

# What Are Our Patients Really Telling Us? Psychological Constructs Associated With Patient- Reported Outcomes After Anterior Cruciate Ligament Reconstruction

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**Context:** Depressed patient-reported outcomes (PROs) are directly related to suboptimal recovery after anterior cruciate ligament reconstruction (ACLR). Various PROs commonly used after ACLR can provide a gross estimation of function but do not fully elucidate the causes of self-perceived disability.

**Objective:** To more fully characterize the factors driving responses on PROs.

**Design:** Cross-sectional study. A mixed-methods approach was used, in which qualitative interviews were conducted alongside administration of PROs to uncover the themes behind a participant's PRO responses.

**Setting:** Laboratory.

**Patients or Other Participants:** Twenty-one individuals with unilateral ACLR (age =  $20.90 \pm 2.86$  years, height =  $172.0 \pm 11.03$  cm; mass =  $71.52 \pm 13.59$  kg, postsurgery =  $3.66 \pm 3.03$  years).

**Main Outcome Measure(s):** Patient-reported outcome measures were administered and qualitative interviews were conducted. The PROs consisted of the International Knee Documentation Committee form, Knee Injury and Osteoarthritis Outcomes Score (KOOS), ACL-Return to Sport after Injury (ACL-RSI) scale, and Tampa Scale of Kinesiophobia (TSK). A hierarchical cluster analysis was used to identify subgroups

based on PRO responses. Qualitative interviews provided supplemental insight into perceived disability. Independent *t* tests examined cluster differences for themes. Spearman *p* correlations indicated associations between PRO responses and themes.

**Results:** Two clusters (perceived high or low disability) emerged. Individuals with low perceived disability scored better on all PROs ( $P < .05$ ) except for the KOOS-Activities of Daily Living. Internal and external facilitators or barrier subthemes emerged from the interviews. A significant difference was present between clusters and themes. Lower TSK and greater ACL-RSI and KOOS-Quality of Life scores were associated with more perceived facilitators.

**Conclusions:** Participants with greater internal motivation and confidence and a support network had improved PROs. Those with avoidance tendencies, fear, lack of clear expectations, and less social support scored worse on PROs. The TSK, ACL-RSI, and KOOS-Quality of Life scales were best able to capture the constructs associated with perceived wellness, which reinforces their utility in recovery.

**Key Words:** self-reported function, clinical thresholds, psychology

## Key Points

- Individuals who reported low scores on patient-reported outcome measures after anterior cruciate ligament reconstruction (ACLR) more commonly experienced fear and uncertainty over recovery.
- Use of these outcome tools can be helpful in identifying patients with ACLR who would benefit from additional support or psychological counseling.
- Clinicians should acknowledge and address the facilitators and barriers patients experience after ACLR in order to provide better patient-centered care.

Anterior cruciate ligament (ACL) rupture is a debilitating injury that results in a series of negative consequences that can persist long after an individual ceases formal rehabilitation.<sup>1,2</sup> For instance, those with a history of ACL reconstruction (ACLR) are known to be at high risk for early joint degeneration<sup>3,4</sup> and a lifetime of reduced physical activity. Psychological wellness is also disrupted,<sup>2,5,6</sup> as individuals with a history of

ACLR report hesitancy with movement, lack of confidence, and fear of reinjury.<sup>1,7,8</sup> Deficits in physical wellness have been well studied,<sup>9–13</sup> yet psychological recovery is less understood. Comprehensive medicine requires an understanding of both the physical and psychological factors that influence recovery.<sup>8</sup> Work that can continue to fill the gap by elucidating the psychological factors that influence recovery is desperately needed.

**Table 1. Clinical Cutoff Scores and Patient Acceptable Symptom Score (PASS) Thresholds for Patient-Reported Outcome Measures**

Patient-Reported Outcome	Subscale	Score Range	Clinical PASS Threshold	Domain	Score Interpretation
International Knee Documentation Committee form <sup>27</sup>		0–100	≥75.9	Knee-specific measures of function, symptoms, and sport-specific activity	Higher score is better
Knee Osteoarthritis Outcome Score <sup>27</sup>					
	Pain	0–100	≥88.9	Pain	Higher score is better
	Symptoms	0–100	≥57.1	Knee symptoms	Higher score is better
	Activities of Daily Living	0–100	=100	Knee function during ADLs	Higher score is better
	Quality of Life	0–100	≥62.5	Knee factors affecting QOL	Higher score is better
	Sports	0–100	≥75.0	Knee function during sport-specific tasks	Higher score is better
Tampa Scale of Kinesiophobia <sup>13</sup>		17–68	≤37	Fear of reinjury, kinesiophobia	Lower score is better
Anterior Cruciate Ligament-Return to Sport after Injury <sup>18,37</sup>		0–100	≥56	Readiness to return to functional activities; patient confidence and risk appraisal	Higher score is better

In response to the growing understanding of psychological function as an important component of general wellness after ACLR,<sup>2,6,9,14,15</sup> researchers have emphasized the importance of capturing perceived disability in the form of patient-reported outcomes (PROs). Commonly captured PRO instruments include the International Knee Documentation Committee (IKDC) form, and Knee Injury and Osteoarthritis Outcome Score (KOOS).<sup>16–19</sup> These scales largely measure function, pain, symptoms, and quality of life. Additional PRO measures such as the Tampa Scale of Kinesiophobia (TSK) and ACL-Return to Sport after Injury (ACL-RSI) scale are gaining traction as tools to assess constructs related to fear of movement, pain, or reinjury and readiness to return to sport.<sup>20–22</sup> Capturing these psychological components is important because negative psychological responses may act as barriers to successful rehabilitative outcomes after ACLR.<sup>8</sup> To this point, kinesiophobia and fear of reinjury have been directly related to perceived knee disability and readiness to return to play.<sup>5,23,24</sup>

To help guide clinical decisions, published data<sup>25</sup> exist on clinical cutoffs or patient-acceptable symptom state thresholds that help to identify meaningful PRO thresholds when evaluating patient disability (Table 1). The purpose of incorporating PROs into clinical practice is to help clinicians uncover certain aspects of recovery that may not be observable solely through patient interaction and to quantify perceived function. However, a major shortcoming of PROs is that these metrics do not fully account for why some patients report greater disability than others. To overcome this limitation, the purpose of our study was to uncover factors that drive lower responses on PROs. The overall goal was to help clinicians better understand the barriers to recovery in patients who are at risk for poor psychological health after ACLR. The strength of this design is we used mixed methods (ie, qualitative interviews alongside PRO scales) to capture important aspects of therapy that cannot be reduced into numeric form and are best conveyed through patient interaction. This approach allowed us to more thoroughly examine the factors driving low responses on PRO measures, thereby filling a vital gap in the literature by understanding the barriers that disrupt ACLR recovery.

## METHODS

We used a cross-sectional, convergent, parallel mixed-methods study design to (1) comprehensively assess and characterize the factors driving responses on PROs and (2) evaluate the relationship between responses on PROs and the qualitative findings. This design allows the investigator to collect both quantitative and qualitative data at roughly the same time and then integrate the information into the interpretation of the overall results.<sup>26</sup> Patients were recruited from the local university population through flyers, e-mail servers, and posters across campus. Participants were included if they met the following criteria: (1) had undergone primary, unilateral ACLR, (2) were cleared to return to unrestricted sporting activities by their orthopaedic surgeon, (3) had no history of lower extremity surgery, (4) had no contralateral lower extremity injury in the last 6 months, and (5) understood and spoke English. During a single session, individuals completed a battery of PRO measures and then participated in a one-on-one qualitative interview to explore factors related to perceived knee disability after ACLR. We continuously enrolled volunteers who matched our eligibility requirements according to an a priori power analysis (based on the ACL-RSI scale)<sup>27</sup> that determined the number of participants ( $n = 17$ ) needed to detect differences in PRO scores. Patient recruitment continued until data saturation was achieved to ensure that power was also adequate for determining qualitative outcomes.<sup>28</sup> A total of 21 individuals who were on average 3 years removed from surgery were recruited and participated in the study. Additional demographic variables are outlined in Table 2. Participants were provided with both oral and written information regarding completion of the PRO scales as well as details regarding the interview process. Involvement was voluntary. The study was approved by the university institutional review board, informed consent was obtained before data collection, and respondents were assured of confidentiality.

## Outcome Measures

Participants completed a battery of PROs which consisted of the IKDC form, KOOS subscales, ACL-RSI scale, and TSK (Table 1). These scales are commonly used to measure knee disability; pain, symptoms, quality of life, and

**Table 2. Participant Demographics**

Characteristic	No. or Mean $\pm$ SD
Sex	11 females, 10 males
Age, y	20.90 $\pm$ 2.86
Height, cm	172.0 $\pm$ 11.03
Mass, kg	71.52 $\pm$ 13.59
Years since surgery	3.66 $\pm$ 3.03
Graft type	16 patellar tendon, 5 hamstrings
Tegner Activity Score	6.88 $\pm$ 1.56

readiness to return to functional activities; and fear of reinjury, respectively. After the participants completed the PRO instruments, we conducted exploratory qualitative semistructured interviews to obtain a deeper understanding of the barriers and facilitators influencing recovery after ACLR. A semistructured interview guide (Supplementary File 1; available online at <http://dx.doi.org/10.4085/1062-6050-120-19.S1>) was used to maintain consistency of questions. The interview guide was developed based on current literature<sup>6,29–31</sup> related to physical and psychosocial factors often experienced after traumatic knee-joint injury. Before the start of data collection, 2 highly experienced content experts in the field of sports psychology and qualitative methodology independently reviewed the interview guide for content, clarity, and topic flow. Revisions were made based on the content experts' comments, and the guide was pilot tested for readability with 3 individuals who had undergone ACLR. Further revisions to the interview guide were made as necessary based on their feedback. All interviews were conducted by the primary author (J.P.B.), lasted on average between 15 and 20 minutes and were digitally recorded and transcribed verbatim.

### Quantitative Data Analysis and Management

Participant demographics and descriptive information on PROs can be found in Tables 1 through 3. A 4-step analysis was used (1) to explore the factors driving responses on the PROs and (2) to evaluate the relationship between responses on the PROs and our qualitative findings. We performed a hierarchical cluster analysis using the Ward method based on the squared Euclidean distance to categorize participants by their responses on the PRO instruments.<sup>32</sup> To identify which PRO measure was driving the difference between clusters, we performed independent *t* tests to compare PRO scores between the high and low perceived disability clusters. To determine if differences existed in qualitative theme distributions between clusters, we conducted additional independent *t* tests. Lastly, to see if a clinical link was present between PRO responses and factors reported to influence patient responses, Spearman  $\rho$  correlations were calculated to look for associations between the PRO measures and qualitative subtheme distributions.

### Qualitative Data Analysis and Management

Qualitative data were analyzed using a general inductive approach.<sup>33</sup> Compared with other methods of qualitative analysis, such as phenomenology (which seeks to uncover the meaning within a shared experience), the general inductive approach derives concepts or themes through interpretations of raw participant data to support the

research objectives.<sup>33</sup> Each transcribed interview ( $n = 21$ ) was initially read by 3 authors to acquire an understanding of the participant's experiences, values, and responses regarding the experience after ACLR. The authors performed multiple readings of the qualitative data to appropriately identify the themes and categories that emerged from the data. Transcripts were coded, which allowed a coding frame to be developed. If new codes emerged, the coding frame was altered to include the new code, and transcripts were then reanalyzed to incorporate the new term. Once all inductive codes were identified in the transcripts, common findings were grouped and conceptualized into broad themes representing the participants' perceptions and experiences after ACLR.

### Trustworthiness

Several methods were used to establish data credibility and trustworthiness. A researcher well versed in qualitative analyses (J.S.H.) reviewed and challenged developing categories and themes identified during the multiple-analyst triangulation to ensure credibility and minimize bias in the interpretation of results. A peer reviewer then classified 295/389 codes (75% of the data) into a particular subtheme with 96% accuracy. Triangulation between researchers (J.P.B., L.F.) and peer review by an experienced researcher (J.S.H.) ensured that the data-analysis process appropriately represented the emergent themes from the interviews. Additionally, generated themes were circulated by e-mail to each participant for member checking.<sup>28,33</sup> The purpose of member checking was to provide each participant the opportunity to read the exhaustive description of themes to ensure that it accurately represented his or her experience and perceptions regarding perceived disability after ACLR. We received verification from all individuals that the generated themes accurately depicted their experiences; no modifications were suggested. The distribution of themes reported by each participant was calculated by taking the number of statements or codes for a specific theme and dividing by the total number of statements or codes from the participant for each overarching theme.

### RESULTS

The hierarchical cluster analysis revealed 2 clusters that were defined as high and low levels of perceived disability. *Disability*, as defined by the International Classification of Functioning, Disability and Health refers to "impairments, activity limitations and participation restrictions and denotes the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors)."<sup>34(p2)</sup> Eleven participants were categorized as having a low level of perceived disability and 10 as having a high level (Table 3). Independent *t* tests after the cluster analysis revealed that individuals in the low perceived disability cluster scored better on all PRO measures ( $P < .05$ ) except the KOOS-Activities of Daily Living (ADL) scores, which displayed no differences between groups ( $P = .061$ ). The KOOS-Quality of Life (QOL) subscale scores demonstrated large group differences and predicted 85% of the variance between clusters.

Qualitative data analysis revealed 2 overarching themes with 4 independent subthemes. The first overarching theme,

**Table 3. Patient-Reported Disability Cluster Analysis**

	International Knee Documentation Committee Form	Knee Osteoarthritis Outcome Score					Tampa Scale Kinesiophobia	Anterior Cruciate Ligament Return to Sport after Injury Scale	
Participant		Pain	Symptoms	Activities of Daily Living	Quality of Life	Sports			
Cluster 1- Low Disability	1	89.66	86.11 <sup>a</sup>	64.29	97.06 <sup>a</sup>	95	87.5	25	83.3
	2	80.46	88.89 <sup>a</sup>	85.71	91.18 <sup>a</sup>	80	87.5	33	79.16
	5	96.55	97.22	82.14	100	100	81.25	33	85
	7	93.1	97.22	89.29	100	95	100	22	100
	9	87.36	94.44	89.29	98.53	90	93.75	26	99.2
	10	95.4	97.22	100	100	90	93.75	25	95.83
	13	87.26	97	96	100	100	81	27	95.83
	14	77.1	97	93	100	95	100	31	99.16
	16	72.41*	100	100	100	100	100	30	63.33
	19	96.55	97	96	100	100	88	33	65.83
21	98.85	89	89	100	100	81	28	100	
Average	89.42	95.22	89.9	99.56	96.5	90.62	28	88.75	
Cluster 2- High Disability	3	86.21	91.67	78.57	100	80	75	39.00 <sup>a</sup>	64.16
	4	71.26 <sup>a</sup>	91.67	92.86	100	90	68.75	37.00 <sup>a</sup>	51.60 <sup>a</sup>
	6	66.67 <sup>a</sup>	75.00 <sup>a</sup>	53.57 <sup>a</sup>	92.65 <sup>a</sup>	75	50.00 <sup>a</sup>	39.00 <sup>a</sup>	45.83 <sup>a</sup>
	8	82.76	83.33 <sup>a</sup>	85.71	100	90	81.25	35	83.33
	11	65.52 <sup>a</sup>	75.00 <sup>a</sup>	71	96.00 <sup>a</sup>	75	63	38.00 <sup>a</sup>	33.33 <sup>a</sup>
	12	58.62 <sup>a</sup>	94	86	100	65.00 <sup>a</sup>	56.00 <sup>a</sup>	35	50.00 <sup>a</sup>
	15	71.26 <sup>a</sup>	89	75	100	60.00 <sup>a</sup>	50.00 <sup>a</sup>	38.00 <sup>a</sup>	45.83 <sup>a</sup>
	17	67.82 <sup>a</sup>	92	79	97.00 <sup>a</sup>	75	56.00 <sup>a</sup>	26	66.66
	18	68.97 <sup>a</sup>	78.00 <sup>a</sup>	79	90.00 <sup>a</sup>	50.00 <sup>a</sup>	56.00 <sup>a</sup>	36	65
	20	80.46	94.44	85.71	100	75	62.5	37.00 <sup>a</sup>	66.66
Average	72.73	86.64	79.28	96.98	74.09	64.18	35.73	59.23	
P-value	p <.0001	0.005	0.033	0.061	<.0001	<.0001	<.0001	<.0001	

<sup>a</sup> Score does not meet the recommended PASS cutoff.

internal factors, comprised internal facilitators and barriers subthemes. The second overarching theme was external factors, which consisted of external facilitators and barriers subthemes. Each subtheme is described in the subsequent section and accompanied by quotations from participants who best represented the data. Additional supplementary participant quotes specific to each subtheme are given in Table 4. The distributions of statements by subtheme and cluster differences were also calculated and are presented in Table 5. Overall, the high and low perceived disability clusters differed in the distribution of reported statements related to internal and external subthemes. Specifically, patients with a high level of perceived disability reported more frequent barrier-related experiences during recovery (Table 5). Alternatively, those with a low level of perceived disability experienced more facilitators during recovery. Spearman  $\rho$  correlations also revealed significant associations between the TSK, ACL-RSI, KOOS-QOL scale scores and qualitative subthemes (Table 6). Specifically, lower TSK, greater ACL-RSI, and KOOS-QOL scores were associated with both perceived internal and external facilitators, highlighting a feasible way of assessing these disability constructs after ACLR.

## Theme 1: Internal Factors

Internal factors included both facilitator and barrier constructs. These constructs encompassed factors that the patient had the ability to control, including intrinsic, self-driven characteristics experienced during the recovery process (Table 4). The internal barriers subtheme described obstacles that impeded recovery such as avoidance behaviors, mental blocks to activity participation, fear of reinjury, feelings of incapacity, and negative emotions. Despite allocation to the high or low perceived disability clusters, all participants felt they experienced negative psychological emotions at some point after the ACL injury, which acted as an impedance to their success. Scores for participant 15 (high perceived disability group) on the TSK, ACL-RSI, and KOOS-QOL were poor. During the qualitative interview, they often spoke of negative emotional factors that were challenging to overcome and adversely influenced recovery: "Definitely the emotional [aspects] because you don't want to go too hard because you're always thinking like, what if I tear it again. . . cause it's not as strong as the original one." Additionally, feeling less confident about the reconstructed limb made the participant more fearful of reinjury: "I'm actually less

**Table 4. Themes and Subtheme Descriptions**

Theme	Subtheme	Description	Examples of Participant Statements
Internal factors	Internal facilitators	<ul style="list-style-type: none"> <li>•Individual motivation toward recovery</li> <li>•Feelings of influence over recovery progress (internal locus of control)</li> <li>•Desire to return to previous levels of activity</li> <li>•Confidence in affected limb</li> </ul>	Participant 13: "Push yourself but not too much, know your body. . . I have faith that my leg can do it."
	Internal barriers	<ul style="list-style-type: none"> <li>•Avoidance behaviors, mental blocks to activity participation</li> <li>•Fear of reinjury</li> <li>•Feelings of incapacity in injury event or process</li> <li>•Negative emotions regarding event and rehabilitation progress</li> </ul>	Participant 12: "I don't do a lot of the same activities as a lot of other people. . . I feel like I'm actually still a little less confident in what I can do versus what I actually can do because I'm still worried that deep down I'm going to do something to mess everything up again." Participant 17: "I think the most difficult part, because it was such a long recovery, was the slowness of it. It was so frustrating at times that I couldn't do the simplest things."
External factors	External facilitators	<ul style="list-style-type: none"> <li>•Encouragement from friends, teammates, and coaches</li> <li>•Support to involved knee such as bracing and strength training</li> <li>•Clear expectations of the rehabilitation process</li> </ul>	Participant 10: "My parents and even my friends were unbelievable [helpful]."
	External barriers	<ul style="list-style-type: none"> <li>•Limitations in coverage of treatment</li> <li>•Persistent symptoms (pain, range of motion, etc)</li> <li>•Inattention of providers to individual's status</li> </ul>	Participant 18: "I'm having a hard time sometimes when I cut, like I feel it tighten sometimes. . . and sometimes when I do squats I lean more to my right side." Participant 20: "Sport-specific skills are definitely not the same."

confident in what I think I can do versus what I can physically do because I'm still worried that deep down I'm going to do something to hurt myself." Participant 11 also spoke frequently of mental barriers after ACLR that ultimately made recovery more challenging:

I think more mentally than physically, like I'm still cautious. The fear of retearing my ACL or doing

something to screw up my surgery—I haven't even gotten on a mountain bike since before my surgery because, is that one ride really worth being on crutches?

The second subtheme was internal facilitators, which included characteristics such as intrinsic motivation, feelings of control over recovery, internal locus of control, and desire or motivation to return to the previous sporting

**Table 5. Theme-Related Statements Reported by Each Participant and Cluster Differences**

Participant	Percentage				Cluster: High or Low Perceived Disability
	Internal Facilitators	Internal Barriers	External Facilitators	External Barriers	
1	61	39	50	50	Low
2	45	55	85	15	Low
5	45	55	73	27	Low
7	64	36	85	15	Low
9	90	10	64	36	Low
10	53	47	82	18	Low
13	53	47	29	71	Low
14	59	41	43	57	Low
16	45	55	61	39	Low
19	22	78	38	62	Low
21	80	20	100	0	Low
Mean $\pm$ SD	56 $\pm$ 18	44 $\pm$ 18	64 $\pm$ 23	36 $\pm$ 23	$P = .001$
3	20	80	31	69	High
4	20	80	43	57	High
6	43	57	32	68	High
8	22	78	47	53	High
11	25	75	19	81	High
12	50	50	50	50	High
15	25	75	33	67	High
17	24	76	60	40	High
18	50	50	75	25	High
20	24	76	69	31	High
Mean $\pm$ SD	30 $\pm$ 12	70 $\pm$ 12	46 $\pm$ 18	54 $\pm$ 18	$P = .001$

**Table 6. Correlations Between Patient-Reported Outcome Scores and Qualitative Themes**

Patient-Reported Outcome	Subscale	Internal Facilitators	Internal Barriers	External Facilitators	External Barriers
International Knee Documentation Committee form Knee Osteoarthritis Outcome Score		$\rho = 0.331, P = .143$	$\rho = -0.331, P = .143$	$\rho = 0.397, P = .075$	$\rho = -0.397, P = .075$
	Pain	$\rho = 0.225, P = .327$	$\rho = -0.225, P = .327$	$\rho = 0.254, P = .266$	$\rho = -0.254, P = .266$
	Symptoms	$\rho = 0.233, P = .310$	$\rho = -0.233, P = .310$	$\rho = 0.243, P = .289$	$\rho = -0.243, P = .289$
	Activities of Daily Living	$\rho = -0.095, P = .683$	$\rho = 0.095, P = .683$	$\rho = -0.055, P = .812$	$\rho = 0.055, P = .812$
	Quality of Life	$\rho = 0.428, P = .05^a$	$\rho = -0.428, P = .05^a$	$\rho = 0.327, P = .148^a$	$\rho = -0.327, P = .148^a$
	Sports	$\rho = 0.306, P = .177$	$\rho = -0.306, P = .177$	$\rho = 0.134, P = .561$	$\rho = -0.134, P = .561$
Tampa Scale of Kinesiphobia		$\rho = -0.689, P = .001^a$	$\rho = 0.689, P = .001^a$	$\rho = -0.513, P = .017^a$	$\rho = 0.513, P = .017^a$
	Anterior Cruciate Ligament-Return to Sport after Injury	$\rho = 0.651, P = .001^a$	$\rho = -0.651, P = .001^a$	$\rho = 0.548, P = .01^a$	$\rho = -0.548, P = .01^a$

<sup>a</sup> Significant correlation ( $P < .05$ ).

level. Such factors generated a sense of self-motivation among participants to resume sporting or functional activities and a strong desire to maintain their health and quality of life. Participant 7 (low perceived disability group) scored well on the TSK, ACL-RSI, and KOOS-QOL and often cited internal facilitators, acknowledging immense intrinsic motivation to rebuild physical ability in order to remain healthy and active:

I was so motivated to improve once I was cleared to do anything I needed to do during rehabilitation. . . [I used] motivational factors of my own. I was very intrinsically motivated. I just wanted to be as healthy as I could be, as fast as I could be.

Participant 10 (low perceived disability) also heavily emphasized the desire to return to functional activities: “I wanted to keep playing sports for a while. . . so there is not a reason to sulk, and I knew if I did a good job with physical therapy [that] I would be better off postrehab” and used intrinsic motivation strategies for help during recovery: “I was pretty self-motivated. . . [after the injury], it just really motivated me to not ever have someone have to care for me like that again.”

## Theme 2: External Factors

External factors that emerged from the qualitative analysis consisted of external facilitators and barriers. Unlike the constructs in the internal subthemes, external factors described more extrinsic and objective characteristics that patients were not able to actively control. These characteristics were related to external support structures and physical limitations to appropriate care. This theme also encompassed both acute and persistent physical symptoms such as pain and lack of range of motion.

When we closely examined the external barriers experienced by participants, symptoms and restricted therapeutic rehabilitation were among the most commonly reported factors that negatively influenced recovery. Many individuals felt that they would have benefitted from more rehabilitation (especially during the return-to-sport phase)

and that this was the reason they continued to struggle with muscle weakness well after discharge. To this point, participant 6 (high perceived disability group) scored poorly on PRO measures of physical disability (IKDC, KOOS pain, symptoms, sport) and reported persistent knee symptoms and pain that inhibited physical ability: “I still have a lot of locking when I sit for too long. . . and I have pain when I sit in the same position for a long time.” These physical symptoms also affected the participant’s level of physical activity: “My functioning is not where it should be.” Participant 17 (high perceived disability group) also described unfavorable perceptions regarding physical therapy due to painful stimuli: “I dreaded going [to physical therapy] because I knew they were going to push it a little farther every day, and I felt that my knee was going to snap, and I hated it.” Participant 4 commented on the lack of physical therapy as a barrier to regaining strength after ACLR:

I was frustrated [that I only got 4 months of therapy] because we couldn’t fully get the whole [physical function back]. . . we did jumping stuff, cutting stuff as much as we could, but I never felt like I got my full strength back. . . everything else I did on my own.

Respondents often spoke of these external barriers as factors that they could not control. They strongly believed that inattention by their provider during the recovery process led to persistent deficits and physical symptoms and ultimately hindered their current activities of daily living.

The subtheme of external facilitators comprised characteristics including encouragement and social support from friends, teammates, and parents. Such factors generated a network of extrinsic support and motivators that helped to ease recovery. Patients also addressed their use of external physical devices such as knee braces during recovery. Participant 19 (low perceived disability group) scored well on the PRO instruments that evaluated physical ability and commented on using the brace as a support during activity: “I feel like I can do any sport I want to do, but I always wear the brace.” The brace provided more security and confidence during physical activities: “My whole goal was

to play sports again, and I feel like I can play any sport I want.” Similarly, Participant 5 (low perceived disability group) felt external social support was helpful during recovery and helped improve perceived physical ability, noting “My parents were really supportive, and my friends and teammates were always asking me if I was okay and making sure that I was good and telling me that they missed me.” Additionally, understanding what to expect throughout the recovery process was crucial to staying positive:

I felt like I did mentally prepare myself [for what to expect after ACLR] but not enough. . . [after the surgery], I was like, “Oh, wow, this is really hard. I really do need help getting up and moving around or that sort of thing”. . . so that’s an important thing, making sure you know what to expect but also that [it] will improve.

The support of an athletic trainer or physical therapist played a crucial role in the recovery process after ACLR:

I think that [athletes need additional support] from their athletic trainer or physical therapist. It’s really important to understand that those health care providers are there for them and have their best interest in mind.

## DISCUSSION

Our purpose was to more fully characterize the underlying factors driving lower scores on PRO measures through the use of qualitative interviews. We also sought to evaluate the relationship between responses on PROs and our qualitative findings to better inform clinical practice. As many of these PROs can provide important context regarding physical and psychological perceived disability, it is important for clinicians to be able to appropriately use these tools when directing care after ACLR. Understanding how other underlying perceptions that are often not easily identified through traditional PRO scores influence overall outcomes and general wellness after ACLR is also clinically valuable. This information can be used to identify individuals who do not perceive themselves as “well” and who may have greater disability. Further, exploration of factors that drive an individual’s responses on PROs may help to identify constructs during the recovery phase that can influence long-term health and quality of life, providing a viable opportunity for clinical interventions.

Not surprisingly, our findings emphasize that broad variations in patient-perceived disability can surface in the years after ACLR. The cluster analysis (Table 3) provided clear evidence that failing to address physical and psychological measures of perceived function during recovery may result in greater disability and reduced quality of life in some patients after ACLR (ie, high perceived disability cluster). Our cluster analysis was further supported by between-clusters comparisons, which revealed differences between the high and low perceived disability clusters on all PRO measures except the KOOS-ADL ( $P = .06$ ; Table 3), demonstrating that this scale may have limited utility after ACLR. Notably, the KOOS-QOL subscale score was the factor that largely distinguished the high and low perceived disability clusters.

Significant differences were present in qualitative subthemes (internal and external facilitators or barriers) between the high and low perceived disability clusters (Table 5). Participants in the low perceived disability cluster experienced more internal and external facilitators; they reported greater internal motivation or internal locus of control, confidence, a stable support network, and clear expectations of the recovery process. Alternatively, more internal and external barriers were found in the high perceived disability cluster group, with individuals describing greater avoidance tendencies, fear of reinjury, physical symptoms, and limitations during postoperative rehabilitation. These findings are clinically important and agree with previous literature,<sup>6,30,35–37</sup> as they directly showed that individuals who used more internally focused approaches and received external support during rehabilitation demonstrated less disability. Further respondents who reported greater internal distress and external barriers also performed worse on PRO measures. Previous researchers highlighted that individuals who described greater hesitancy, fear of reinjury, and heightened awareness of their knee after ACLR often did not return to the preinjury level of sport<sup>6</sup> and performed worse on measures of patient-perceived function.<sup>15</sup> Together, these results indicate that identifying factors within the patient’s control, such as intrinsic motivation strategies, and recognizing factors that may be external to the patient (ie, social support) but can bolster positive rehabilitation outcomes<sup>38,39</sup> are crucial. It is also clinically important to note that, although the low perceived disability group reported fewer internal barriers than the high perceived disability group, both groups experienced similar barriers during recovery; however, these were less intense in the low perceived disability group. This points to the possibility that patients after ACLR often experience similar consequences, but the outcomes of their individual rehabilitation programs may be improved based on their ability to control certain barriers or their access to certain facilitators.

To provide clinicians with a feasible way to identify potential barriers during recovery in patients who may be at risk for poor psychological health after ACLR, we established a link between PRO scores and our qualitative findings. Individuals who scored better on the TSK, ACL-RSI, and KOOS-QOL described more internally driven facilitators, which included greater internal motivation, confidence, and desire to return to physical activities. Those with better scores on the TSK and ACL-RSI also reported more external facilitators, including greater social support, support from rehabilitation specialists, and a better understanding of what to expect after surgery and throughout recovery. Similar to having external support systems, clear expectations of the rehabilitation process post-ACLR was also pertinent. Unfortunately, although a majority of patients (84%) expected to return to their preinjury level of play before surgery, only about 24% actually did so.<sup>40</sup> This highlights the disconnect between patients’ expectations and reality during and after ACLR and emphasizes the importance of establishing realistic patient expectations. Our findings also indicated that the TSK and ACL-RSI scales captured constructs related to both internal and external aspects of recovery, which have important implications for postoperative success.

Previous investigators<sup>37,41</sup> have shown that greater fear of reinjury and less readiness to resume functional activities are associated with suboptimal outcomes after ACLR, including a higher risk of reinjury and reduction or cessation of sports participation. Additionally, despite achieving satisfactory knee function, a patient's fear of reinjury is often cited as a major contributor to why he or she may choose not to resume sports after ACLR.<sup>6,8</sup> Our study supports similar findings in which individuals who scored worse on the TSK, ACL-RSI, and KOOS-QOL communicated greater fear of reinjury and more avoidance behaviors during their interview sessions. Specifically, they felt they would have benefitted from additional activity-specific rehabilitation therapy that was dedicated to increasing confidence and self-efficacy during the reintegration of functional movement patterns (Table 4). Participants with greater fear (indicated on the TSK) and less readiness to resume functional activities (indicated on the ACL-RSI) also experienced more external barriers after ACLR, such as more persistent knee symptoms, inability to continue rehabilitation due to insurance limitations, and less support from individual health care providers. Together, these findings showed that the TSK, ACL-RSI, and KOOS-QOL can identify underlying barriers to successful outcomes that may be targeted during rehabilitation. When clinical time is limited, using such scales to identify those individuals who may benefit from additional support or psychological counseling or both may be valuable. Further, these tools may be helpful to clinicians when making decisions regarding the resumption or continuation of physical activity, as well as reflecting the patient's overall quality of life. Thus, it is important for clinicians to discuss the PRO findings with their patients to help overcome barriers and facilitate positive outcomes after ACLR. As many of these barriers and facilitators influencing recovery are modifiable, intervention strategies can be used to mitigate these factors. Interventions that bolster psychological wellness include strategies such as guided imagery,<sup>42,43</sup> goal setting,<sup>44</sup> and relaxation techniques.<sup>45</sup>

## Practical Applications

- (1) Patients who report more avoidance tendencies, fear, lack of expectations, and lack of a social support network described greater perceived disability on common PRO measures used after ACLR.
- (2) The TSK, ACL-RSI, and KOOS-QOL instruments were the best scales for identifying individuals who may be experiencing more avoidance behaviors or fear or who may receive inadequate social support or attention from providers after ACLR.
- (3) Clinicians should address (either through the use of PROs or discussions with patients) the potential barriers and facilitators that patients experience to facilitate recovery after ACLR.

## Limitations

The cohort of individuals in this study was a sample of convenience from the local university population. As such, we enrolled participants with mixed graft types, and we were not able to control their postoperative rehabilitation.

Given the retrospective nature of the data collection and the time since ACLR, the perceptions recalled by participants should be viewed as representations of their experiences closer to surgery. Hence, their ability to recall specific information regarding recovery may have been different than with acute recall. Although this recall bias is a possible limitation of our study, it is also a strength because participants who had more time since ACLR could fully process and reflect on their experiences. It is interesting to note that many of our respondents, despite being several years post-ACLR, still did not achieve patient acceptable symptom score (PASS) clinical thresholds on several PRO measures (Table 3). This may indicate that those who experienced more obstacles or barriers during recovery may have a more difficult time leading an active, healthy lifestyle after ACLR. Future researchers should continue to evaluate clinical thresholds for common PRO measures in various active populations. Lastly, due to the smaller convenience sample, we were unable to evaluate outcomes based on sex, time from injury, current age, or age at the time of surgery. Future prospective, longitudinal studies should evaluate PRO scores and perceived disability during earlier stages of rehabilitation after ACLR.

## CONCLUSIONS

Patient-reported outcome instruments aimed at evaluating psychological wellness, specifically the TSK, ACL-RSI, and KOOS-QOL, can capture both internal and external constructs that influence perceived wellness. These outcome tools can be helpful in identifying patients after ACLR who would benefit from additional support or psychological counseling or both. Our data collectively highlight the importance of recognizing and addressing common barriers (ie, avoidance behaviors or fear, insurance limitations) and facilitators (ie, greater internal locus of control, confidence, social support, clear expectations) experienced during ACLR recovery to provide more comprehensive patient-centered care.

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