78–0.91$	Content and face[33]: children with foot or ankle problems and parents involved in the development and item generation Discriminant[34]: between neurologic or syndromes and benign or fluctuating conditions; between children in elective and trauma clinics Convergence and divergence[34]: correlations with Kidscreen domain scores	None	MDC[35]: 6%–8%	MID[35]: 7%–17% (elective patients)	Adjectival
	Pediatric International Knee Documentation Committee Subjective Knee Evaluation Form (Pedi-IKDC)	Test-retest[37]: ICC = 0.91 Internal consistency[37]: Cronbach $\alpha = 0.91$	Content[37]: preoperative scores used Criterion[37]: correlations with CHQ subscales, $r = 0.20–0.65$ Construct[37]: >75% relevant items	None[37]	ES[37] = 1.39; improvement after knee surgery[37] = 29.1 points	NR	Binary, adjectival, VAS
Generic	Child Health Questionnaire (CHQ)	NR	NR (parental version validated)	NR	NR	NR	NR
	Multidimensional Fatigue Scale	Internal consistency[58]: Cronbach $\alpha = 0.95$	Construct[58]: >75% relevant items Discriminant[58]: between healthy children and those with rheumatologic arthritis	NR	NR	NR	Adjectival
	Pediatric Quality of Life Inventory (PedsQL)	Internal consistency[46,47]: Cronbach $\alpha = 0.86–0.91$	Concurrent[46,47]: heterotrait-monomethod correlations = 0.45–0.48 Construct[46]: healthy children scored higher than children with chronic health conditions	None[46]	SEM[47]: 4.4 points	MCID[7]: 4.4 points	Adjectival
	Pediatric Outcomes Data Collection Instruments (PODCI)	Test-retest[50]: $r = 0.76–0.97$ Internal consistency[50]: Cronbach $\alpha = 0.76–0.92$	NR	NR	NR	NR	Adjectival
Single item	Global Rating of Change (GROC)	NR	Longitudinal[42]: improved over time ($P < .001$); fair to moderate correlation with multi-item scales	NR	NR	NR	NR
	Global Rating of Athletic Activity	NR	Longitudinal[42]: improved over time ($P < .001$); fair to moderate correlation with multi-item scales	NR	NR	NR	NR
	Global Rating of Daily Activity	NR	Longitudinal[42]: improved over time ($P < .001$); fair to moderate correlation with multi-item scales	NR	NR	NR	NR

Table 4. Continued From Previous Page

Region	Instrument	Reliability	Validity	Floor and Ceiling Effects	Responsiveness	Interpretability	Precision
	Single Assessment Numerical Evaluation (SANE)	NR	NR	NR	NR	NR	NR
Activity	Activities Scale for Kids (ASK)	Interrater[51]: ICC = 0.99 Test-retest[51]: ICC = 0.97	Construct[51]: correlation with CHAQ $r = 0.81–0.82$ Convergent[51]: correlation with HUI_3 $r_s = 0.43$ for similar constructs; $r_s = -0.03$ for dissimilar constructs Criterion[51]: correlation with clinician-reported ASK, $r = 0.92$; significant differences between mild, moderate, and severely disabled groups ($P < .0001$) for clinicians' global ratings	None[51]	Predicted to worsen[51]: ES = 0.63–0.84 Predicted to improve[51]: ES = 1.08–1.15	NR	Adjectival
	Hospital for Special Surgery Pediatric Functional Activity Brief Scale (HSS Pedi-FABS)	Internal consistency[18]: Cronbach $\alpha = 0.91$ Test-retest[18]: ICC = 0.91	Concurrent[18]: correlation with activity scales: $r = 0.23–0.60$ Discriminant[18]: no association with age, body mass index, or Daniel Scale	None[18]	NR	NR	Adjectival
	Marx Activity Scale	Test-retest[54]: ICC = 0.90–0.97 Cronbach $\alpha = 0.97$	NR	Ceiling effect[54]: 50.6%–56.9%	NR	NR	Adjectival
	Physical Activity Questionnaire for Older Children (PAQ-C)	Internal consistency[55]: Cronbach $\alpha = 0.75–0.78$	Concurrent[56]: correlation with activity rating and competence, $r = 0.41–0.63$	NR	NR	NR	Adjectival, binary
	Physical Activity Questionnaire for Adolescents (PAQ-A)	Internal consistency[55]: Cronbach $\alpha = 0.81–0.88$	Concurrent[57]: correlation with physical activity, $r = 0.33–0.73$	NR	NR	NR	Adjectival, binary

Abbreviations: CHAQ, childhood health assessment questionnaire; ES, effect size; HUI_3, Health Utilities Index Mark III; ICC, intraclass correlation coefficient; MCID, minimal clinically important difference; MDC, minimal detectable change; MID, minimal important difference; NR, not reported; SDC, smallest detectable change; SEM, standard error of measurement; VAS, visual analog scale.

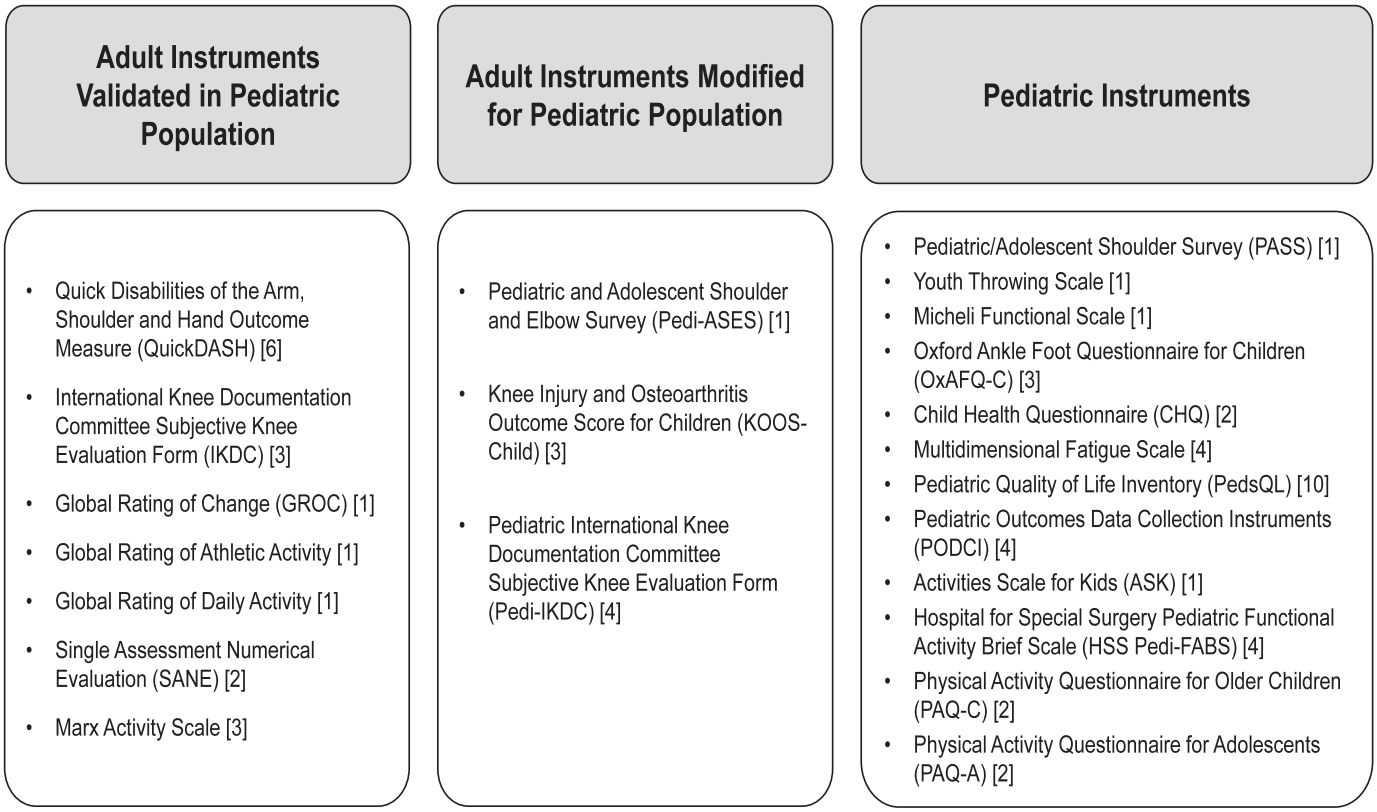

Figure 2. Patient-reported outcome measures organized by type. [Number of studies]

for full-text review. We eliminated another 83 articles once the exclusion criteria were applied to the full text, leaving 39 articles (11.8%; Table 5) from which data were extracted and synthesized in the results. Among these 39 articles, a total of 22 PROMs were identified. Considerations for clinical utility are reported in Tables 1–3 and psychometric properties of each instrument in Table 4.

Four PROMs were identified for use with upper extremity conditions[23–28] and 5 for lower extremity conditions.[19,20,29–39] In addition, 4 generic,[25,27,28,36,37,40–50] 4 single-item,[23,26,42] and 5 activity-based[18,31,51–57] instruments were identified. Twelve of the PROMs were developed specifically for the pediatric population,[18,23,25,27,28,31–37,40–53,55–58] 3 were modified versions of an adult scale,[20,23–29,31,36–39] and 7 were adult measures used in a pediatric population[18,23,26,29–31,36–38,42,54] (Figure 2).

DISCUSSION

Despite a call to incorporate PROMs into all aspects of health care,[59,60] little is known about which measures are best suited for a pediatric patient population with sport-related injuries. Instruments are typically developed for specific patient populations, which can be problematic if clinicians and researchers expand their use beyond the originally intended group. Selecting and implementing PROMs that are suitable for youth and adolescents is challenging, and not all measures reflect the unique demands of this population.[17,19,20] Although the authors of a recent systematic review[61] investigated the psychometric properties of PROMs used in the pediatric population, they did not report the specific psychometric findings, nor did they include several critical considerations related to the clinical utility of the measures (eg, readability, health domains, ICF disablement levels). To the best of our knowledge, we are the first to review the literature and assemble a repository of PROMs that are used by sports medicine health care professionals for pediatric patients, along with these associated variables. Our findings will help guide both clinicians and researchers in using PROMs in pediatric sports medicine.

The current standards for the development of a PROM, established by the Scientific Advisory Committee of the Medical Outcomes Trust,[62] consist of the following attributes: (a) the conceptual and measurement model, (b) reliability, (c) validity, (d) responsiveness, (e) interpretability, (f) the respondent and administrative burden, (g) alternative forms, and (h) cultural and language adaptation translations. Clinicians and researchers should consider these psychometric values when selecting an instrument, as adequate measurement properties of a PROM are essential to ensuring the integrity of an instrument and enabling the administrator to trust the quality of the information provided. In those instruments with reports of various types of validity (81.8%, 18/22 instruments) or reliability (72.7%, 16/22 instruments), the measurement qualities were sufficient (Table 4). For instance, the Activities Scale for Kids (ASK) demonstrated the highest value for test-retest reliability (intraclass correlation coefficient = 0.97),[51] whereas the Multidimensional Fatigue Scale produced the highest value for internal consistency (Cronbach α = 0.95).[58] Additionally, the presence of floor or ceiling effects helps to determine how an instrument will perform in populations with broad ranges of function, those that experience extreme limits on function, or both. Floor or

Table 5. Characteristics of Included Studies Continued on Next Page

Study (y)	Study Design; Level of Evidence[a]	Instrument(s)	Population	Age, y (Range or Mean ± SD)	Sample Size
Ahmad et al[25] (2016)	Cohort; 2	Youth Throwing Scale, PODCI, QuickDASH	Youth and adolescent baseball players	10–18	223
Bertisch et al[43] (2017)	Cohort; 2	Peds-QL	Children who sustained traumatic brain injury (mild to severe)	8–18	134
Boykin et al[36] (2013)	Cross-sectional; 3	Pedi-IKDC, Child Health Questionnaire	Pediatric patients with anterior cruciate ligament injury	13–17	135
Daltroy et al[50] (1998)	Cohort; 2	PODCI	Children and adolescents	2–18	470
Edmonds et al[23] (2017)	Cohort; 2	PASS, QuickDASH, SANE	Pediatric patients presenting to sports clinics with shoulder complaints	12–19	259
Eisner et al[26] (2013)	Retrospective cohort; 3	QuickDASH, SANE	Adolescents with rotator cuff tear	8–18	53
Ernat et al[27] (2017)	Cohort; 2	PODCI, QuickDASH	Pediatric patients with supracondylar humerus fracture who required operative management	2–13	132
Fabricant et al[18] (2013)	Cohort; 2	HSS Pedi-FABS, Marx Activity Scale	Children who presented to pediatric orthopaedic surgeon with minor complaint	10–18	51
Fabricant et al[52] (2014)	Cohort; 1	HSS Pedi-FABS	Adolescents enrolled in physical education	14–17	182
Fabricant et al[53] (2018)	Cross-sectional; 3	HSS Pedi-FABS	Children and adolescents without current injury that resulted in significant sport or activity limitations	10–18	2002
Heyworth et al[24] (2018)	Cohort; 2	Pedi-ASES, QuickDASH	Children and adolescents presenting to clinic with primary diagnosis of shoulder or elbow injury/ dysfunction	10–18	50
Houston et al[40] (2016)	Cohort; 2	PedsQL, Multidimensional Fatigue Scale	Adolescent athletes who sustained sport-related concussion	15.8 ± 1.1	122
Iversen et al[19] (2010)	Cross-sectional; 2	IKDC	Children presenting to sports medicine clinic with primary knee injury	10–18	30
Iversen et al[31] (2016)	Cohort; 2	KOOS-Child, Marx Activity Scale, HSS Pedi-FABS	Children presenting to sports medicine clinic with sport-related lower extremity injury	10–18	30
Janz et al[55] (2008)	Part 1: Cohort; 2 Part 2: Cross-sectional; 3	PAQ-C, PAQ-A	Children	11 and 13	210
Kocher et al[37] (2011)	Cohort; 2	Pedi-IKDC, Child Health Questionnaire	Pediatric patients with knee disorder	10–18	589
Kowalski et al[56] (1997)	Cohort; 2	PAQ-C	Elementary school students	8–13	97
Kowalski et al[57] (1997)	Cohort; 2	PAQ-A	High school students	13–20	85
Lam et al[44] (2013)	Cross-sectional; 3	PedsQL	Interscholastic athletes	14–18	2659
MacDonald et al[32] (2016)	Retrospective cohort; 3	Micheli Functional Scale	Adolescent patients presenting with back pain for >1 y	7–18	93
Morris et al[33] (2007)	Cross-sectional; 3	OxAFQ-C	Children with foot or ankle problems	5–15	16
Morris et al[34] (2008)	Cohort; 2	OxAFQ-C	Children with foot or ankle problems	5–16	158
Morris et al[35] (2009)	Cohort; 2	OxAFQ-C	Children with foot or ankle problems	5–16	80
Nasreddine et al[38] (2017)	Cross-sectional; 3	Pedi-IKDC	Children and adolescents	10–18	2000
Oak et al[29] (2015)	Cohort; 2	IKDC, Pedi-IKDC	Adolescents with knee injuries	13–17	100
Ortqvist et al[20] (2012)	Cohort; 2	KOOS-Child	Children and adolescents with symptomatic knee injuries	10–16	34
Ortqvist et al[39] (2014)	Cohort; 2	KOOS-Child	Children and adolescents with knee disorders	7–16	115
Quatman-Yates et al[28] (2013)	Cross-sectional; 3	QuickDASH, PedsQL	Pediatric patients referred for outpatient rehabilitation of upper extremity injury	8–18	149
Schmitt et al[30] (2010)	Cohort; 2	IKDC, PedsQL	Pediatric patients referred to physical therapy for evaluation and treatment of knee condition	6–18	673
Shirazi et al[54] (2016)	Cohort; 2	Marx Activity Scale	Pediatric patients being seen in outpatient sports medicine clinic for upper or lower extremity injury	8–17	162

Table 5. Continued From Previous Page

Study (y)	Study Design; Level of Evidence[a]	Instrument(s)	Population	Age, y (Range or Mean ± SD)	Sample Size
Snyder et al[49] (2010)	Cross-sectional; 3	PODCI	Adolescent athletes and nonathletes	Athletes: 16.0 ± 1.1 Nonathletes: 15.6 ± 1.3	325
Snyder Valier et al[41] (2013)	Cross-sectional; 3	PedsQL	Adolescent athletes who sustained musculoskeletal injury requiring orthopaedic consultation	14–18	13
Snyder Valier et al[45] (2017)	Cross-sectional; 3	PedsQL, Multidimensional Fatigue Scale	Interscholastic adolescent athletes	13–18	4903
Valier et al[42] (2016)	Cohort; 2	PedsQL, Multidimensional Fatigue Scale, Global Rating of Change, Global Rating of Athletic Activities, Global Rating of Daily Activities	Male interscholastic athletes	15.7 ± 1.1	94
Varni et al[48] (1999)	Cross-sectional; 3	PedsQL	Pediatric patients with cancer	8–18	291
Varni et al[46] (2001)	Cohort; 2	PedsQL	Children and adolescents	5–18	963
Varni et al[47] (2003)	Cross-sectional; 3	PedsQL	Children and adolescents	5–16	5991
Varni et al[58] (2004)	Cross-sectional; 3	Multidimensional Fatigue Scale	Healthy children and adolescents and pediatric rheumatology patients	6–18	163
Young et al[51] (2000)	Cohort; 2	Activities Scale for Kids	Children with musculoskeletal limitations	5–15	200

Abbreviations: HSS Pedi-FABS, Hospital for Special Surgery Pediatric Functional Activity Brief Scale; IKDC, International Knee Documentation Committee Subjective Knee Form; KOOS-Child, Knee and Osteoarthritis Outcome Score for Children; OxAFQ-C, Oxford Ankle Foot Questionnaire for Children; PAQ-A, Physical Activity Questionnaire for Adolescents; PAQ-C, Physical Activity Questionnaire for Older Children; PASS, Pediatric/Adolescent Shoulder Survey; Pedi-ASES, Pediatric and Adolescent Shoulder and Elbow Survey; Pedi-IKDC, Pediatric International Knee Documentation Committee Subjective Knee Form; PedsQL, Pediatric Quality of Life Inventory; PODCI, Pediatric Outcomes Data Collection Instrument; QuickDASH, Quick Disabilities of Arm, Shoulder & Hand; SANE, Single Assessment Numerical Evaluation.

[a] According to the Oxford Centre for Evidence-Based Medicine (https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebm-levels-of-evidence).

ceiling effects were not provided for 54.5% (12/22 instruments) of the PROMs (Table 4); however, a floor effect was observed for the Micheli Functional Scale[32] and a ceiling effect for the Marx Activity Scale.[18] Most instruments lacked estimates of responsiveness (72.7%, 16/22 instruments) or interpretability (90.9%, 20/22 instruments; Table 4), which potentially limits our confidence in their ability to accurately measure change. Incorporating instruments into patient care without considering the associated psychometric properties can result in adverse consequences, including an increased burden on the patient, missing or unreliable data, or biased results.[63]

Clinicians working with a pediatric population also need to choose PROMs that are age appropriate. The intended patient population for each of these instruments varies from children as young as 2 to 5 years old through adults. Readability formulae offer some indication of how easily a document is understood, and health literacy experts recommend that the maximum US reading grade level for a PROM used in a youth or adolescent population should be fifth to sixth grade.[64,65] Nonetheless, 40.9% (9/22) of the instruments assessed in this review exceed that threshold (Table 1). Interestingly, 3 of the PROMs that exceed the threshold were specifically developed for the pediatric population: the Micheli Functional Scale,[32] the Oxford Ankle Foot Questionnaire for Children (OxAFQ-C),[33–35] and the Hospital for Special Surgery Pediatric Functional Activity Brief Scale.[18,31,52,53] This is significant because if a patient is unable to understand the instrument, the other psychometric properties of the tool, such as validity and reliability, are assumed to be negatively affected.[66]

Five of the 22 identified PROMs (22.7%) have acceptable measurement properties and readability levels (Tables 1 and 4). These instruments are the Youth Throwing Scale, Knee Injury and Osteoarthritis Outcome Score for Children (KOOS-Child), Pediatric International Knee Documentation Committee Subjective Knee Evaluation Form (Pedi-IKDC), Pediatric Quality of Life Inventory (PedsQL), and ASK. Each of these measures has reported acceptable reliability, validity, and responsiveness and meets the fifth- to sixth-grade readability threshold. However, we also need to balance these psychometric properties with practical considerations.

One factor in determining an instrument's clinical utility is the feasibility of administering the measure. Of the PROMs identified, none require clinician training, all are easy to administer, and each has a relatively quick time to completion ($\leq$20 minutes; Table 2). Only the Child Health Questionnaire (CHQ)[36,37] requires a license, and both the CHQ[36,37] and Pediatric Outcomes Data Collection Instrument (PODCI)[27,49,50] were identified as long assessments (87 and 83 items, respectively). Several of the PROMs had identified recall periods (31.8%, 7/22 instruments), most of which lasted about a week. These findings provide a perspective on how often an instrument should be administered and should correspond with the purpose of the assessment. When choosing a PROM, clinicians and researchers should consider the length of the instrument as

well as the documented recall period in order to match their patient care goals.

Estimating HRQOL helps to integrate the patient's perspective into health care and is an important component in delivering effective, whole-person, patient-centered care. Health-related quality of life is a multifaceted concept comprising several health domains; however, PROMs may assess only 1 or a few aspects.[63] In our review, nearly all of the PROMs included questions that addressed the physical health domain (90.9%, 20/22 instruments); most, the physiological domain (63.6%, 14/22 instruments); and a few, the social domain (36.4%, 8/22 instruments; Table 3). Regarding the ICF disablement levels, each PROM addressed either the body, structure and function level or the activity and participation level. Only 1 measure had questions related to environmental and personal factors (OxAFQ-C). Health-related quality of life is an important concept, as any of its constructs may be affected by a sport-related injury or health condition. Therefore, to provide patient-centered care, it is essential for clinicians and researchers to know which components are evaluated by the instruments of interest so that the PROM selected fulfills its intended purpose.[63]

This systematic review was not without limitations. First, we chose not to include parent or proxy PROMs. Although these options may be appropriate to use in youth athletes, our intent was to focus specifically on identifying self-report instruments, as having patients assess their own HRQOL has been recommended.[67,68] Additionally, we did not include foreign-language translations of pediatric instruments; however, we did note if the included PROMs had additional versions available. Finally, we supplied the level of evidence for each included study (Table 1) but did not analyze the methodologic quality due to the varied study designs. Future researchers should address the gaps in the literature and continue to evaluate the psychometric properties and clinical utility of the PROMs identified in this systematic review. Furthermore, we observed that few PROMs address the spiritual, social, and economic health domains and the environmental and personal ICF disablement levels. Investigators should consider these areas when developing future PROMs for the pediatric sports medicine population.

CONCLUSIONS

In this systematic review, we provide insight into the PROMs used by athletic health care providers for pediatric patients with sport-related injuries. The measures identified are the most comprehensive in their development and generally have appropriate psychometric properties; however, most of the instruments require further evaluation. For example, reporting of interpretability and responsiveness is lacking, which may make it difficult to assess change over time. Most of the measures were short in length and feasible to administer; the recall period, readability, and areas of HRQOL the instruments measured varied. Furthermore, evidence indicates that adolescent athletes may be their own patient population[44] and may require PROMs developed specifically for them. Considering the acceptability, feasibility, appropriateness, and psychometric qualities, the OxAFQ-C and the PedsQL had the greatest number of items assessed and reported in the literature. Although a variety of instruments are presently used in pediatric sports medicine, clinicians and researchers should select a PROM that has appropriate psychometric evidence and meets both their goals and the goals of the patient.

REFERENCES

1. State of play 2020. Project Play. Aspen Institute. Published 2020. Accessed October 20, 2020. https://www.aspenprojectplay.org/state-of-play-2020/introduction
2. Annual estimates of the resident population: April 1, 2010 to July 1, 2019. United States Census Bureau. Published 2019. Accessed October 1, 2020. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk
3. Bienefeld M, Pickett W, Carr P. A descriptive study of childhood injuries in Kingston, Ontario, using data from computerized injury surveillance system. *Chronic Dis Can*. 1996;17(1):21–27.
4. King MA, Pickett W, King AJ. A secondary analysis of the 1993–94 health and behavior in school-aged children survey. *Can J Public Health*. 1998;89(6):397–401. doi:10.1007/BF03404082
5. Emery CA, Meeuwisse WH, McAllister JR. Survey of sport participation and sport injury in Calgary and area high schools. *Clin J Sport Med*. 2006;16(1):20–26. doi:10.1097/01.jsm.0000184638.72075.b7
6. Emery C, Tyreman H. Sport participation, sport injury, risk factors and sport safety practices in Calgary and area junior high schools. *Paediatr Child Health*. 2009;14(7):439–444. doi:10.1093/pch/14.7.439
7. Crane J, Temple V. A systematic review of dropout from organized sport among children and youth. *Eur Phys Educ Rev*. 2015;21(1):114–131. doi:10.1177/1356336X14555294
8. McGuine TA, Winterstein AP, Carr K, Hetzel S. Changes in health-related quality of life and knee function after knee injury in young female athletes. *Orthop J Sports Med*. 2014;2(4):2325967114530988. doi:10.1177/2325967114530988
9. Lam KC, St Thomas S, Snyder Valier AR, Valovich McLeod TC, Bay RC. Previous knee injury and health-related quality of life in collegiate athletes. *J Athl Train*. 2017;52(6):534–540. doi:10.4085/1062-6050-50.5.01
10. Marshall AN, Snyder Valier AR, Yanda A, Lam KC. The impact of a previous ankle injury on current health-related quality of life in college athletes. *J Sport Rehabil*. 2020;29(1):43–50. doi:10.1123/jsr.2018-0249
11. 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. doi:10.4085/1062-6050-331-17
12. ICF disablement model. National Athletic Trainers' Association. Published 2020. Accessed December 2, 2021. https://www.nata.org/icf-disablement-model
13. Valovich McLeod TC, Snyder AR, Parsons JT, Bay RC, Michener LA, Sauers 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. doi:10.4085/1062-6050-43.4.437
14. Evans TA, Lam KC. Clinical outcomes assessment in sport rehabilitation. *J Sport Rehabil*. 2011;20(1):8–16. doi:10.1123/jsr.20.1.8
15. 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. doi:10.4085/1062-6050-49.3.15
16. 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. doi:10.4085/1062-6050-108-17
17. Vitale MG, Levy DE, Johnson MG, et al. Assessment of quality of life in adolescent patients with orthopaedic problems: are adult measures appropriate? *J Pediatr Orthop*. 2001;21(5):622–628.
18. Fabricant PD, Robles A, Downey-Zayas T, et al. Development and validation of a pediatric sports activity rating scale: the Hospital for Special Surgery Pediatric Functional Activity Brief Scale (HSS Pedi-FABS). *Am J Sports Med.* 2013;41(10):2421–2429. doi:10.1177/0363546513496548
19. Iversen MD, Lee B, Connell P, Andersen J, Anderson AF, Kocher MS. Validity and comprehensibility of the International Knee Documentation Committee Subjective Knee Evaluation form in children. *Scand J Med Sci Sports*. 2010;20(1):e87–e95. doi:10.1111/j.1600-0838.2009.00917.x
20. Örtqvist M, Roos EM, Broström EW, Janarv PM, Iversen MD. Development of the Knee Injury and Osteoarthritis Outcome Score for Children (KOOS-Child): comprehensibility and content validity. *Acta Orthop*. 2012;83(6):666–673. doi:10.3109/17453674.2012.747921
21. Lam KC, Marshall AN, Snyder Valier AR. Patient-reported outcome measures in sports medicine: a concise resource for clinicians and researchers. *J Athl Train*. 2020;55(4):390–408. doi:10.4085/1062-6050-171-19
22. ICF browser. World Health Organization. Accessed September 8, 2020. http://apps.who.int/classifications/icfbrowser
23. Edmonds EW, Bastrom TP, Roocroft JH, Calandra-Young VA, Pennock AT. The Pediatric/Adolescent Shoulder Survey (PASS): a reliable youth questionnaire with discriminant validity and responsiveness to change. *Orthop J Sports Med*. 2017;5(3):2325967117698466. doi:10.1177/2325967117698466
24. Heyworth B, Cohen L, von Heideken J, Kocher MS, Iversen MD. Validity and comprehensibility of outcome measures in children with shoulder and elbow disorders: creation of a new Pediatric and Adolescent Shoulder and Elbow Survey (Pedi-ASES). *J Shoulder Elbow Surg*. 2018;27(7):1162–1171. doi:10.1016/j.jse.2017.11.009
25. Ahmad CS, Padaki AS, Noticewala MS, Makhni EC, Popkin CA. The Youth Throwing Score: validating injury assessment in young baseball players. *Am J Sports Med*. 2016;45(2):317–324. doi:10.1177/0363546516667503
26. Eisner EA, Roocroft JH, Moor MA, Edmonds EW. Partial rotator cuff tears in adolescents: factors affecting outcomes. *J Pediatr Orthop*. 2013;33(1):2–7. doi:10.1097/BPO.0b013e318279c2e0
27. Ernat J, Ho C, Wimberly R, Jo CH, Riccio AI. Fracture classification does not predict functional outcomes in supracondylar humerus fractures: a prospective study. *J Pediatr Orthop*. 2017;37(4):e233–e237. doi:10.1097/BPO.0000000000000889
28. Quatman-Yates CC, Gupta R, Paterno MV, Schmitt LC, Quatman CE, Ittenbach RF. Internal consistency and validity of the QuickDASH instrument for upper extremity injuries in older children. *J Pediatr Orthop*. 2013;33(8):838–842. doi:10.1097/BPO.0b013e3182a00688
29. Oak SR, O'Rourke C, Strnad G, et al. Statistical comparison of the pediatric versus adult IKDC subjective knee evaluation form in adolescents. *Am J Sports Med*. 2015;43(9):2216–2221. doi:10.1177/0363546515589108
30. Schmitt LC, Paterno MV, Huang S. Validity and internal consistency of the International Knee Documentation Committee Subjective Knee Evaluation form in children and adolescents. *Am J Sports Med*. 2010;38(10):2443–2447. doi:10.1177/0363546510374873
31. Iversen MD, von Heideken J, Farmer E, Rihm J, Heyworth BE, Kocher MS. Validity and comprehensibility of physical activity scales for children with sports injuries. *J Pediatr Orthop*. 2016;36(3):278–283. doi:10.1097/BPO.0000000000000448
32. MacDonald JP, d'Hemecourt PA, Micheli LJ. The reliability and validity of a pediatric back outcome measure. *Clin J Sports Med*. 2016;26(6):490–496. doi:10.1097/JSM.0000000000000282
33. Morris C, Liabo K, Wright P, Fitzpatrick R. Development of the Oxford Ankle Foot Questionnaire: finding out how children are affected by foot and ankle problems. *Child Care Health Dev*. 2007;33(5):559–568. doi:10.1111/j.1365-2214.2007.00770.x
34. Morris C, Doll HA, Wainwright A, Theologis T, Fitzpatrick R. The Oxford Ankle Foot Questionnaire for Children: scaling, reliability and validity. *J Bone Joint Surg Br*. 2008;90(11):1451–1456. doi:10.1302/0301-620X.90B11.21000
35. Morris C, Doll H, Davies N, et al. The Oxford Ankle Foot Questionnaire for Children: responsiveness and longitudinal validity. *Qual Life Res*. 2009;18(10):1367–1376. doi:10.1007/s11136-009-9550-7
36. Boykin RE, McFeely ED, Shearer D, et al. Correlation between the Child Health Questionnaire and the International Knee Documentation Committee score in pediatric and adolescent patients with an anterior cruciate ligament tear. *J Pediatr Orthop*. 2013;33(2):216–220. doi:10.1097/BPO.0b013e3182745439
37. Kocher MS, Smith JT, Iversen MD, et al. Reliability, validity, and responsiveness of a modified International Knee Documentation Committee Subjective Knee Form (Pedi-IKDC) in children with knee disorders. *Am J Sports Med*. 2011;39(5):933–939. doi:10.1177/0363546510383002
38. Nasreddine AY, Connell PL, Kalish LA, et al. The Pediatric International Knee Documentation Committee (Pedi-IKDC) Subjective Knee Evaluation Form: normative data. *Am J Sports Med*. 2017;45(3):527–534. doi:10.1177/0363546516672456
39. Ortqvist M, Iversen MD, Janarv PM, Broström EW, Roos EM. Psychometric properties of the Knee injury and Osteoarthritis Outcomes Score for Children (KOOS-Child) in children with knee disorders. *Br J Sports Med*. 2014;48(19):1437–1446. doi:10.1136/bjsports-2013-093164
40. Houston MN, Bay RC, Valovich McLeod TC. The relationship between post-injury measures of cognition, balance, symptom reports and health-related quality-of-life in adolescent athletes with concussion. *Brain Inj*. 2016;30(7):891–898. doi:10.3109/02699052.2016.1146960
41. Snyder Valier AR, Swank EM, Lam KC, Hansen ML, Valovich McLeod TC. Comparison of patient and proxy reporting of health-related quality of life in adolescent athletes who suffer a sports-related injury and require orthopaedic consultation. *J Sport Rehabil*. 2013;22(4):248–253. doi:10.1123/jsr.22.4.248
42. Valier AR, Welch Bacon CE, Bay RC, Houston MN, Valovich McLeod TC. Validity of single-item patient-rated outcomes in adolescent football athletes with concussion. *Arch Phys Med Rehabil*. 2016;97(7):1202–1205. doi:10.1016/j.apmr.2015.11.015
43. Bertisch H, Rivara FP, Kisala PA, et al. Psychometric evaluation of the pediatric and parent-proxy Patient-Reported Outcomes Measurement Information System and the Neurology and Traumatic Brain Injury Quality of Life measurement item banks in pediatric traumatic brain injury. *Qual Life Res*. 2017;26(7):1887–1899. doi:10.1007/s11136-017-1524-6
44. Lam KC, Snyder Valier AR, Bay RC, Valovich McLeod TC. A unique patient population? Health-related quality of life in adolescent athletes versus general, healthy adolescent individuals. *J Athl Train*. 2013;48(2):233–241. doi:10.4085/1062-6050-48.2.12
45. Snyder Valier AR, Welch Bacon CE, Bay RC, Molzen E, Lam KC, Valovich McLeod TC. Reference values for the Pediatric Quality of Life Inventory and the Multidimensional Fatigue Scale in adolescent athletes by sport and sex. *Am J Sports Med*. 2017;45(12):2723–2729. doi:10.1177/0363546517714471
46. 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. doi:10.1097/00005650-200108000-00006
47. 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. doi:10.1367/1539-4409(2003)003<0329:tpaapp>2.0.co;2
48. Varni JW, Seid M, Rode CA. The PedsQL: measurement model for the Pediatric Quality of Life Inventory. *Med Care*. 1999;37(2):126–139. doi:10.1097/00005650-199902000-00003
49. Snyder 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. doi:10.1123/jsr.19.3.237
50. Daltroy LH, Liang MH, Fossel AH, Goldberg MJ. The POSNA Pediatric Musculoskeletal Functional Health Questionnaire: report on reliability, validity, and sensitivity to change. Pediatric Outcomes Instrument Development Group. Pediatric Orthopaedic Society of North America. *J Pediatr Orthop*. 1998;18(5):561–571. doi:10.1097/00004694-199809000-00001
51. Young NL, Williams JI, Yoshida KK, Wright JG. Measurement properties of the Activities Scale for Kids. *J Clin Epidemiol*. 2000;53(2):125–137. doi:10.1016/s0895-4356(99)00113-4
52. Fabricant PD, Robles A, McLaren SH, Marx RG, Widmann RF, Green DW. Hospital for Special Surgery Pediatric Functional Activity Brief Scale predicts physical fitness testing performance. *Clin Orthop Relat Res*. 2014;472(5):1610–1616. doi:10.1007/s11999-013-3429-1
53. Fabricant PD, Suryavanshi JR, Calcei JG, Marx RG, Widmann RF, Green DW. The Hospital for Special Surgery Pediatric Functional Activity Brief Scale (HSS Pedi-FABS): normative data. *Am J Sports Med*. 2018;46(5):1228–1234. doi:10.1177/0363546518756349
54. Shirazi CP, Israel HA, Kaar SG. Is the Marx Activity Scale reliable in patients younger than 18 years? *Sports Health*. 2016;8(2):145–148. doi:10.1177/1941738115600388
55. Janz KF, Lutuchy EM, Wenthe P, Levy SM. Measuring activity in children and adolescents using self-report: PAQ-C and PAQ-A. *Med Sci Sports Exerc*. 2008;40(4):767–772. doi:10.1249/MSS.0b013e3181620ed1
56. Kowalski KC, Crocker PRE, Faulkner RA. Validation of the Physical Activity Questionnaire for Older Children. *Pediatr Exerc Sci*. 1997;9(2):174–186. doi:10.1123/pes.9.2.174
57. Kowalski KC, Crocker PRE, Kowalski NP. Convergent validity of the Physical Activity Questionnaire for Adolescents. *Pediatr Exerc Sci*. 1997;9(4):342–352. doi:10.1123/pes.9.4.342
58. Varni JW, Burwinkle TM, Szer IS. The PedsQL Multidimensional Fatigue Scale in pediatric rheumatology: reliability and validity. *J Reumatol*. 2004;31(12):2494–2500.
59. Davis JC, Bryan S. Patient Reported Outcome Measures (PROMs) have arrived in sports and exercise medicine: why do they matter? *Br J Sports Med*. 2015;49(24):1545–1546. doi:10.1136/bjsports-2014-093707
60. Ruzbarsky JJ, Marom N, Marx RG. Measuring quality and outcomes in sports medicine. *Clin Sports Med*. 2018;37(3):463–482. doi:10.1016/j.csm.2018.03.001
61. Suryavanshi JR, Goto R, Jivanelli B, et al. Age-appropriate pediatric sports patient-reported outcome measures and their psychometric properties: a systematic review. *Am J Sports Med*. 2019;47(13):3270–3276. doi:10.1177/0363546518818822
62. Lohr KN. Assessing health status and quality-of-life instruments: attributes and review criteria. *Qual Life Res*. 2002;11:193–205. doi:10.1023/a:1015291021312
63. Parsons JT, Snyder AR. Health-related quality of life as a primary clinical outcome in sport rehabilitation. *J Sport Rehabil*. 2011;20(1):17–36. doi:10.1123/jsr.20.1.17
64. Communicating with patients who have limited literacy skills. Report of the National Work Group on Literacy and Health. *J Fam Pract*. 1998;46(2):168–176.
65. Weiss BD, Coyne C. Communicating with patients who cannot read. *N Engl J Med*. 1997;337(4):272–274. doi:10.1056/NEJM199707243370411
66. Pace CC, Atcherson SR, Zraick RI. A computer-based readability analysis of patient-reported outcome questionnaires related to oral health quality of life. *Patient Educ Couns*. 2012;89(1):76–81. doi:10.1016/j.pec.2012.05.010
67. Kirkley A, Griffin S. Development of disease-specific quality of life measurement tools. *Arthroscopy*. 2003;19(10):1121–1128. doi:10.1016/j.arthro.2003.10.028
68. Osoba D. Lessons learned from measuring health-related quality of life in oncology. *J Clin Oncol*. 1994;12(3):608–616. doi:10.1200/JCO.1994.12.3.608

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