# American Journal of Sports Medicine

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# Knee-Specific Quality-of-Life Instruments

## Which Ones Measure Symptoms and Disabilities Most Important to Patients?

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**Background:** Knee-specific quality-of-life instruments are commonly used outcome measures. However, they have not been compared for their ability to detect symptoms and disabilities important to patients.

**Study Design:** Cohort study (diagnosis); Level of evidence, 1.

**Methods:** Subjective portions of 11 knee-specific instruments were consolidated. The frequency and importance of each item were assessed. One hundred fifty-three patients with anterior cruciate ligament ruptures, isolated meniscal tears, or osteoarthritis were polled. Instruments were ranked according to the number of items with high mean importance, high frequency importance product, and low mean importance, and according to the number endorsed by at least 51% of patients.

**Results:** For anterior cruciate ligament tears, the Mohtadi quality-of-life instrument scored highest in 3 categories. For meniscal tears, the Western Ontario Meniscal Evaluation Tool scored highly in all 4 categories. For osteoarthritis, the Western Ontario and McMaster Universities Osteoarthritis Index scored highly in 4 categories. Of the general knee instruments, the International Knee Documentation Committee Standard Evaluation Form and the Knee Injury and Osteoarthritis Outcome Score scored favorably.

**Conclusion:** The Mohtadi quality-of-life instrument, Western Ontario Meniscal Evaluation Tool, and Western Ontario and McMaster Universities Osteoarthritis Index—disease-specific instruments—contain many items important to patients. Of general knee instruments studied, the International Knee Documentation Committee Standard Evaluation Form and the Knee Injury and Osteoarthritis Outcome Score contain the most items important to patients.

**Clinical Relevance:** This study guides clinicians and researchers in selecting instruments that ensure that the patient's perspective is considered for outcome studies involving 3 common knee disorders.

**Keywords:** quality-of-life instruments; ligament; meniscus; osteoarthritis

Well-designed clinical research of orthopaedic conditions of the knee requires relevant outcome instruments to assess the effect of disease and response to treatment.[11] Traditionally, outcome after treatment for knee injuries and disorders has been based on objective measurement of

physical examination findings, such as ligamentous laxity, strength, radiographic findings, and performance on functional tests.[4] During the past 2 decades, it has increasingly been realized that the patient's perspective is necessary to make a complete assessment of the effect of disease and treatment.[17] Newer outcome instruments have been designed to include a questionnaire to be completed by the patient. This subjective section is commonly used to determine the changes in frequency or severity of symptoms and functional limitations (ie, disabilities) affecting quality of life.[22,26] The degree to which knee-specific outcome instruments include items to detect symptoms and disabilities that are important to patients, however, has not been compared. The purpose of this study was to define which

| *Sample Question:* 1. | Standing hurts your knee. | | | | |
|---|---|---|---|---|---|
| Not experienced | Experienced but not important | Experienced and a little important | Experienced and moderately important | Experienced and very important | Experienced and extremely important |
| 0 | 1 | 2 | 3 | 4 | 5 |

**Figure 1.** Example of 5-point Likert scale used in study questionnaire.

knee-specific instruments should be selected when assessing treatment outcome, determining injury or disease severity, or following the natural history of knee disorders to ensure that the patient's perspective is considered. This information may guide clinicians and researchers in their selection of instruments to ensure that the patient's perspective is considered for outcome studies involving 3 common knee disorders. The subjective questionnaire portions of 11 knee-specific quality-of-life instruments were compared according to the frequency with which they contain items that detect symptoms and disabilities that are experienced by, and are important to, patients with 3 disorders: ACL tears, meniscal tears, and mild to moderate osteoarthritis (OA).

## MATERIALS AND METHODS

### The Instruments

Eleven commonly used knee-specific instruments were selected for evaluation: 5 for a variety of disorders, 4 specific to ACL deficiency, 1 specific to meniscal tears, and 1 specific to OA of the knee. The instruments were chosen based on consultation with 5 orthopaedic surgeons specializing in sports medicine and total joint replacement. The Tegner Activity Scale was also administered as a separate questionnaire. The 5 non–disease-specific knee instruments studied were (1) the American Academy of Orthopaedic Surgeons (AAOS) Sports Knee Rating Scale, (2) the Knee Injury and Osteoarthritis Outcome Score (KOOS), (3) the 2000 International Knee Documentation Committee (IKDC) Standard Evaluation Form, (4) the Activities of Daily Living (ADL) Scale of the Knee Outcome Survey, and (5) the Knee Disorders Subjective Form of Visual Analog Scale (VAS; Hughston Sports Medicine Foundation). Ligament-specific knee instruments included (6) the Cincinnati Knee Ligament Rating Scale, (7) the Revised Hospital for Special Surgery (HSS) Knee Ligament Rating Form, (8) the Modified Lysholm Knee Scoring Scale, and (9) the Mohtadi Quality of Life (QOL) Assessment in Anterior Cruciate Ligament Deficiency. The instrument specifically designed for outcomes related to meniscal tears was (10) the Western Ontario Meniscal Evaluation Tool (WOMET). The instrument specific for OA of the knee was (11) the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). A description of the instruments is available online (see Appendix, available in the online version of this article at http://ajsm.sagepub.com/cgi/content/full/35/9/1450/DC1).

### Development of the Study Questionnaire

For the purpose of this study, a questionnaire of 111 items was developed by combining 222 patient-directed questions from the 11 knee-specific quality-of-life instruments. A consolidated questionnaire, rather than administration of each instrument, was necessary to create a survey of acceptable length (approximately 30 minutes rather than 1 hour for completion), analyze double-barreled questions, and include a Likert scale for data analysis. Three reviewers independently developed the final questionnaire by evaluating and choosing questions that best reflected the content of all the instruments.

Some modifications were necessary so that the study instrument was consistent. For instance, in some cases, the original questionnaires used disease-specific wording. For the current study, the questions were modified so they would pertain to patients with any of the 3 diagnoses. For example, the question "How much of a concern is it for you to lose time from school or work because of the treatment of your ACL-deficient knee?" was modified to "How much of a concern is it for you to lose time from school or work because of treatment of your knee?" "Double-barreled" questions, that is, those dealing with more than 1 feeling or symptom (eg, "How would you rate your pain and stiffness?"), were separated into 2 questions. To consolidate the key issues from multiple questionnaires and to avoid recall error, questions were worded in the present tense. For example, questions on the 2000 IKDC form begin with "during the past 4 weeks" or "since your injury." These were changed to the present tense. Patients were asked to rate the importance of the described symptom or disability using a 6-point Likert scale as seen in Figure 1. Examples of questionnaire items are in Table 1.

The final questionnaire was pretested in a small sample of orthopaedic clinic patients to ensure clarity of design, language, and ease of completion. The questionnaire took approximately 30 minutes to complete. The Tegner Activity Scale was administered as a separate tool to determine the activity level of the participating patients at the time the study questionnaire was administered. This scale was developed in 1985 by Tegner and Lysholm[25] to assign functional scores to a patient's level of activity at the time of evaluation. A patient's activity score from 0 to 10 is assigned, with corresponding definitions ranging from "on sick leave/disability" to "participation in competitive sports such as soccer at a national or international elite level."

TABLE 1
Important Symptoms and Disabilities[a]

| Condition | Preoperative Symptoms and Disabilities | Postoperative Symptoms and Disabilities |
|---|---|---|
| Torn ACL | Fear of reinjuring knee[b] | Fear of reinjuring knee[b] |
| | Knee condition is frustrating and discouraging | Sports and recreation expectations have changed |
| | Difficult to participate in favorite sport or recreational activity[b] | Often aware and conscious of knee problem |
| | Squatting is difficult | Worried what will happen to knee in the future |
| | Fear of knee giving way during sport | Need to participate in sports and recreation with caution |
| | Knee is weak | Difficult to participate in favorite sport or recreational activity[b] |
| | Lack of confidence in knee | Knee limits participation in competitive sports |
| | Squatting hurts | Difficult to go "full out" during sports or recreation |
| | Frustrating to consider knee with respect to sports and recreation | Modified lifestyle to avoid activities that are potentially damaging to knee |
| | Knee prevents competitiveness | |
| Meniscal tear | Sports and recreation performance expectations have changed | Fear of reinjuring knee[b] |
| | Amount of time participating at preinjury level is affected | Often aware and conscious of knee problem[b] |
| | Often aware and conscious of knee problem[b] | Knee hurts |
| | Difficult to participate in favorite sport or recreational activity | Squatting is difficult |
| | Squatting hurts | Frustrating to consider knee with respect to sports and recreation[b] |
| | Fear of reinjuring knee[b] | Worried what will happen to knee in the future[b] |
| | Worried what will happen to knee in the future[b] | Knee pain makes it difficult to perform heavy physical labor |
| | Difficult to quickly change direction[b] | Apprehensive about knee |
| | Frustrating to consider knee with respect to sports and recreation[b] | Difficult to quickly change direction[b] |
| | Knee makes it difficult to participate in second most favorite sport or activity | Modified lifestyle to avoid activities that are potentially damaging to knee |
| Osteoarthritis | Going up stairs hurts | Often aware and conscious of knee problem |
| | Bending hurts | Going up stairs hurts |
| | Kneeling is difficult[b] | Worried what will happen to knee in the future |
| | Bending knee is difficult | Knee hurts |
| | Knee makes you limp | Going up stairs is difficult |
| | Going down stairs is difficult | Apprehensive about knee |
| | Knee grinds or grates | Fear of reinjuring knee |
| | Going down stairs hurts[b] | Going down stairs hurts[b] |
| | Walking on uneven terrain is difficult | Modified lifestyle to avoid activities that are potentially damaging to knee |
| | Knee hurts while rising from a chair | Kneeling is difficult[b] |

[a]The most important 10 symptoms and disabilities are ranked by frequency importance product (FIP) from top to bottom. The FIP is calculated by multiplying the number of patients endorsing a question by the mean importance rating of that question.
[b]Refers to symptoms or disabilities that are in the top-10 FIP rating both preoperatively and postoperatively.

## Patient Recruitment

The study was approved by the University of Western Ontario's research ethics board for the review of health sciences research involving human subjects. Three patient populations were included: patients with a complete rupture of the ACL requiring surgical reconstruction, patients with an isolated meniscal tear of the knee requiring arthroscopy, and patients with mild to moderate OA (Kellgren and Lawrence[15] grades I-III) of the knee who

TABLE 2
Inclusion/Exclusion Criteria for Patients in Each of the 3 Diagnosis Groups

| | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| All groups | Informed consent obtained; must be 14 years old or older; must read and speak English fluently | Major psychiatric illness that precludes informed consent and/or completion of questionnaire (ie, major depression) |
| ACL tear | Primary diagnosis for treatment and surgically confirmed primary unilateral ACL tear with or without meniscal tear; ACL reconstruction using autologous hamstring tendons | Previous ACL surgery; concomitant ligamentous injury or other significant pathology |
| Meniscal tear | Primary diagnosis for treatment and surgically confirmed primary meniscal tear treated with debridement and/or repair | Intra-articular/extra-articular active infection; concomitant injuries or significant pathology |
| Osteoarthritis (OA) of the knee | Primary diagnosis for treatment of mild to moderate (grade I-III[a]) OA based on clinical and radiographic criteria | Severe OA based on clinical and radiographic criteria; concomitant injuries, disease, or pathology |

[a]Classified using the Altman classification and Kellgren and Lawrence Scale. Altman R, Asch E, Bloch D, et al. Development of criteria for the classification and reporting of osteoarthritis. *Arthritis Rheum*. 1986;29:1039-1049; Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis*. 1957;16:494-502.

TABLE 3
Demographic Characteristics of the Total Sample

| Characteristic | No. |
|---|---|
| Total population studied | 153 |
| Gender | |
|     Male | 75 |
|     Female | 78 |
| Mean age, y (range) | 44.6 (14-82) |
| Involved knee | 65 unilateral left knees; 67 unilateral right knees; 9 patients with bilateral knees involved |
| Patient status at data collection | 30 nonoperative; 45 preoperative; 78 postoperative |

were treated both nonoperatively and operatively. All patients were categorized according to their primary diagnosis or reason for treatment, recognizing that although this does not create pure categories, it is consistent with clinical practice. Specific inclusion and exclusion criteria are listed in Table 2. Eligible patients were identified in an outpatient sport medicine clinic and by the surgical schedules of 4 orthopaedic surgeons. Both preoperative and postoperative patients were sampled to assess the frequency and importance of symptoms and function across the spectrum of disease. Demographics of the study populations are listed in Tables 3 and 4.

Patients were approached to participate in the study by a research assistant from the clinic. A sample size of 150 was selected based on those used in other validation surveys. An ideal model of questionnaire development dictates semistructured interviews with 50 to 100 patients.[6] This population size was selected to allow sampling of the complete spectrum of disease under consideration and include patients from varied subclasses (ie, age, sex, and duration of disease).

Once the study was explained, informed consent was obtained from all participants. A demographics form was completed by the patient and the research assistant. The demographics form included date of birth, date of surgery, diagnosis, and previous treatment. For patients who were surveyed preoperatively, operative diagnosis was later confirmed using clinical records.

### Data Analysis

All data were entered into a secure, custom-designed computerized database. A double data entry technique was used to ensure accuracy, and analysis was done by an external statistician using the SAS statistical package (SAS Institute, Cary, NC).

Important criteria for retaining items during questionnaire development include the number of patients who listed the item as a problem (item frequency) and the importance attached to the items.[6] To combine frequency and importance data, we selected frequency importance product (FIP) calculation described by Guyatt et al[6] and Juniper et al,[13] which has been recommended for use in the development of quality-of-life questionnaires. For each item on the current study questionnaire, subjects were asked to assess whether they experienced the item and then, if experienced, to rate the importance of the item to their overall knee function. The importance was ranked on a Likert scale from 0 (not experienced) to 5 (experienced and extremely important) (Figure 1). The frequency with which each item was experienced and the mean importance were entered for each item. The FIP was then calculated (FIP = frequency × mean importance) for each item.[6] The number of respondents who endorsed an item, such

TABLE 4
Demographic Characteristics by Diagnosis Group

|  | ACL Injury | Meniscal Tear | Osteoarthritis |
|---|---|---|---|
| No. of patients | 58 | 28 | 67 |
| Preoperative patients | 16 | 11 | 32 |
| Postoperative patients | 42 | 13 | 30 |
| No operation planned | 0 | 4 | 5 |
| Mean age, y (range) | 30.1 (14-82) | 40.5 (16-74) | 57.9 (37-78) |
| Gender |  |  |  |
|   Male | 30 | 18 | 27 |
|   Female | 28 | 10 | 40 |
| Tegner activity score |  |  |  |
|   Preoperative mean (maximum of 10) | 5 | 4 | 4[a] |
|   Postoperative mean | 5 | 6 | 3 |

[a]Includes patients before total knee arthroplasty and those treated nonoperatively.

TABLE 5
Results: Population With ACL Deficiency[a]

| | | No. of Questions | | | |
|---|---|---|---|---|---|
| Instrument | On Instrument | Endorsed by at Least 51% of Patients[b] | With Mean Importance Ranking of at Least 3[c] | With Mean Importance Ranking of 1 or Less[c] | With Top-20 FIP Scores | Relative Score[d] |
| Mohtadi QOL | 31 | 27 (87) | 6 | 7 | 13 | 33 |
| IKDC | 18 | 13 (72) | 2 | 6 | 4 | 32 |
| KOOS | 42 | 19 (45) | 1 | 9 | 3 | 23 |
| HSS | 10 | 7 (70) | 0 | 4 | 2 | 22 |
| Cincinnati | 9 | 4 (44) | 0 | 7 | 0 | 10 |
| Lysholm | 8 | 2 (25) | 0 | 6 | 0 | 9 |
| VAS | 28 | 17 (61) | 0 | 17 | 0 | 7 |
| ADL | 17 | 7 (41) | 0 | 15 | 0 | 6 |
| AAOS | 20 | 8 (40) | 0 | 15 | 0 | 5 |

[a]FIP, frequency importance product; QOL, quality of life; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; HSS, Hospital for Special Surgery Knee Ligament Rating Form; VAS, visual analog scale; ADL, activities of daily living; AAOS, American Academy of Orthopaedic Surgeons.

[b]Numbers in parentheses are percentages.

[c]Score on a Likert scale of 0 to 5, with 0 being not experienced and 5 being experienced and very important.

[d]Score was calculated by assigning points for each instrument in columns 3 to 6. If an instrument had the top score in a column, 9 points were assigned. If an instrument had the second best score in a column, 8 points were assigned, and so forth. If an instrument had 0 questions listed in column 4, 0 points were assigned. Points were then summed (maximum, 36 points).

as knee locking, for example, was multiplied by the mean importance of the question on the Likert scale (1-5). The greater the FIP, the more important a symptom or disability is to patients. A high FIP indicates that a symptom or disability is both frequently experienced and most important to patients.

Ideal quality-of-life instruments include questions about symptoms and disabilities with a high FIP.[6] Endorsement data for each instrument were determined in 3 categories for each of the 3 populations. Calculations were made for (1) the number of questions that at least 51% of the patients endorsed with a value of at least 1 on the Likert scale, (2) the number of questions that had an average mean importance ranking of at least 3 on the Likert scale, and (3) the number

of questions that had an average mean importance ranking of 1 or less on the Likert scale. For each of the 3 disorders, data were determined for the 5 general knee instruments (AAOS, KOOS, IKDC, VAS, and ADL) and 6 disease-specific knee instruments (Cincinnati, HSS, Lysholm, and Mohtadi QOL for ACL tears; the WOMET for meniscal pathology; and the WOMAC for OA).

An instrument was considered ideal if it had the best score in all 4 categories of endorsement compared with other instruments. According to endorsement data, it would contain (1) the most, or highest percentage, of questions that at least 51% of the patients endorsed with an importance value of at least 1; (2) the most questions with a mean importance ranking of at least 3; and (3) the fewest

TABLE 6
Results: Population With Meniscal Tears[a]

| | | | No. of Questions | | | |
|---|---|---|---|---|---|---|
| Instrument | On Instrument | Endorsed by at Least 51% of Patients[b] | With Mean Importance Ranking of at Least 3[c] | With Mean Importance Ranking of 1 or Less[c] | With Top-20 FIP Scores | Relative Score[d] |
| WOMET | 16 | 15 (94) | 8 | 3 | 7 | 22 |
| IKDC | 18 | 18 (100) | 2 | 2 | 4 | 19 |
| KOOS | 42 | 36 (86) | 5 | 14 | 6 | 14 |
| VAS | 28 | 26 (93) | 2 | 6 | 1 | 12 |
| ADL | 17 | 13 (76) | 0 | 4 | 5 | 10 |
| AAOS | 20 | 12 (60) | 2 | 11 | 2 | 9 |

[a]WOMET, Western Ontario Meniscal Evaluation Tool; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; VAS, visual analog scale; ADL, activities of daily living; AAOS, American Academy of Orthopaedic Surgeons.
[b]Numbers in parentheses are percentages.
[c]Score on a Likert scale of 0 to 5, with 0 being not experienced and 5 being experienced and very important.
[d]Score was calculated by assigning points for each instrument in columns 3 to 6. If an instrument had the top score in a column, 6 points were assigned. If an instrument had the second best score in a column, 5 points were assigned, and so forth. Points were then summed (maximum, 24 points).

questions with a mean importance ranking of 1 or less. An ideal instrument would also contain (4) the most questions with a high FIP. For ease of description and aggregation, each question was assigned to 1 of 5 domains: (1) sports and recreation, (2) work (inside or outside the home), (3) activities of daily living, (4) physical sensations such as pain, or (5) emotions such as fear of reinjuring the knee.

## RESULTS

Of 216 patients approached, 153 (75 male, 78 female) agreed to participate and completed the study questionnaire. Participant demographics are outlined in Tables 3 and 4.

### Anterior Cruciate Ligament Tears

For this population, the Mohtadi QOL instrument had the top score in 3 of 4 endorsement categories. It contained the most questions (27) and highest percentage of questions (87%, 27/31) endorsed by at least 51% of patients with an ACL deficiency, the most questions (6) with a mean importance ranking of at least 3, and the most questions (13) with a top-20 FIP score. The only weakness identified was that 7 of 31 questions (22%) had a mean importance ranking of 1 or less in this population. As shown in column 7 of Table 5, this instrument had the highest ranking compared with 8 other instruments.

The IKDC performed favorably for patients in the ACL deficiency category. Seventy-two percent of questions (13/18) were endorsed by at least 51% of patients, and it contained 4 questions with a top-20 FIP score. Only 2 questions had a mean importance ranking of at least 3, however, and 33% of questions (6/18) had a mean importance ranking of 1 or less (Table 5).

Nineteen of the KOOS questions were endorsed by at least 51% of patients, but this accounted for only 45% of its questions (19/42). Three questions had a top-20 FIP score. Only 1 question, however, had a mean importance ranking

of at least 3 (2%), and 9 questions (21%) had a mean importance of 1 or less (Table 5).

Seventy percent of HSS questions (7/10) were endorsed by at least 51% of patients, and 2 questions had a top-20 FIP score. However, no questions had a mean importance ranking of at least 3, and 4 questions (40%) had a mean importance ranking of 1 or less (Table 5). The other 5 instruments fared less favorably in patients with ACL tears.

For patients with ACL tears, the domain that was ranked most frequently important preoperatively was emotions, as determined by those questions that had the highest FIP scores. After reconstruction, sports and recreation was the most frequently important domain. Fear of reinjury was the disability with the highest FIP both preoperatively and postoperatively. Difficulty participating in favorite sport also had a high FIP preoperatively and postoperatively. Fear of giving way was less frequently important postoperatively than it was preoperatively (Table 1).

### Meniscal Tears

The WOMET scored highly in all 4 endorsement categories in patients with meniscal tears. It contained a high percentage of questions (94%, 15/16) endorsed by at least 51% of patients, the most questions (8) with a high importance ranking, the most questions (7) with a top-20 FIP score, and only 3 questions (19%) with a low mean importance ranking (Table 6).

All of the 18 IKDC questions were endorsed by at least 51% of patients. It contained few questions (2) with a low mean importance ranking, and 4 questions (22%) had a top-20 FIP score. A weakness, though, was that only 2 questions (11%) had a high mean importance ranking.

The KOOS ranked third of the 6 instruments tested (column 7 of Table 6). Eighty-six percent of its questions (36/42) were frequently endorsed, 5 questions (11%) had a high mean importance ranking, and 6 questions (14%) had a top-20 FIP score. Many questions (14/42, 33%), however, had a low mean importance ranking (Table 6).

TABLE 7
Results: Population With Mild to Moderate Osteoarthritis[a]

| Instrument | On Instrument | Endorsed by at Least 51% of Patients[b] | With Mean Importance Ranking of at Least 3[c] | With Mean Importance Ranking of 1 or Less[c] | With Top-20 FIP Scores | Relative Score[d] |
|---|---|---|---|---|---|---|
| WOMAC | 24 | 23 (96) | 23 | 2 | 7 | 24 |
| ADL | 17 | 16 (94) | 5 | 0 | 8 | 22 |
| KOOS | 42 | 38 (90) | 14 | 3 | 9 | 21 |
| IKDC | 18 | 18 (100) | 4 | 2 | 3 | 18 |
| VAS | 28 | 25 (89) | 10 | 5 | 4 | 13 |
| Lysholm | 8 | 2 (25) | 2 | 4 | 7 | 10 |
| AAOS | 20 | 11 (55) | 3 | 11 | 3 | 7 |

*The No. of Questions spans the columns On Instrument through With Top-20 FIP Scores.*

[a]WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; ADL, activities of daily living; KOOS, Knee Injury and Osteoarthritis Outcome Score; IKDC, International Knee Documentation Committee; VAS, visual analog scale; AAOS, American Academy of Orthopaedic Surgeons.

[b]Numbers in parentheses are percentages.

[c]Score on a Likert scale of 0 to 5, with 0 being not experienced and 5 being experienced and very important.

[d]Score was calculated by assigning points for each instrument in columns 3 to 6. If an instrument had the top score in a column, 7 points were assigned. If an instrument had the second best score in a column, 6 points were assigned, and so forth. Points were then summed (maximum, 42 points).

The VAS had many questions (26/28, 93%) endorsed by at least 51% of patients. It scored less favorably, though, in the other 3 endorsement categories (Table 6).

For patients with meniscal tears, the domain that was ranked most frequently important preoperatively was sports and recreation, as determined by those questions that had the highest FIP scores. Postoperatively, the emotional domain was the most frequently important. The disability with the highest FIP preoperatively was a change in sports and recreation expectations. Postoperatively, a fear of reinjury was the disability with the highest FIP. Pain with squatting had a high FIP preoperatively, but difficulty squatting had a high FIP postoperatively (Table 1). The symptom of knee locking during vigorous sports had a top-20 FIP score preoperatively and a bottom-10 FIP score postoperatively.

## Osteoarthritis

The WOMAC scored well in all 4 categories of endorsement for this population. Most of the WOMAC questions (23/24, 96%) were endorsed by at least 51% of patients with mild to moderate OA. Most of the WOMAC questions (23/24, 96%) had a high mean importance ranking. Only 2 questions (8%) had a low importance ranking. Seven questions (29%) had a top-20 FIP score. The KOOS scored similarly because it contains the WOMAC (Table 7).

The ADL had a high percentage of questions (16/17, 94%) endorsed by at least 51% of the population, many questions with a top-20 FIP score (8), and no question with a low mean importance ranking. Only 5 questions (29%), however, had a high mean importance (Table 7).

All of the 18 IKDC questions were endorsed by at least 51% of patients, and only 2 questions (11%) had a low mean importance ranking. Weaker areas included that only 4 questions (22%) had a mean importance ranking of at least 3, and only 3 questions had a top-20 FIP score (Table 7).

Five of 7 instruments studied (WOMAC, ADL, KOOS, IKDC, and VAS) had at least 89% of questions endorsed by at least 51% of patients with OA. Only 2 instruments had few questions endorsed by at least 51% of patients: the AAOS (11/20 questions, 55%) and Lysholm (2/8 questions, 25%) (Table 7).

For patients with mild to moderate OA, the domain that was ranked most frequently important both preoperatively and after total knee arthroplasty was activities of daily living. Pain ascending stairs was the symptom with the highest FIP preoperatively and the symptom with the second highest FIP postoperatively. Pain with knee flexion had a high FIP preoperatively but not postoperatively (Table 1). Disabilities pertaining to participation in moderate to vigorous sports were considered the least important, consistent with the fact that this patient population was the oldest (mean age, 59.9 years; range, 37-78 years) and had the lowest mean Tegner activity level (2.87; range, 0-8).

## DISCUSSION

Outcomes research has become a central process in health care today.[14] It is based on a critical assumption, however, that appropriate outcome measures are available to assess the health status of patients and to distinguish interventions that are effective from those that are not.[23] Current knee-specific instruments include questionnaires for patients, physical examination findings, and information from radiologic evaluation. The latter 2 are objective and provide important information to clinicians. These outcomes are of limited interest to patients, however, because they do not always correlate with functional capacity and well-being.[5] Recently, increased emphasis has been placed on the perspective of the patient.[18,20] Knee-specific questionnaires are designed to measure patients' perceptions of the severity of their injury or condition and their subsequent

improvement with intervention, the most important parameter in determining if treatment is truly successful.[1,21] Also, patient perceptions of importance of level of knee function vary[8] according to their work and sport demands.

The purpose of this study was to define which knee-specific instruments should be selected when assessing treatment outcome, determining injury or disease severity, or following the natural history of knee disorders to ensure that the patient's perspective is considered. Specifically, the purpose was to determine which of 11 knee-specific quality-of-life instruments best detects symptoms and disabilities that are experienced by patients with 3 common knee disorders. The subjective questionnaire portions of 11 knee-specific quality-of-life instruments were compared according to the frequency with which they contain items that detect symptoms and disabilities that are experienced by, and are important to, patients with 3 disorders: ACL tears, meniscal tears, and mild to moderate OA.

To our knowledge, this is the first study to compare the subjective questionnaire portions of commonly used knee instruments. Although other studies have focused on testing the objective portion of instruments and determining reliability, validity, and responsiveness, a unique feature of the current study is that emphasis has been placed on determining the ability of instruments to measure quality of life from the patient's perspective.

Strengths of the research methodology employed include the high number of instruments that were assessed (11 instruments), the fairly large sample surveyed (153 patients), and confirmation of diagnosis by standardized criteria. It is likely that use of a self-administered questionnaire, rather than an interviewer-administered questionnaire, yielded more accurate disclosure from patients and avoided the "white-coat" effect, which is well known to alter scores.[7,16,24] Recall error[16] was avoided by wording the study questions to detect the patient's current emotions, symptoms, and disabilities.

The study was designed to assess symptoms and disabilities across the entire spectrum of disease, so patients were surveyed both preoperatively and postoperatively. The similarity of symptoms and disabilities both preoperatively and postoperatively is demonstrated in Table 1. Fear of reinjury, for example, was often important to patients with ACL tears both preoperatively and after reconstruction. Likewise, squatting was a problem for patients with meniscal tears both preoperatively and postoperatively.

Limitations of this study included the unknown effect of changing disease-specific questions such as "your knee with ACL tear" to "your knee," of separating double-barreled questions into 2 questions, of changing HSS and Lysholm instruments to a self-administered (ie, patient-administered) format, and of wording questions in the present tense (ie, not phrasing the question to state, "during the past 4 weeks," as is included in the IKDC instrument), as well as lack of complete validation of the study questionnaire itself. These issues are unlikely to greatly affect the results presented, however, because the study was designed as a descriptive investigation to provide further insight into appropriate use of quality-of-life instruments.

Because of the plethora of current knee instruments, the goal was not to develop yet another instrument but to guide clinicians and researchers in selecting appropriate instruments. The questionnaire was, therefore, not designed to determine if there are additional symptoms and disabilities experienced by patients with knee disorders that are not included in current instruments. Because 111 symptoms and disabilities were assessed, it is unlikely that other major symptoms or disabilities remain undetected.

A ranking of the instruments for the 3 conditions was presented for ease in comparing the instruments. However, it is impossible to know if each of the 4 criteria used to compare the instruments should receive equal rating.

The focus of this study was to identify instruments that most frequently contain items that detect symptoms and disabilities that are experienced by, and are important to, patients with 3 common knee disorders. When selecting knee instruments to determine treatment outcome and follow the natural history of a knee condition, it is important that contents of objective sections (ie, physical examination and radiographic findings); validity, reliability, and responsiveness; and scoring systems also be considered. These properties are presented in a "Description of the Instruments" available in the online Appendix for this article (see online Appendix at http://ajsm.sagepub.com/cgi/content/full/35/9/1450/DC1).

In each of the 3 knee conditions assessed in this study, the top-scoring instrument was a disorder-specific knee instrument. These instruments were the Mohtadi QOL for patients with ACL deficiency, the WOMET for patients with meniscal tears, and the WOMAC for patients with mild to moderate OA. The instruments share common features. They were all recently developed. The Mohtadi QOL was published in 1998.[19] The WOMET was presented in 2005 (unpublished, presented by Griffin and Kirkley at the 2005 International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine Congress). The WOMAC was published in 1988.[3] These instruments were each developed using patient input to determine question inclusion, and each underwent rigorous methodology for question selection.[3,19] Validity, reliability, and responsiveness have been demonstrated for each of these 3 instruments.[3,19] All employ a VAS, similar to the Likert scale used on the study questionnaire.[3,19] The current study verifies the value of the use of rigorous methodology for instrument development.

The IKDC and KOOS were identified as the top general knee quality-of-life instruments that contained many questions regarding symptoms and disabilities important to patients with the 3 knee disorders. These instruments were recently developed as well. The IKDC was published in 2001,[9] and the KOOS was published in 1998.[23] Validity, responsiveness, and reliability have been demonstrated for each instrument.[2,9,10,12] A Likert scale is used with each questionnaire.[9,23]

In conclusion, 3 knee disorder–specific quality-of-life instruments contain items that most frequently detect symptoms and disabilities that are experienced by, and are important to, patients with 3 common knee disorders: the Mohtadi QOL instrument for patients with ACL tears, the WOMET

for patients with meniscal tears, and the WOMAC for patients with OA. The IKDC and KOOS are both general knee quality-of-life instruments that contain many questions regarding symptoms and disabilities important to patients with the 3 knee disorders. The value of this study is that it guides clinicians and researchers in their selection of instruments to ensure that the patient's perspective is considered for outcome studies involving 3 common knee disorders.

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