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Original Article

High Rate of Overlapping Question Content Among Commonly Used Patient-Reported Outcome Measurements for Anterior Cruciate Ligament Injury

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Purpose: To precisely compare the questions and content between the most commonly cited knee-specific patient-reported outcome measurements (PROs) for anterior cruciate ligament (ACL) injury. **Methods:** A literature review through Medline from November 1, 2018, to November 1, 2020, was performed to find the most cited knee-specific PROs for assessment of ACL injuries. Each question was then classified as 1) identical, similar, or unique; 2) pertaining to 1 of 6 domains (pain, symptoms, functional activities, occupational activities, sports/recreation, and quality of life). The PROs were then compared to each other to assess question overlap and domain coverage. **Results:** A total of 133 questions were analyzed from the seven most common PROs: International Knee Documentation Committee (IKDC) form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm Knee Scoring Scale, Tegner Activity Scale, Marx Scale, Knee Outcome Survey (KOS), and Cincinnati Knee Rating System (CKRS). The total distribution of identical (31.6%), similar (31.6%), and unique (36.8%) questions was found to be relatively even. However, this distribution varied within each PRO. KOS and Lysholm had the highest percentages of identical questions (64% and 62.5%, respectively). KOOS had the highest number of unique questions (26/42, 61.9%), while Tegner held the highest percentage (11/16, 68.8%). Sports/recreation was the only domain assessed by all PROs. **Conclusion:** Nearly two-thirds of questions overlap between the commonly used PROs for ACL injury. Although sports/recreation is assessed by all PROs, each has its own pattern of coverage across this and other domains. **Level of Evidence:** IV, cross-sectional study.

Introduction

Outcome measures are valuable instruments in assessment of injury, surgery, and rehabilitation. A standardized manner of evaluation allows comparisons between patients, treatments, and studies. These comparisons provide further knowledge and enable clinicians to deliver the highest level of evidence-based medicine. However, studies that examine the same disease process often use different patient-reported outcomes (PROs), making comparisons between studies challenging.

In a 2020 consensus meeting that sought to establish a standardized evaluation of ACL treatment, patient-reported outcome (PROs) measures were identified as one of four robust outcome categories; the other three being early adverse events, ACL graft failure/recurrent ligament disruption, and clinical measures of knee function and structure.[1] A 2015 consensus also recognized PROs as part of the criteria for successful outcome following ACL injury or reconstruction.[2] PROs allow patients to give a direct report of their health condition.[3] Previous studies in orthopaedic populations have shown that clinicians, as compared to patients, rate symptoms as less severe and function as better. This discrepancy supports the notion that patient-relevant data should be collected from patients themselves.[4]

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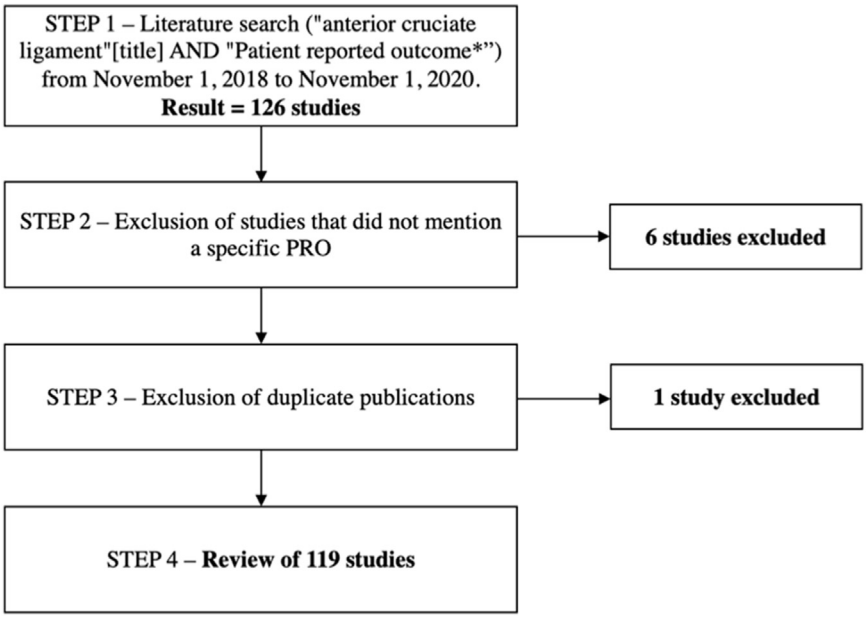

Fig 1. Selection of studies.

Clinicians can use these questionnaires to understand what matters most to patients, such as symptoms with daily activities.[5]

Although earlier studies have assessed the validity and applicability of PROs in evaluating patients with ACL injuries,[1,6–8] no study has examined exactly how similar these PROs are to each other. Understanding the question content of PROs may allow clinicians and researchers to select the appropriate measurement for a given study or population.

The purpose of this study is to precisely compare the questions and domain coverage between the most commonly cited knee-specific PROs for ACL injury. Our hypothesis is that there is significant overlap (identical or similar questions) between different PROs; however, each PRO may offer a different perspective based on its question composition and focus.

Methods

A literature review was performed through Medline using "anterior cruciate ligament" [title] AND "patient reported outcome*" from November 1, 2018, to November 1, 2020. This literature search was limited to the preceding 2 years in an effort to capture the most current usage. Duplicate studies and those that did not mention a specific PRO were excluded. From the remaining studies, the most frequently used knee-specific PROs were determined.

Questions from each PRO were then analyzed. Each question was first classified as "identical," "similar," or "unique." A question that was repeated in another PRO was labeled "identical." A question that imprecisely asked about the same activity or symptom was labeled "similar." A question that did not appear in another PRO was labeled "unique." The classification for each question was agreed upon by all authors. PROs were then compared to each other to determine the amount of overlap (identical and similar questions) and uniqueness.

Next, in reviewing the content of all questions, it was determined that each question could be characterized as pertaining to one of six domains: pain, symptoms, functional activities, sports/recreation, quality of life, and occupational. Again, the domain classification for each question was agreed upon by all authors. Each PRO was then assessed for the degree of coverage across the various domains.

Results

PRO Questionnaires

As depicted in Fig 1, literature review of ACL studies involving PROs within the preceding 2 years yielded 126 studies. Six studies did not identify a specific PRO. One study was copublished in more than one journal. Of the remaining 119 studies, the most commonly used knee-specific PROs were the International Knee Documentation Committee (IKDC) form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm Knee Scoring Scale, Tegner Activity Scale, Marx Scale, Knee Outcome Survey (KOS), and Cincinnati Knee Rating System (CKRS) (Appendix 1).

The most frequently used PRO, found in 83 studies (69.7%), was the IKDC form. The IKDC was formed in 1987 by a group of clinicians who felt there was a need for a standardized method to quantify the disability caused by knee ligament injuries and the results of treatment. The IKDC Knee Ligament Standard

Table 1. The most common knee-specific PROs cited in studies pertaining to ACL injury between November 1, 2018, and November 1, 2020

	Percent of Studies	Publication Date	Domains	Number of Questions
IKDC	69.7%	2001	Pain, symptoms, functional activities, sports/recreation	19
KOOS	60.5%	1998	Pain, symptoms, functional activities, sports/recreation, quality of life	42
Lysholm	43.7%	1982	Pain, symptoms, functional activities	8
Tegner	37.0%	1985	Functional activities, sports/recreation, occupational	11
Marx	10.9%	2001	Sports/recreation	4
KOS	7.6%	1998	Pain, symptoms, functional activities, sports/recreation	25
CKRS	6.7%	1983	Pain, symptoms, functional activities, sports/recreation, occupational	19

ACL, anterior cruciate ligament; CKRS, Cincinnati Knee Rating System; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; KOS, Knee Outcome Survey; PROs, patient-reported outcomes.

Evaluation Form was subsequently published in 1993.[9] In 1997, the American Orthopaedic Society for Sports Medicine (AOSSM) moved to revise the form to broaden its application, including ligament and meniscal injuries, articular cartilage lesions, arthritis, and patellofemoral conditions. The resultant IKDC Subjective Knee Form was published in 2001 and has 19 questions divided in three sections: 1) symptoms, including pain, stiffness, swelling, locking/catching, and giving way; 2) sports and daily activities; and 3) current knee function and knee function prior to knee injury.[10]

The next most common PRO was the KOOS, cited in 72 studies (60.5%). The KOOS was published in 1998 as an instrument to assess young and middle-aged patients with ACL injury, meniscus injury, or posttraumatic osteoarthritis.[11] The creators of KOOS emphasized "patient-relevant outcomes," covering five dimensions: pain, symptoms, activities of daily living, sport and recreation function, and knee-related quality of life. Among the 42 questions is the Western Ontario and MacMaster Universities (WOMAC) Osteoarthritis Index, widely used in the evaluation of patients with hip and knee osteoarthritis.[11,12]

The Lysholm and Tegner forms appeared in 52 (43.7%) and 44 (37%) studies, respectively. The Lysholm Knee Scoring Scale was originally published in 1982 to evaluate outcomes of knee ligament surgery, particularly symptoms of instability.[13] The scale was revised in 1985, at the same time that the Tegner Activity Score was introduced. The Tegner score was intended for use in conjunction with the Lysholm. The Lysholm scale asks about 8 items: limp, support, locking, instability, pain, swelling, stair-climbing, and squatting. To complement this, the Tegner scale consists of a graduated list of sports/recreation, functional, and occupational activities. The patient selects the option that best describes their activity level at a given time point (i.e., current level, before injury or following surgery).

On the 11-item Tegner Activity Scale, there was occasionally more than one domain asked in a single query. For example, one item combined "sedentary work" (occupational) and "walking on even ground" (functional activities). The decision was made to treat these combined items separately, yielding instead a total of 16 questions for analysis.

The more recently created (2001) Marx scale was used in 13 studies (10.9%). The goal of the Marx scale is to provide information on a patient's baseline level of activity.[14] Its authors explained that a patient's activity level must be taken into account when evaluating their outcome. Namely, active patients will have different expectations and demands than patients who are relatively sedentary. The questionnaire was purposely designed with the goal that it could be completed in 1 minute, so as to allow use with other instruments. With this focus, the Marx scale asks about four activities: running, cutting, deceleration, and pivoting. By choosing not to base questions on specific sports, authors are able to compare patients across different activities. The Marx scale distinguishes itself from the Tegner Activity Score by evaluating both the type of activity and the amount of participation time.

Nine studies (7.6%) employed the KOS. Its 1998 publication explains that the questionnaire was developed from existing instruments, including the CKRS, Lysholm, WOMAC, and IKDC.[15] The KOS consists of 25 questions within two scales: the Activities of Daily Living Scale (KOS-ADLS) and the Sports Activity Scale (KOS-SAS). The questions address symptoms and functional limitations experienced during activities of daily living and sports activities.

Finally, the CKRS was used in 8 studies (6.7%) and consisted of 19 questions. Its first version, published in 1983, focused on knee function in athletic participation.[16,17] It has been subsequently revised with

Table 2. Identical Questions

Domain	Question	IKDC	KOOS	Lysholm	Tegner	Marx	KOS	Cincinnati
Pain	Pain			+			+	+
Symptom	Swelling		+	+			+	+
	Limping			+			+	
	(Slipping or) Partial giving way						+	+
	(Buckling or) Full giving way						+	+
Functional activities	Go upstairs (ascending)	+	+				+	
	Go down stairs (descending)	+	+				+	
	Stairs			+				+
	Kneel on the front of your knee	+					+	
	Squatting	+		+			+	
	Sit with your knee bent	+					+	
	Rise from a chair	+					+	
	Standing		+				+	
	Walking						+	+
Sports/recreation	Running straight	+					+	+
	Jump and land on involved/affected leg	+					+	+
	Stop and start quickly	+					+	

IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; KOS, Knee Outcome Survey.

additional scales and modifications for occupational activities, athletic activities, symptoms, and functional limitations with sports and daily activities.[18,19]

PRO Question Analysis of Overlap

Seven PROs, with a total of 133 questions, were evaluated (Table 1). The KOOS had the highest number of questions (42), with the KOS second (25). The Marx contained the fewest number of questions (4). The aggregate distribution of identical, similar, and unique questions was found to be 31.6% (42 questions), 31.6% (42 questions), and 36.8% (49 questions), respectively. Table 2 lists identical questions, and Table 3 lists unique questions. Despite this relatively even distribution across all gathered questions, the distribution for each individual PRO differed from one another (Fig 2). The KOOS had the highest number of unique questions (26/42, 61.9%), while Tegner held the highest percentage (11/16, 68.8%). The KOS, which was developed from four of the other PROs (the CKRS, Lysholm, WOMAC, and IKDC)[15], was found to have the highest percentage of identical questions (16/25, 64%). Aside from Marx, the KOS also had the lowest percentage of unique questions (2/25, 8%). All four questions in the Marx scale were similar to those in other PRO scales.

Table 4 lists the most commonly asked questions. Questions about stiffness/swelling, stairs, running, and jumping were included in 5 of the 7 PROs. There was no single question that was included in every PRO. The percentages of both identical and similar questions between different pairs of PROs are shown in Fig 3. All 4 (100%) Marx questions overlapped with the KOS and 3 (75%) questions overlapped with the CKRS. The Lysholm overlapped 75% (6/8) with both the IKDC and KOS. The Lysholm and Tegner, made to complement one another, did not overlap at all. Neither overlapped with the Marx scale as well.

PRO Question Analysis of Domain Coverage

Fig 4 illustrates each PRO's coverage across different domains. No single PRO assessed all 6 domains of patient outcomes. Instead, each PRO had a distinct question composition that varied across the different domains. The CKRS and KOOS evaluated all domains except Quality of Life and Occupational, respectively. The KOS and IKDC evaluated 4/6 domains, while the Lysholm and Tegner evaluated 3/6. Sports/Recreation was the only domain assessed by all PROs. With the exception of Marx, which only assessed Sports/Recreation, Functional Activities was evaluated in all PROs. The KOOS was the only PRO that evaluated Quality of Life.

Discussion

There is notable overlap among commonly used patient-administered questionnaires in evaluation of ACL injuries. Within the seven PROs examined in this study, 62.4% (84 of 133 questions) of questions were found to be identical or similar. This amount of overlap can be reassuring when attempting to compare studies that employ different PROs. Each PRO, however, is distinguished by its pattern of domain coverage. Understanding the strengths and limitations of available PROs will help guide clinicians in selecting the appropriate surveys for their desired goals.

Table 3. Unique Questions

	Domain	Question
IKDC	Pain	What is the highest level of activity that you can perform without significant knee pain?
	Symptoms	What is the highest level of activity you can perform without significant swelling in your knee?
	Functional Activities	Function prior to your knee injury
KOOS	Pain	Twisting/pivoting on your knee
		Straightening knee fully
		Bending knee fully
		Walking on flat surface
		Going up or down stairs
		At night while in bed
		Sitting or lying
		Standing upright
	Symptoms	Can you straighten your knee fully?
		Can you bend your knee fully?
	Functional activities	Bending to floor/pick up an object
		Getting in/out of car
		Going shopping
		Putting on socks/stockings
		Rising from bed
		Talking off socks/stockings
		Lying in bed (turning over, maintaining knee position)
		Getting in/out of bath
		Getting on/off toilet
		Light domestic duties (cooking, dusting, etc.)
	Sports/recreation	Squatting
		Kneeling
	Quality of life	How often are you aware of your knee problem?
		Have you modified your life style to avoid potentially damaging activities to your knee?
		How much are you troubled with lack of confidence in your knee?
		In general, how much difficulty do you have with your knee?
Lysholm	Symptoms	Support ("Using cane or crutches")
Tegner	Sports/recreation	Soccer: national and international elite
		Soccer, lower divisions; ice hockey; wrestling; gymnastics
		Tennis and badminton; handball; basketball; downhill skiing; jogging, at least 5 times per week
		Competitive sports (cycling, cross-country skiing) or recreational sports (jogging on uneven ground at least twice per week)
		Recreational sports (cycling, cross-country skiing, jogging on even ground at least twice weekly)
		Competitive and recreational sports (swimming) or walking in forest possible
	Occupational	Work (heavy labor [e.g., building, forestry])
		Work (light labor [e.g., nursing])
		Work (light labor)
		Work (sedentary work)
		Sick leave or disability pension because of knee problems
KOS	Symptoms	Weakness
Cincinnati	Occupational	Sitting
		Standing / walking
		Squatting
		Climbing
		Lifting / carrying
		Pounds carried

IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; KOS, Knee Outcome Survey.

The IKDC and KOOS are the most commonly used today, cited in 69.7% and 60.5%, respectively, of ACL studies over the past 2 years. Most of the questions asked in the IKDC were found to be identical (47.4%) or similar (36.8%) to another PRO. The KOOS displayed an opposite distribution: 61.9% of its questions were unique, while only 9.5% were identical. Incorporated questions from the WOMAC, commonly used

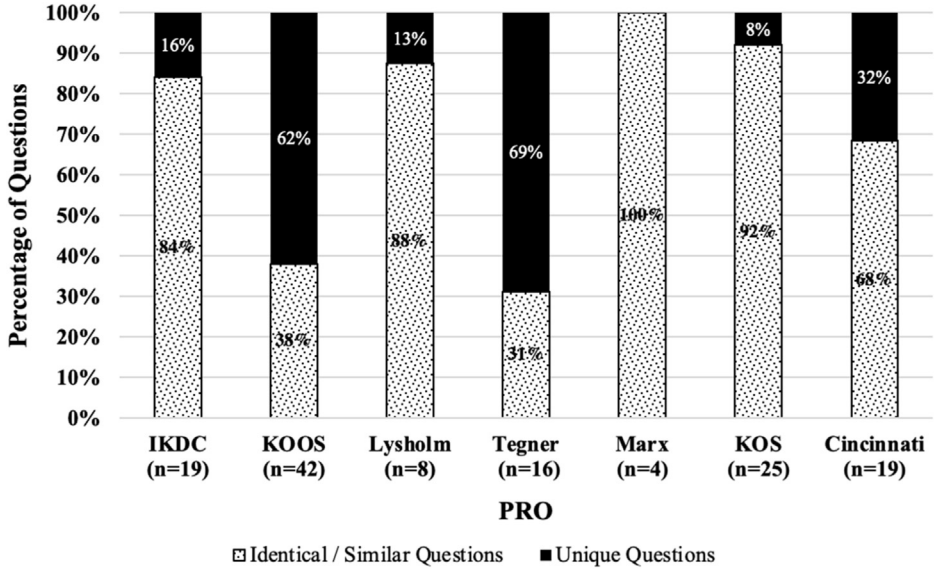

Fig 2. Distributions of overlapping (identical and similar) and unique questions for each patient-reported outcome (PRO) measurement: International Knee Documentation Committee (IKDC) form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm Knee Scoring Scale, Tegner Activity Scale, Marx Scale, Knee Outcome Survey (KOS), and Cincinnati Knee Rating System (CKRS).

for hip and knee osteoarthritis patients, were a large contributor to this uniqueness. Importantly, despite the KOOS covering 5/6 domains and the greatest number of questions among this selection of PROs, it does not include specific items related to instability. This notable absence suggests that KOOS may be more appropriately applied for general knee health.

A 2015 study looked at the various objective and subjective outcomes presented in studies related to ACL reconstruction in four high-impact-factor orthopaedic journals from 2010 through 2014.[20] Authors similarly found that the IKDC was the most prevalent PRO used, found in 71.4% of those studies. The Lysholm and Tegner followed with 63% and 42%, respectively. Interestingly, the KOOS was found to be the fourth most common PRO. Notably, when compared to the preceding 5-year period (2005 through 2009), the KOOS showed the largest increase in usage from 8% to 20%.[20] It is possible that with greater appreciation of patient well-being, the use of KOOS has continued to increase with time. As patient satisfaction draws more attention with increasing clinical and economic implications,[21] the Quality of Life section of KOOS may be seen as a meaningful advantage.

In the same 2015 review on ACL studies in high-impact factor orthopaedic journals, it was found that most studies reported either two (41%) or three (33%) PROs.[20] The 2020 consensus statement agrees with this practice of applying more than one outcome measurement in evaluation of ACL treatment.[1] Specifically, the consensus recommends the use of at least one knee-specific tool, one health-related quality-of-life tool, and one activity rating scale.[1] The IKDC Subjective Knee Form is the endorsed knee-specific tool, agreed upon by nearly all (24/25) consensus members. However, the authors add that despite the IKDC being "currently the optimal scale, … we should be careful not to neglect the other scores."[1] For sports and activity assessment, the consensus recommends the Marx scale. The consensus statement did not recommend a

Table 4. Most Commonly Asked Questions

Domain	Question Stem	Percent of PROs	IKDC	KOOS	Lysholm	Tegner	Marx	KOS	Cincinnati
Symptom	Stiffness/Swelling	71.4% (5/7)	+	+	+			+	+
Functional activity	Stairs		+	+	+			+	+
Sports/recreation	Running		+	+			+	+	+
	Jumping		+	+		+		+	+
Pain	Pain Severity	57.1% (4/7)	+		+			+	+
Symptom	Giving way		+		+			+	+
Functional activity	Squatting		+		+			+	+
	Walking			+		+		+	+
Sports/recreation	Pivoting			+			+	+	+
Symptom	Lock/catch	42.9% (3/7)	+	+	+				
Functional activity	Kneeling		+					+	+
	Sitting		+	+				+	
	Rising		+	+				+	
Sports/recreation	Stopping/starting		+				+	+	
	Cutting						+	+	+

	IKDC	KOOS	Lysholm	Tegner	Marx	KOS	Cincinnati
IKDC (n=19)	x	47.4%	36.8%	5.3%	10.5%	63.2%	57.9%
KOOS (n=42)	26.2%	x	14.3%	7.1%	4.8%	31.0%	21.4%
Lyshom (n=8)	75.0%	37.5%	x	0.0%	0.0%	75.0%	62.5%
Tegner (n=16)	12.5%	25.0%	0.0%	x	0.0%	18.8%	25.0%
Marx (n=4)	50.0%	50.0%	0.0%	0.0%	x	100.0%	75.0%
KOS (n=25)	72.0%	56.0%	52.0%	8.0%	12.0%	x	68.0%
Cincinnati (n=19)	52.6%	31.6%	31.6%	15.8%	10.5%	52.6%	x

Fig 3. Percentage of overlapping questions between pairs of patient-reported outcome (PROs) measurements for the International Knee Documentation Committee (IKDC) form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm Knee Scoring Scale, Tegner Activity Scale, Marx Scale, Knee Outcome Survey (KOS), and Cincinnati Knee Rating System (CKRS). The row for each PRO lists the percentage of its total questions that are identical or similar to those of another PRO (column). The denominator for the percentage of overlap is based on the total number of questions for the PRO in that row (indicated by *n*). Red color indicates a higher percentage of overlap. Green color indicates a lower percentage of overlap.

particular health-related quality of life measure. However, among their list of possible options, the KOOS is the only PRO analyzed in this study that fulfills the role. The impact of ACL injury on the patient's overall well-being should not be overlooked.[22] The KOOS validation study showed that the quality of life subscale had the highest effect size at 6 months postoperatively for patients who underwent ACL reconstruction.[11] It is notable that this domain only makes up 9.5% (4 questions) of the questionnaire.

There are other measures that could instead serve as a health-related quality of life measure, including Quality of Life Outcome Measure for Chronic Anterior Cruciate Ligament Deficiency (ACL-QOL), European Quality of Life-5 dimensions (EQ-5D), Short-Form-36 and -8 health surveys (SF-36, SF-8), Sickness Impact Profile (SIP), and Quality of Well-being (QWB).[1] Notably, in a systematic review of patients following ACL reconstruction, poorer health-related qualify of life measures were reported using the KOOS Quality of Life subscale than those assessed using a generic health-related qualify of life measure such as SF-36.[23] The authors added the caveat that only a limited number of studies investigated these factors and would be a valuable direction for future research. Although there are PROs like the KOOS that broadly cover multiple domains, this comprehensive coverage comes with the risk of survey fatigue for patients. A concise and targeted PRO that covers all domains could be validated for patients with ACL and ligamentous injuries to the knee, but that would need to be further studied. It is our recommendation that IKDC and Marx, with the addition of SF-12 if a quality of life measure is desired, be used for the most comprehensive and efficient combination.

Limitations

There are several limitations to this study. First, only the seven most cited knee-specific PROs for ACL injury were selected for analysis, possibly excluding others that may provide valuable insight. For example, general

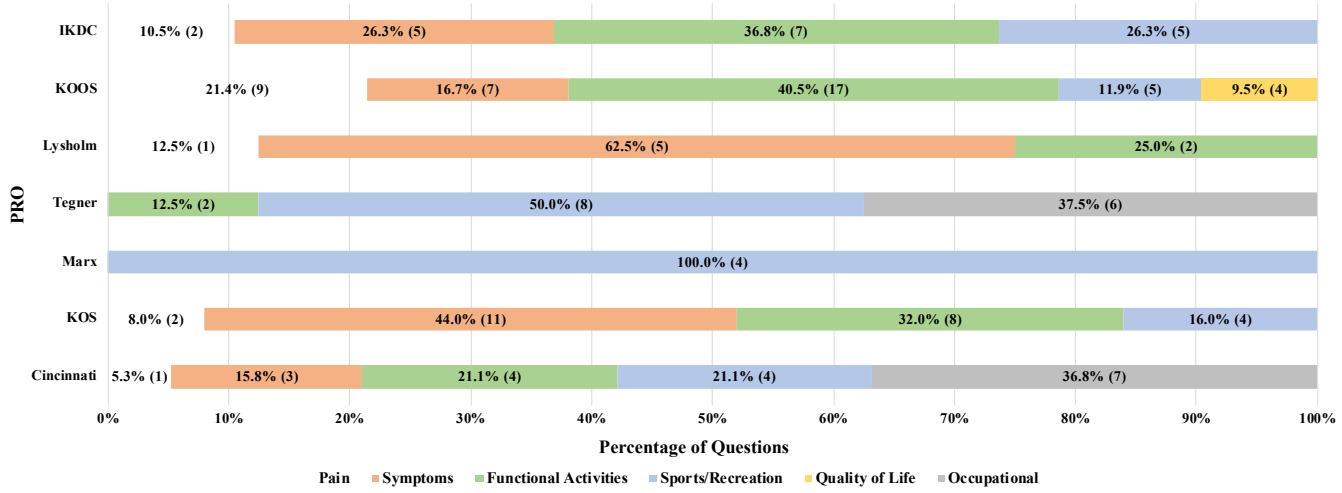

Fig 4. Percentage of question distribution by domain across each patient-reported outcome (PRO) measurement for the International Knee Documentation Committee (IKDC) form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm Knee Scoring Scale, Tegner Activity Scale, Marx Scale, Knee Outcome Survey (KOS), and Cincinnati Knee Rating System (CKRS).

health measures such as SF-36 and EQ-5D were not included but could provide supplementary information in evaluation of these patients. Second, the Marx and Tegner activity scores were not intended to be used in isolation. It may not be appropriate to compare the focused nature of these tools to the broader assessments sought by other PROs. Third, the clinician-reported portions of IKDC and CKRS were not included in the present study but may further distinguish these PROs from others. Fourth, the classification of questions as "identical," "similar," or "unique" is not a validated instrument. The classification for each question was agreed upon by all authors without an intra- or inter-rater reliability analysis performed. Finally, only the questions themselves were analyzed. The question format, answer choices, and scoring systems were not included in this analysis but could certainly impact patient response and score interpretation.

Conclusion

Nearly two-thirds of questions overlap between the commonly used PROs for ACL injury. Although Sports/Recreation is assessed by all PROs, each has its own pattern of coverage across this and other domains.

References

1. Svantesson E, Hamrin Senorski E, Webster KE, et al. Clinical outcomes after anterior cruciate ligament injury: Panther symposium ACL injury clinical outcomes consensus group. *Knee Surg Sport Traumatol Arthrosc* 2020;28:2415-2434.
2. Lynch AD, Logerstedt DS, Grindem H, et al. Consensus criteria for defining "successful outcome" after ACL injury and reconstruction: A Delaware-Oslo ACL cohort investigation. *Br J Sports Med* 2015;49:335-342.
3. Black N. Patient reported outcome measures could help transform healthcare. *BMJ* 2013;346:1-5.
4. Roos EM. Outcome after anterior cruciate liagment reconstruction—A comparison of patients' and surgeons' assessments. *Scand J Med Sci Sport* 2001;11:287-291.
5. Lavallee DC, Chenok KE, Love RM, et al. Incorporating patient-reported outcomes into health care to engage patients and enhance care. *Health Aff* 2016;35:575-582.
6. Meta F, Lizzio VA, Jildeh TR, Makhni EC. Which patient reported outcomes to collect after anterior cruciate ligament reconstruction. *Ann Jt* 2017;2:21-21.
7. Wang D, Jones MH, Khair MM, Miniaci A. Patient-reported outcome measures for the knee. *J Knee Surg* 2010;23:137-151.
8. Agarwalla A, Puzzitiello RN, Liu JN, et al. Timeline for maximal subjective outcome improvement after anterior cruciate ligament reconstruction. *Am J Sports Med* 2019;47:2501-2509.
9. Hefti E, Müller W, Jakob RP, Stäubli HU. Evaluation of knee ligament injuries with the IKDC form. *Knee Surg Sport Traumatol Arthrosc* 1993;1:226-234.
10. Rossi MJ, Lubowitz JH, Guttmann D. Development and validation of the International Knee Documentation Committee Subjective Knee form. *Am J Sports Med* 2002;30:152.
11. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)—Development of a self-administered outcome measure. *J Orthop Sports Phys Ther* 1998;28:88-96.
12. Roos EM, Toksvig-larsen S. Knee Injury and Osteoarthritis Outcome Score (KOOS)— Validation and comparison to the WOMAC in total knee replacement. *Health Qual Life Outcomes* 2003;1:1-10.
13. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. *Am J Sports Med* 1982;10:150-154.
14. Marx RG, Stump TJ, Jones EC, Wickiewicz TL, Warren RF. Development and evaluation of an activity rating scale for disorders of the knee. *Am J Sports Med* 2001;29:213-218.
15. Irrgang JJ, Snyder-Mackler L, Wainner RS, Fu FH, Harner CD. Development of a patient-reported measure of function of the knee. *J Bone Jt Surg A* 1998;80:1132-1145.
16. Noyes FR, Mooar PA, Matthews DS, Butler DL. The symptomatic anterior cruciate-deficient knee. Part I. The long-term functional disability in athletically active individuals. *J Bone Jt Surg* 1983;65:154-162.
17. Noyes FR, Matthews DS, Mooar PA, Grood ES. The symptomatic anterior cruciate knee. Part II. The results of rehabilitation, activity modification, and counseling on functional disability. *J Bone Jt Surg* 1983;65:163-174.
18. Noyes FR, Barber SD, Mooar LA. A rationale for assessing sports activity levels and limitations in knee disorders. *Clin Orthop Relat Res* 1989;246:238-249.
19. Barber-Westin SD, Noyes FR, McCloskey JW. Rigorous statistical reliability, validity, and responsiveness testing of the cincinnati knee rating system in 350 subjects with uninjured, injured, or anterior cruciate ligament-reconstructed knees. *Am J Sports Med* 1999;27:402-416.
20. Makhni EC, Padaki AS, Petridis PD, et al. High variability in outcome reporting patterns in high-impact ACL literature. *J Bone Jt Surg Am* 2015;97:1529-1542.
21. Ardern CL, Österberg A, Sonesson S, Gauffin H, Webster KE, Kvist J. Satisfaction with knee function after primary anterior cruciate ligament reconstruction is associated with self-efficacy, quality of life, and returning to the preinjury physical activity. *Arthroscopy* 2016;32:1631-1638.e3.
22. Irrgang JJ, Anderson AF. Development and validation of health-related quality of life measures for the knee. *Clin Orthop Relat Res* 2002;(402):95-109.
23. Filbay SR, Ackerman IN, Russell TG, Macri EM, Crossley KM. Health-related quality of life after anterior cruciate ligament reconstruction: A systematic review. *Am J Sports Med* 2014;42:1247-1255.

International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form

2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

Your Full Name_____

Today's Date: _____/_____/_____ (Day Month Year) Date of Injury: _____/_____/_____ (Day Month Year)

SYMPTOMS*:

*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1. What is the highest level of activity that you can perform without significant knee pain?

   ❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   ❑Strenuous activities like heavy physical work, skiing or tennis
   ❑Moderate activities like moderate physical work, running or jogging
   ❑Light activities like walking, housework or yard work
   ❑Unable to perform any of the above activities due to knee pain

2. During the past 4 weeks, or since your injury, how often have you had pain?

	0	1	2	3	4	5	6	7	8	9	10	
Never	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	Constant

3. If you have pain, how severe is it?

	0	1	2	3	4	5	6	7	8	9	10	
No pain	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	Worst pain imaginable

4. During the past 4 weeks, or since your injury, how stiff or swollen was your knee?

   ❑Not at all
   ❑Mildly
   ❑Moderately
   ❑Very
   ❑Extremely

5. What is the highest level of activity you can perform without significant swelling in your knee?

   ❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   ❑Strenuous activities like heavy physical work, skiing or tennis
   ❑Moderate activities like moderate physical work, running or jogging
   ❑Light activities like walking, housework, or yard work
   ❑Unable to perform any of the above activities due to knee swelling

6. During the past 4 weeks, or since your injury, did your knee lock or catch?

   ❑Yes ❑No

7. What is the highest level of activity you can perform without significant giving way in your knee?
   ❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   ❑Strenuous activities like heavy physical work, skiing or tennis
   ❑Moderate activities like moderate physical work, running or jogging
   ❑Light activities like walking, housework or yard work
   ❑Unable to perform any of the above activities due to giving way of the knee

Page 2 – 2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

SPORTS ACTIVITIES:

8. What is the highest level of activity you can participate in on a regular basis?

❑Very strenuous activities like jumping or pivoting as in basketball or soccer
❑Strenuous activities like heavy physical work, skiing or tennis
❑Moderate activities like moderate physical work, running or jogging
❑Light activities like walking, housework or yard work
❑Unable to perform any of the above activities due to knee

9. How does your knee affect your ability to:

		Not difficult at all	Minimally difficult	Moderately Difficult	Extremely difficult	Unable to do
a.	Go up stairs	❑	❑	❑	❑	❑
b.	Go down stairs	❑	❑	❑	❑	❑
c.	Kneel on the front of your knee	❑	❑	❑	❑	❑
d.	Squat	❑	❑	❑	❑	❑
e.	Sit with your knee bent	❑	❑	❑	❑	❑
f.	Rise from a chair	❑	❑	❑	❑	❑
g.	Run straight ahead	❑	❑	❑	❑	❑
h.	Jump and land on your involved leg	❑	❑	❑	❑	❑
i.	Stop and start quickly	❑	❑	❑	❑	❑

FUNCTION:

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

FUNCTION PRIOR TO YOUR KNEE INJURY:

Cannot perform daily activities	0	1	2	3	4	5	6	7	8	9	10	No limitation in daily activities
	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	

CURRENT FUNCTION OF YOUR KNEE:

Cannot perform daily activities	0	1	2	3	4	5	6	7	8	9	10	No limitation in daily activities
	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	

Knee Injury and Osteoarthritis Outcome Score (KOOS)

KOOS KNEE SURVEY

Today's date: _____/_____/_____ Date of birth: _____/_____/_____

Name: _____

INSTRUCTIONS: This survey asks for your view about your knee. This information will help us keep track of how you feel about your knee and how well you are able to perform your usual activities.
Answer every question by ticking the appropriate box, only one box for each question. If you are unsure about how to answer a question, please give the best answer you can.

Symptoms

These questions should be answered thinking of your knee symptoms during the **last week**.

S1. Do you have swelling in your knee?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S2. Do you feel grinding, hear clicking or any other type of noise when your knee moves?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S3. Does your knee catch or hang up when moving?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S4. Can you straighten your knee fully?

Always	Often	Sometimes	Rarely	Never
☐	☐	☐	☐	☐

S5. Can you bend your knee fully?

Always	Often	Sometimes	Rarely	Never
☐	☐	☐	☐	☐

Stiffness

The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

S6. How severe is your knee joint stiffness after first wakening in the morning?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

S7. How severe is your knee stiffness after sitting, lying or resting **later in the day**?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Pain

P1. How often do you experience knee pain?

Never	Monthly	Weekly	Daily	Always
☐	☐	☐	☐	☐

What amount of knee pain have you experienced the **last week** during the following activities?

P2. Twisting/pivoting on your knee

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P3. Straightening knee fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P4. Bending knee fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P5. Walking on flat surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P6. Going up or down stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P7. At night while in bed

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P8. Sitting or lying

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P9. Standing upright

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Function, daily living

The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A1. Descending stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A2. Ascending stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A3. Rising from sitting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A4. Standing

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A5. Bending to floor/pick up an object

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A6. Walking on flat surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A7. Getting in/out of car

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A8. Going shopping

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A9. Putting on socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A10. Rising from bed

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A11. Taking off socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A12. Lying in bed (turning over, maintaining knee position)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A13. Getting in/out of bath

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A14. Sitting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A15. Getting on/off toilet

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A17. Light domestic duties (cooking, dusting, etc)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Function, sports and recreational activities

The following questions concern your physical function when being active on a higher level. The questions should be answered thinking of what degree of difficulty you have experienced during the **last week** due to your knee.

SP1. Squatting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP2. Running

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP3. Jumping

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP4. Twisting/pivoting on your injured knee

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP5. Kneeling

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Quality of Life

Q1. How often are you aware of your knee problem?

Never	Monthly	Weekly	Daily	Constantly
☐	☐	☐	☐	☐

Q2. Have you modified your life style to avoid potentially damaging activities to your knee?

Not at all	Mildly	Moderately	Severely	Totally
☐	☐	☐	☐	☐

Q3. How much are you troubled with lack of confidence in your knee?

Not at all	Mildly	Moderately	Severely	Extremely
☐	☐	☐	☐	☐

Q4. In general, how much difficulty do you have with your knee?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Lysholm Knee Scoring Scale

LYSHOLM KNEE SCORING SCALE

Instructions: Below are common complaints which people frequently have with their knee problems. Please check the statement which best describes your condition.

I. LIMP:
_____ I have no limp when I walk. (5)
_____ I have a slight or periodical limp when I walk. (3)
_____ I have a severe and constant limp when I walk. (0)

II. USING CANE OR CRUTCHES
_____ I do not use a cane or crutches. (5)
_____ I use a cane or crutches with some weight-bearing. (2)
_____ Putting weight on my hurt leg is impossible. (0)

III. LOCKING SENSATION IN THE KNEE
_____ I have no locking and no catching sensations in my knee. (15)
_____ I have catching sensation but no locking sensation in my knee. (10)
_____ My knee locks occasionally. (6)
_____ My knee locks frequently. (2)
_____ My knee feels locked at this moment. (0)

IV. GIVING WAY SENSATION FROM THE KNEE
____ My knee never gives way. (25)
____ My knee rarely gives way, only during athletics or other vigorous activities. (20)
____ My knee frequently gives way during athletics or other vigorous activities, in turn I am unable to participate in these activities. (15)
____ My knee occasionally gives way during daily activities. (10)
____ My knee often gives way during daily activities. (5)
____ My knee gives way every step I take. (0)

V. PAIN:
____ I have no pain in my knee. (25)
____ I have intermittent or slight pain in my knee during vigorous activities. (20)
____ I have marked pain in my knee during vigorous activities. (15)
____ I have marked pain in my knee during or after walking more than 1 mile. (10)
____ I have marked pain in my knee during or after walking less than 1 mile. (5)
____ I have constant pain in my knee. (0)

VI. SWELLING
____ I have no swelling in my knee. (10)
____ I have swelling in my knee only after vigorous activities. (6)
____ I have swelling in my knee after ordinary activities. (2)
____ I have swelling constantly in my knee. (0)

VII. CLIMBING STAIRS:
____ I have no problems climbing stairs. (10)
____ I have slight problems climbing stairs. (6)
____ I can climb stairs only one at a time. (2)
____ Climbing stairs is impossible for me. (0)

VIII. SQUATTING
____ I have no problems squatting. (5)
____ I have slight problems squatting. (4)
____ I can not squat beyond a 90 degree bend in my knee. (2)
____ Squatting is impossible because of my knee. (0)

TOTAL_____/100

Tegner Activity Scale

Activity Level Before Injury	Current Activity Level	Activity Level Following Surgery if applicable	
○	○	○	Competitive sports Soccer - national and international elite
○	○	○	Competitive sports Soccer, lower divisions Ice hockey Wrestling Gymnastics
○	○	○	Competitive sports Bandy Squash or badminton Athletics (jumping, etc.) Downhill skiing
○	○	○	Competitive sports Tennis Athletics (running) Motorcross, speedway Handball Basketball Recreational sports Soccer Bandy and ice hockey Squash Athletics (jumping) Cross-country track findings both recreational and competitive
○	○	○	Recreational sports Tennis and badminton Handball Basketball Downhill skiing Jogging, at least five times per week
○	○	○	Work Heavy labor (*e.g.*, building, forestry) Competitive sports Cycling Cross-country skiing Recreational sports Jogging on uneven ground at least twice weekly
○	○	○	Work Moderately heavy labor (*e.g.*, truck driving, heavy domestic work) Recreational sports Cycling Cross-country skiing Jogging on even ground at least twice weekly
○	○	○	Work Light labor (*e.g.*, nursing) Competitive and recreational sports Swimming Walking in forest possible
○	○	○	Work Light labor Walking on uneven ground possible but impossible to walk in forest
○	○	○	Work Sedentary work Walking on even ground possible
○	○	○	Sick leave or disability pension because of knee problems

Marx Scale

MARX SCALE (ENGLISH VERSION)

Please indicate how often you performed each activity in your healthiest and most active state, in the past year. Kindly put a (☑) mark on the appropriate space after each item.

	Less than one time in a month	One time in a month	One time in a week	2 or 3 times in a week	4 or more times in a week
Running: running while playing a sport or jogging	0	1	2	3	4
Cutting: changing directions while running	0	1	2	3	4
Deceleration: coming to a quick stop while running	0	1	2	3	4
Pivoting: turning your body with your foot planted while playing sport; For example: skiing, skating, kicking, throwing, hitting a ball (golf, tennis, squash), etc.	0	1	2	3	4

Knee Outcome Survey (KOS)

Knee Outcome Survey Activities of Daily Living Scale (ADLS).

Symptoms: To what degree does each of the following symptoms affect your level of activity? (check one answer on each line)

	I do not have the symptom	I have the symptom, but it does not affect my activity	The symptom affects my activity slightly	The symptom affects my activity moderately	The symptom affects my activity severely	The symptom prevents me from all daily activity
Pain						
Stiffness						
Swelling						
Giving way, buckling, or shifting of the knee						
Weakness						
Limping						

Functional Limitations With Activities of Daily Living: How does your knee affect your ability to: (check one answer on each line)

	Activity is not difficult	Activity is minimally difficult	Activity is somewhat difficult	Activity is fairly difficult	Activity is very difficult	I am unable to do the activity
Walk						
Go up stairs						
Go down stairs						
Stand						
Kneel on front of your knee						
Squat						
Sit with your knee bent						
Rise from a chair						

Scoring: The first column is scored 5 points for each item, followed in successive columns by scores of 4, 3, 2, 1, and 0 for the last column. The total points from all items are summed, then divided by 70 and multiplied by 100 for the ADLS score. For example, if the individual places marks for 12 items in the first column, and 2 items in the second column the total points would be 12x5 = 60 points, plus 2 x 4 = 8 points, for a total of 68 points. The ADLS score would then be 68/70 x 100 = 97%.

Knee Outcome Survey Sports Activities Scale (SAS).

Symptoms: To what degree does each of the following symptoms affect your level of sports activity? (check one answer on each line)

	Never have	Have, but does not affect my sports activity	Affects sports activity slightly	Affects sports activity moderately	Affects sports activity severely	Prevents me from all sports activity
Pain						
Grinding or grating						
Stiffness						
Swelling						
Slipping or partial giving way of knee						
Buckling or full giving way of knee						
Weakness						

Functional Limitations With Sports Activities: How does your knee affect your ability to: (check one answer on each line)

	Not difficult at all	Minimally difficult	Somewhat difficult	Fairly difficult	Very difficult	Unable to do
Run straight ahead						
Jump and land on your involved leg						
Stop and start quickly						
Cut and pivot on your involved leg						

Scoring: The first column is scored 5 points for each item, followed in successive columns by scores of 4, 3, 2, 1, and 0 for the last column. The total points from all items are summed, then divided by 55 and multiplied by 100 for the SAS score. For example, if the individual places marks for 9 items in the first column, and 2 items in the second column the total points would be 9x5 = 45 points, plus 2 x 4 = 8 points, for a total of 53 points. The SAS score would then be 53/55 x 100 = 96%.

Cincinnati Knee Rating System (CKRS)

Appendix I. Cincinnati Knee Rating System: Symptom Rating Scales, Patient Perception Scale

DIRECTIONS: Using the key below, circle the appropriate boxes on the four scales below which indicate the highest level you can reach WITHOUT having symptoms.

Scale	Description
10	Normal knee, able to do strenuous work/sports with jumping, hard pivoting
8	Able to do moderate work/sports with running, turning and twisting; symptoms with strenuous work/sports
6	Able to do light work/sports with no running, twisting or jumping; symptoms with moderate work/sports
4	Able to do activities of daily living alone; symptoms with light work/sports
2	Moderate symptoms (frequent, limiting) with activities of daily living
0	Severe symptoms (constant, not relieved) with activities of daily living

1. PAIN

10 — 8 — 6 — 4 — 2 — 0

2. SWELLING (actual fluid in the knee; obvious puffiness)

10 — 8 — 6 — 4 — 2 — 0

3. PARTIAL GIVING-WAY (partial knee collapse, no fall to the ground)

10 — 8 — 6 — 4 — 2 — 0

4. FULL GIVING-WAY (knee collapse occurs with actual falling to the ground)

10 — 8 — 6 — 4 — 2 — 0

Patient Grade: **Rate the overall condition of your knee at the present time. Circle one number below.**

1 — 2 poor — 3 — 4 fair — 5 — 6 good — 7 — 8 — 9 — 10 normal

poor -- I have significant limitations that affect activities of daily living.
fair -- I have moderate limitations that affect activities of daily living, no sports possible.
good -- I have some limitations with sports but I can participate; I compensate.
normal/excellent -- I am able to do whatever I wish (any sport) with no problems.

Appendix II. Cincinnati Knee Rating System: Sports Activity Scale, Activities of Daily Living Function Scales, Sports Function Scales

Sports Activity Scale

Level I (participates 4-7 days/week)

100 Jumping, hard pivoting, cutting (basketball, volleyball, football, gymnastics, soccer)

95 Running, twisting, turning (tennis, racquetball, handball, ice hockey, field hockey, skiing, wrestling)

90 No running, twisting, jumping (cycling, swimming)

Level II (participates 1-3 days/week)

85 Jumping, hard pivoting, cutting (basketball, volleyball, football, gymnastics, soccer)

80 Running, twisting, turning (tennis, racquetball, handball, ice hockey, field hockey, skiing, wrestling)

75 No running, twisting, jumping (cycling, swimming)

Level III (participates 1-3 times/month)

65 Jumping, hard pivoting, cutting (basketball, volleyball, football, gymnastics, soccer)

60 Running, twisting, turning (tennis, racquetball, handball, ice hockey, field hockey, skiing, wrestling)

55 No running, twisting, jumping (cycling, swimming)

Level IV (no sports)

40 I perform activities of daily living without problems

20 I have moderate problems with activities of daily living

0 I have severe problems with activities of daily living; on crutches, full disability

Activities of Daily Living Function Scales

1. Walking

check one box:

40☐ normal, unlimited

30☐ some limitations

20☐ only 3-4 blocks possible

0☐ less than 1 block; cane, crutch

2. Stairs

check one box:

40☐ normal, unlimited

30☐ some limitations

20☐ only 11-30 steps possible

0☐ only 1-10 steps possible

3. Squatting / kneeling

check one box:

40☐ normal, unlimited

30☐ some limitations

20☐ only 6-10 possible

0☐ only 0-5 possible

Sports Function Scales

1. Straight running

check one box:

100☐ fully competitive

80☐ some limitations, guarding

60☐ definite limitations, half speed

40☐ not able to do

2. Jumping / landing on affected leg

check one box:

100☐ fully competitive

80☐ some limitations, guarding

60☐ definite limitations, half speed

40☐ not able to do

3. Hard twists / cuts / pivots

check one box:

100☐ fully competitive

80☐ some limitations, guarding

60☐ definite limitations, half speed

40☐ not able to do

Appendix III. Cincinnati Knee Rating System: Occupational Rating Scale

Check the response which best describes what you actually do at work. Check only one response per column. *Total Points* _____ x 2 =_____

Factor 1 sitting	**Factor 2** standing/ walking	**Factor 3** walking on uneven ground	**Factor 4** squatting	**Factor 5** climbing	**Factor 6** lifting/carrying	**Factor 7** pounds carried
0 ☐ 8-10 hrs/day	0 ☐ 0 hr/day	0 ☐ 0 hr/day	0 ☐ 0 times/day	0 ☐ 0 times/day	0 ☐ 0 times/day	0 ☐ 0-5 lbs
1 ☐ 6-7 hrs/day	2 ☐ 1 hr/day	2 ☐ 1 hr/day	1 ☐ 1-5 times/day	2 ☐ 1 flight, 2 times/day	1 ☐ 1-5 times/day	1 ☐ 6-10 lbs
2 ☐ 4-5 hrs/day	4 ☐ 2-3 hrs/day	4 ☐ 2-3 hrs/day	2 ☐ 6-10 times/day	4 ☐ 3 flights, 2 times/day	2 ☐ 6-10 times/day	2 ☐ 11-20 lbs
3 ☐ 2-3 hrs/day	6 ☐ 4-5 hrs/day	6 ☐ 4-5 hrs/day	3 ☐ 11-15 times/day	6 ☐ 10 flights/ ladders	3 ☐ 11-15 times/day	3 ☐ 21-25 lbs
☐ 1 hr/day	8 ☐ 6-7 hrs/day	8 ☐ 6-7 hrs/day	4 ☐ 16-20 times/day	8 ☐ ladders with weight 2-3 days/week	4 ☐ 16-20 times/day	4 ☐ 26-30 lbs
4 5 ☐ 0 hr/day	10 ☐ 8-10 hrs/day	10 ☐ 8-10 hrs/day	5 ☐ more than 20 times/day	10 ☐ ladders daily with weight	5 ☐ more than 20 times/day	5 ☐ more than 30 lbs

Appendix IV. Cincinnati Knee Rating System: Overall Rating Scheme

Subjective: 20 points

10 = Normal knee, able to do strenuous work/sports with jumping, hard pivoting
8 = Able to do moderate work/sports with running, twisting, turning; symptoms with strenuous work/sports
6 = Able to do light work/sports with no running, twisting, jumping; symptoms with moderate work/sports
4 = Able to do activities of daily living alone; symptoms with light work/sports
2 = Moderate symptoms (frequent, limiting) with ADL
0 = Severe symptoms (constant, not relieved) with ADL
*highest level possible with no or rare symptoms

		Excellent		Good		Fair		Poor	
		Level	Pts.	Level	Pts.	Level	Pts.	Level	Pts.
Pain	10 8 6 4 2 0	10	5	8	3	6-4	1	2-0	0
Swelling	10 8 6 4 2 0	10	5	8	3	6-4	1	2-0	0
Partial Giving-Way	10 8 6 4 2 0	10	5	8	3	6-4	1	2-0	0
Full Giving-Way	10 8 6 4 2 0	10	5	8	3	6-4	1	2-0	0

Activity Level: 15 points

	Pts 3	Pts 2	Pts 1	Pts 0		Pts.	Pts.	Pts.	Pts.
Walking	Normal, unlimited	Some limitations	Only 3-4 blocks possible	Less than 1 block, cane		3	2	1	0
Stairs	Normal, unlimited	Some limitations	Only 11-30 steps possible	Only 1-10 steps possible	> Score lowest	3	2	1	0
Squatting	Normal, unlimited	Some limitations	Only 6-10 possible	Only 0-5 possible					
Running	Normal, unlimited	Some limitations	Run 1/2 speed	Not able to do		3	2	1-0	
Jumping	Normal, unlimited	Some limitations	Definite limitations, 1/2 speed	Not able to do		3	2	1-0	
Twists/Cuts	Normal, unlimited	Some limitations	Definite limitations, 1/2 speed	Not able to do		3	2	1-0	

Examination: 25 points

	NL	Pts	MILD	Pts	MOD	Pts	SEV	Pts	Pts.	Pts.	Pts.	Pts.
Effusion	NL	5	≤25 cc	4	26-60 cc	2	>60 cc	0	5	4	2	0
Lack of Flexion	0-5°	5	6-15°	4	16-30°	2	>30°	0	5	4	2	0
Lack of Extension	0-3°	5	4-5°	4	6-10°	2	>10°	0	5	4	2	0
Tibiofemoral Crepitus	NL	5			Mod*	2	Sev*	0	5		2	0
Patellofemoral Crepitus	NL	5			Mod*	2	Sev*	0	5	2		0

(*indicates definite fibrillation, cartilage abnormality;moderate 25-50°, severe > 50°)

Instability: 20 points

		Pts		Pts		Pts		Pts				
Anterior (KT-1000)	<3 mm	10	3-5 mm	7	6 mm	4	>6 mm	0	10	7	4	0
Pivot Shift	negative	10	slip	7	definite	4	severe	0	10	7	4	0

Radiographs: 10 points

	4 pts	3 pts	2 pts		0 pt			Convert sum x-ray pts:			
Medial Tibiofemoral	NL	Mild	Mod	narrowing	Sev	narrowing		12 x-ray pts = 10 final pts	11-9 x-ray pts = 7 final pts	8-6 x-ray pts = 4 final pts	5-0 x-ray pts = 0 final pts
Lateral Tibiofemoral	NL	Mild	Mod	<1/2 joint space	Sev	>1/2 joint space					
Patellofemoral	NL	Mild	Mod		Sev		Sum points: ___				

Function Testing: 10 points

Use any two

			Symmetry	Pts.	Symmetry	Pts.	Symmetry	Pts.	Symmetry	Pts.
One-Legged Hop, 1 hop for distance	____% limb symmetry		100-85	10	84-75	7	74-65	4	<65	0
One-Legged Hop, 3 hops for distance	____% limb symmetry	____ average % limb symmetry								
One-Legged Hop, timed hop over 6 meters	____% limb symmetry									
One-Legged Hop, cross-over for distance	____% limb symmetry									

Final Rating Acute Injury Studies: Category _____ Final Rating Chronic Injury Studies: Point Sum _____

Excellent: all in "excellent" (may have one in "good"); Good: all in "excellent" and "good"
Fair: any one in "fair"; Poor: any one in "poor"

Appendix V. Modifications for Overall Rating Scheme: Symptom and Instability Ratings

Subjective: 20 points

6 = Able to do light/moderate/strenuous work/sports without symptoms
4 = Able to do activities of daily living alone; symptoms with light/moderatestrenuous work/sports
2 = Moderate symptoms (frequent, limiting) with ADL
0 = Severe symptoms (constant, not relieved) with ADL

		Excellent		Good		Fair		Poor	
		Level	*Pts.*	Level	*Pts.*	Level	*Pts.*	Level	*Pts.*
Pain	6 4 2 0	6	*5*	4	*3*	2	*1*	0	*0*
Swelling	6 4 2 0	6	*5*	4	*3*	2	*1*	0	*0*
Partial Giving-Way	6 4 2 0	6	*5*	4	*3*	2	*1*	0	*0*
Full Giving-Way	6 4 2 0	6	*5*	4	*3*	2	*1*	0	*0*

Instability*: 20 points

		Pts.		*Pts.*		*Pts.*	*Pts.*	*Pts.*		*Pts.*
ACL	< 3 mm	*5*	3-5.5 mm	*3*	≥ 6 mm	*0*	5	3		0
PCL	< 3 mm	*5*	3-5.5 mm	*3*	≥ 6 mm	*0*	5	3		0
MCL	< 3 mm	*5*	3-5 mm	*3*	≥ 6 mm	*0*	5	3		0
LCL/PL complex	< 3 mm & < 5° ER	*5*	3-5 mm or 6-10° ER	*3*	> 5 mm or > 10° ER	*0*	5	3		0

*ACL: use knee arthrometer test total AP displacement 20°, 134 N, involved-noninvolved limb
PCL: use knee arthrometer test (70°, 89 N) or stress radiographs (70°, 89 N)
MCL: use valgus stress test, 25
LCL/PL complex: use varus stress test 25°, external tibial rotation test 30° & 90°, varus recurvatum test

Appendix VI. Similar Questions

Domain	Question Stem	Question	IKDC	KOOS	Lysholm	Tegner	Marx	KOS	Cincinnati
Pain	Pain frequency	During the past 4 weeks, or since your injury, how often have you had pain?	+						
		How often do you experience knee pain?		+					
	Pain severity	If you have pain, how severe is it?	+						
		Pain			+			+	+
Symptom	Stiffness/Swelling	During the past 4 weeks, or since your injury, how stiff or swollen was your knee?	+						
		How severe is your knee joint stiffness after first wakening in the morning?		+					
		How severe is your knee stiffness after sitting, lying or resting later in the day?		+					
		Swelling (in your knee)?		+	+			+	+
		Stiffness						+	
	Lock/Catch	During the past 4 weeks, or since your injury, did your knee lock or catch?	+						
		Does your knee catch or hang up when moving?		+					
		Locking			+				
	Giving way	What is the highest level of activity you can perform without significant giving way in your knee?	+						
		Instability ("Giving way sensation from the knee")			+				
		Giving way, buckling, or shifting of the knee						+	
		(Slipping or) Partial giving way						+	+
		(Buckling or) Full giving way						+	+
	Knee sensations (e.g., grinding)	Do you feel grinding or hear clicking or any other type of noise when your knee moves?		+					
		Grinding or grating						+	
Functional Activities	Stairs	Go upstairs (ascending)	+	+				+	
		Go down stairs (descending)	+	+				+	
		Stairs			+				+
	Kneeling	Kneel on the front of your knee	+					+	
		Squatting / kneeling							+
	Squatting	Squatting	+		+			+	
		Squatting / kneeling							+
	Sitting	Sit with your knee bent	+					+	
		Sitting		+					
	Rising	Rise from a chair	+					+	
		Rising from sitting		+					
	Function/condition	Current function on your knee	+						
		Rate the overall condition of your knee at the present time							+
	Walking	Walking on flat surface		+					
		Walking on even ground				+			
		Walking						+	+
	Heavy domestic duties	Heavy domestic duties (moving heavy boxes, scrubbing floors, etc.)		+					
		Work (Moderately heavy labor [e.g., truck driving, heavy domestic work])				+			

(continued)

Appendix VI. Continued

Domain	Question Stem	Question	IKDC	KOOS	Lysholm	Tegner	Marx	KOS	Cincinnati
Sports/ Recreation	Highest level of activity	What is the highest level of activity you can participate in on a regular basis?	+						
		Sports Activity Scale							+
	Walking uneven surface	Walking on uneven ground possible but impossible to walk in forest				+			
		Walking on uneven ground							+
	Running	Run straight ahead / Straight running	+					+	+
		Running		+					
		Running: running while playing a sport or jogging					+		
	Jumping	Jump and land on your involved/affected leg	+					+	+
		Jumping		+					
		Bandy; Squash or badminton; Athletics (jumping, etc.); Downhill skiing				+			
		Competitive sports (tennis; athletics [running]; motocross, speedway; handball; basketball) or recreational sports (soccer, bandy, and ice hockey; squash, athletics [jumping], cross-country track, findings both recreational and competitive)				+			
	Stopping/Starting	Stop and start quickly	+					+	
		Deceleration: coming to a quick stop while running					+		
	Pivoting	Twisting/pivoting on your injured knee		+					
		Pivoting: turning your body with your foot planted while playing sport, e.g., skiing, skating, kicking, throwing, hitting a ball (golf, tennis, squash).					+		
		Cut and pivot on your involved leg						+	
		Hard twists / cuts / pivots							+
	Cutting	Cutting: changing directions while running					+		
		Cut and pivot on your involved leg						+	
		Hard twists / cuts / pivots							+

Note that questions listed may also appear in Table 2 (Identical Questions) because two questions are identical, but a question from another survey is similar to the two identical questions. As a result, two of the questions would be identical and the third would be similar.