

# Return to Sports After Anterior Cruciate Ligament Reconstruction

## Validity and Reliability of the SPORTS Score at 6 and 12 Months

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**Background:** The Subjective Patient Outcome for Return to Sports (SPORTS) score is a single-item scale that measures athletes' ability to return to their preinjury sport based on effort and performance.

**Purpose/Hypothesis:** The purpose of this study was to examine the psychometric properties of the SPORTS score and a modified score within the first year after anterior cruciate ligament reconstruction (ACLR). The modified version replaced "same sport" with "any sport" in the answer choices. It was hypothesized that both versions of the SPORTS score would have acceptable floor and ceiling effects and internal responsiveness, moderate convergent validity, and excellent test-retest reliability.

**Study Design:** Cohort study (diagnosis); Level of evidence, 2.

**Methods:** Patients were recruited preoperatively from 2 academic medical centers. The authors collected responses to the 1-item SPORTS scores at 6 and 12 months after ACLR and the Tegner activity scale, Lysholm knee score, Knee injury and Osteoarthritis Outcome Score (KOOS)–sport/recreation subscale, and Marx activity rating scale preoperatively and 6 and 12 months after ACLR. Ceiling and floor effects and responsiveness were assessed using descriptive statistics and cross-tabulations, respectively, at both follow-up time points. Spearman correlations and intraclass correlation coefficients were used to examine convergent validity and test-retest reliability, respectively.

**Results:** Follow-up rates at 6 and 12 months were 100% and 99%, respectively. Test-retest follow-up was 77%. Floor effects for the SPORTS scores were not observed, while ceiling effects at 12 months ranged from 38% to 40%. Cross-tabulation of the SPORTS scores showed that 64% to 66% of patients reported a change in their score from 6 to 12 months, with significant differences noted between the proportions that improved versus worsened for return to any sport. Convergent validity was observed at 6 and 12 months via moderate correlations with the Tegner, Lysholm, KOOS–sport/recreation, and Marx scores ( $r = 0.31$  to  $0.47$ ). Fair to good test-retest reliability (intraclass correlation coefficient, 0.58 and 0.60) was found at 12 months after ACLR.

**Conclusion:** The SPORTS score appears to be a reliable, responsive, and valid 1-item scale that can be used during the first year after ACLR. No differences in psychometric properties were found between the SPORTS score and the modified version.

**Keywords:** return to sport; ACL reconstruction; validation study; short-term outcomes; patient-reported outcomes

Anterior cruciate ligament (ACL) injuries are common in young athletes participating in sports that involve cutting, jumping, and pivoting movements.<sup>22</sup> ACL ruptures are generally treated with ACL reconstruction (ACLR) to restore knee stability and function in order to allow athletes to return to their preinjury level of sports participation.<sup>14,35</sup>

This return-to-sports (RTS) component is key, as many athletes expect to resume their sport within 12 months of ACLR.<sup>3,34,35</sup> A recent consensus statement from the First World Congress in Sports Physical Therapy proposed an RTS spectrum, including (1) return to participation, (2) RTS activity, and (3) return to preinjury level of performance.<sup>1</sup> A meta-analysis by Ardern et al<sup>2</sup> found that despite 81% of participants returning to any sport, only 65% returned to their preinjury level of performance. Additional studies have shown that RTS varies from 31% to 83%

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within 12 months of ACLR, with great variability in competition level of sport.<sup>3,26,29,47,51</sup> The wide range in RTS across studies may be due to various factors, such as inclusion criteria relating to type of athlete (competitive vs recreational) or primary sport (football vs soccer) and the lack of a standardized outcome measure.

To date, RTS has been assessed using measures that were not developed to assess this specific construct. One of the most commonly used RTS measures is the Tegner activity scale.<sup>20,23,28</sup> However, the Tegner scale<sup>49</sup> was developed to complement the Lysholm knee score, not as an RTS measure but as a scale to assess activity level related to walking, running, work, and sports. The Tegner and Lysholm scores have been proven to be reliable and valid assessments of work and sports activities and knee function and impairment, respectively, in patients undergoing ACLR.<sup>6,12,45,49</sup> Additional measures that have been used to assess RTS include the Marx activity rating scale and the Knee injury and Osteoarthritis Outcome Score (KOOS)–sport/recreation subscale.<sup>15,20,32</sup> The Marx scale was developed as an activity rating scale and validated against other activity scales,<sup>32</sup> while the KOOS–sport/recreation subscale was developed as a functional assessment of sports and recreational activities (ie, squatting, running, jumping, turning/twisting, and kneeling) and validated against physical health measures such as the 36-Item Short Form Survey (SF-36).<sup>41-43</sup> In addition, studies have reported that these measures have weak correlations with objective assessments of physical performance and activity and are unable to measure large changes in activity level and rank athletes by level or frequency of sports participation, which are important aspects of RTS.<sup>7,8,40</sup> Overall, the most commonly used RTS measures have been ones that were designed to assess activity and function and not RTS directly.

One tool that holds promise as an RTS measure is the 1-item Subjective Patient Outcome for Return to Sports (SPORTS) score,<sup>9-11</sup> which was designed to measure athletes' ability to return to their preinjury sports at the same level of effort and performance. While the SPORTS score was initially used in athletes undergoing arthroscopic capsulectomy and/or osteocapsular arthroplasty,<sup>11</sup> it has since been assessed in athletes after surgery for shoulder instability.<sup>9</sup> One study has assessed the SPORTS score in patients after ACLR<sup>10</sup>; however, Blonna et al<sup>10</sup> focused on

longer-term follow-up (ie, 5-10 years). Additional work is needed to understand the reliability and validity of the SPORTS score within the first year after ACLR. Structured rehabilitation and clearance for RTS commonly occurs during the first year after surgery,<sup>34,35</sup> and it is critical that a reliable and valid RTS outcome measure is available to assess effort and performance during this phase of recovery.

The primary purpose of this study was to examine the psychometric properties of the SPORTS score at 6 months and 12 months after ACLR. Since the SPORTS score assesses return to the *same sport*, a secondary objective was to examine psychometric properties in a modified version of the SPORTS score that assesses return to *any sport*. We hypothesized that both versions of the SPORTS score would have acceptable floor and ceiling effects, acceptable internal responsiveness, and moderate convergent validity at 6- and 12-month follow-ups and excellent test-retest reliability at 12 months. The SPORTS score, which was developed to assess RTS and rank athletes by level of sports participation, has the potential to address the limitations of other measures commonly used to assess RTS.

## METHODS

Institutional review board approval for this study was received from the participating sites, and all participants provided written informed consent before study enrollment. This psychometric study was embedded within a randomized controlled trial (NCT03243162). A total of 163 patients aged 14 to 35 years were screened for recruitment before an ACLR from 2 academic medical centers, Vanderbilt University Medical Center and Cleveland Clinic, between June 2017 and January 2019. Patients were excluded if they had a complex knee injury with additional ligament tears (n = 5), had a previous knee surgery (n = 4), were not participating in a sport on a weekly basis before injury (n = 4), did not speak the English language (n = 3), had a medical history of schizophrenia or other psychotic disorders (n = 2), and had a revision ACLR (n = 1). Additional exclusion criteria included (1) a time from injury to surgery of >12 months (n = 1), (2) simultaneous bilateral ACLRs (n = 1), (3) a workers' compensation claim (n = 1), (4) concurrent osteotomies or meniscal transplantations (n = 1), (5) surgery because of a traumatic event not related to

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Ethical approval for this study was obtained from Vanderbilt University (reference No. 161927).

TABLE 1  
SPORTS Score<sup>a</sup>

Category	Definition	Relative Value
Unlimited effort Unlimited performance No pain	Perform same sport at same level of effort and performance as before onset of impairment and with no pain	10
Unlimited effort Unlimited performance Some pain	Perform same sport at same level of effort and performance as before onset of impairment but with pain	9
Unlimited effort Limited performance	Perform same sport at same level of effort but reduced performance level compared with before onset of impairment	6
Limited effort Limited performance	Perform same sport but at reduced level of effort and performance compared with before onset of impairment	3
Disabled	Unable to return to same sport	0

<sup>a</sup>SPORTS, Subjective Patient Outcome for Return to Sports.

a sport (n = 1), and (6) an inability to provide a stable address and access to a telephone (n = 1).

Three people cancelled surgery and were no longer eligible. Of the 135 eligible patients, 29 declined to participate in the study, and 16 were not approached by the research coordinator. The remaining 90 patients provided consent and were randomized to cognitive-behavioral-based physical therapy or an education program before surgery. Both treatments were delivered over the telephone by physical therapists and consisted of 1 session before surgery and 6 sessions after ACLR. All patients followed the Multicenter Orthopaedic Outcomes Network ACL rehabilitation guidelines, which include preoperative recommendations and 4 postoperative phases progressed over 16 weeks. The recommended number of visits to a rehabilitation specialist is 16 to 24 visits. This protocol has been previously published.<sup>52</sup>

## Procedures

Patients completed a preoperative questionnaire that collected information on their characteristics (age, sex, race, education level, and body mass index) and sports history (primary sport and level of sport). Surgical information related to graft type and meniscal treatment was abstracted from the medical record or a prospective measurement evaluation system. Patients completed the following validated RTS-related measures before surgery and at 6 and 12 months after ACLR: Tegner activity scale, Lysholm knee score, KOOS-sport/recreation, and Marx activity rating scale. The SPORTS score and a modified SPORTS score to assess return to the same sport and any sport, respectively, were collected at the 6- and 12-month follow-up time points. To assess test-retest reliability, patients completed the SPORTS score and the modified version at an additional time within 2 to 4 weeks of the 12-month follow-up assessment. Study data were collected and managed using Research Electronic Data Capture (REDCap), a secure, web-based software platform for electronic data capture.<sup>24,25</sup>

## Outcome Measures

**SPORTS Score.** The SPORTS score has 5 response categories constructed around 3 separate concepts related to pre-injury sport: (1) ability to perform the same sport at the same or reduced level of effort, (2) ability to perform the same sport at the same or reduced level of performance, and (3) ability to perform with no pain or with pain (Table 1).<sup>11</sup> The single item of the score is rated on a 10-point scale, with 10 indicating a patient who performs the same sport at the same level of effort and performance as before onset of impairment and with no pain, and 0 indicating a patient who is unable to return to the same sport. A modified version of the SPORTS score was also used in this study to assess return to any sport. Modifications were made by replacing “same sport” with “any sport” in the response categories.

**Tegner Activity Scale.** After the initial publication of the Lysholm score, an activity level scale was developed to be used concurrently.<sup>49</sup> The single-item Tegner scale ranges from 10 (competitive sports at the elite level) to 0 (sick leave or disability pension because of knee problems). Studies have reported good to excellent test-retest reliability, and convergent validity has been demonstrated via moderate correlations with the Lysholm score, KOOS subscales, International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, and 12-Item Short Form Health Survey (SF-12) in patients with knee injuries and after ACLR.<sup>12,15,18,36,48</sup>

**Lysholm Knee Score.** The Lysholm is an 8-item questionnaire designed to evaluate the patient’s knee function.<sup>30</sup> An overall score from 0 to 100 is calculated, with scores 90 to 100 representing excellent outcomes and <65 representing a poor outcome. Studies have reported good test-reliability, moderate internal consistency, and convergent validity via moderate to strong correlations with the IKDC form, Tegner activity scale, and SF-12 in patients with ACL injuries.<sup>12,15,18,39,48</sup>

**KOOS-Sport/Recreation Subscale.** The KOOS was originally designed to evaluate a young, highly active population and measure knee-related function.<sup>42</sup> The KOOS holds 5

separately scored subscales: pain, other symptoms, function in daily living, function in sports and recreation, and knee-related quality of life. In this study, we used the 5-item KOOS–sport/recreation subscale, which rates each item using a 5-point scale, ranging from 0 (none) to 4 (extreme). The summed KOOS subscale scores are transformed to a score ranging from 0 to 100, where higher scores represent higher functioning. Previous studies have reported the KOOS–sport/recreation subscale to be reliable, valid, and responsive to change in patients with knee injuries.<sup>15,41–43</sup>

**Marx Activity Rating Scale.** The Marx has 4 items relating to running, cutting, decelerating, and pivoting that are scored on a 5-point Likert scale.<sup>32</sup> A total score ranges from 0 to 16 and is calculated by summing the scores for the individual items. Studies have reported moderate internal consistency; excellent test-retest reliability; and convergent validity via moderate correlations with the KOOS subscales, Tegner scale, and SF-12 in both healthy individuals and patients with ACL injury.<sup>32,36</sup>

### Statistical Analysis

Descriptive statistics were used to examine the mean scores ( $\pm$  SD) and frequency of all patient, sports, and surgical characteristics, as well as the patient-reported outcomes. The percentage of patients reporting the highest (10) and lowest (0) possible score on the 2 versions of the SPORTS score at 6 and 12 months after ACLR was calculated to assess floor and ceiling effects. A range of 15% to 33% for ceiling and floor effects has been considered acceptable for sports-related instruments.<sup>37,38,50</sup> Based on prior work by Blonna et al,<sup>9</sup> ceiling and floor effects for Lysholm and KOOS–sport/recreation scores were also assessed at 12 months for comparison. The Lysholm score was divided into 10-point subgroups, and the KOOS–sport/recreation score was divided into 20-point subgroups, based on the minimal detectable differences reported for these measures, in order to create categories that were comparable to the SPORTS score levels.<sup>12,37</sup> Patients with a Lysholm score of 91 to 100 and a KOOS–sport/recreation score of 81 to 100 were considered to have the highest score; those with scores of 0 to 10 and 0 to 20, respectively, the lowest possible score. Internal responsiveness was assessed using cross-tabulations with the McNemar test of the SPORTS score at 6- and 12-month follow-ups. Differences in SPORTS score responses were compared by sex at each time point using chi-square statistics.

The Spearman correlation was used to examine convergent validity via associations between the SPORTS scores (ie, return to same sport and any sport) and the Tegner, Lysholm, KOOS–sport/recreation, and Marx scores at both follow-up time points. The Spearman correlation coefficient ( $r$ ) ranges from 0 to 1, where values  $<0.3$ ,  $0.3$  to  $0.5$ , and  $>0.5$  are considered as weak, moderate, and strong validity, respectively.<sup>19</sup> The test-retest reliability of the SPORTS score and the modified version were assessed using an absolute-agreement, 2-way mixed-effects model to evaluate the intraclass correlation coefficient (ICC) 95% confidence interval (CI). The values of ICC range from 0 to 1, and  $<0.40$ ,  $0.40$  to  $0.75$ , and  $>0.75$  are considered poor, fair to good, and excellent reliability, respectively.<sup>19</sup>

TABLE 2  
Preoperative Patient, Sports, and Surgical Characteristics  
(N = 90 Participants)<sup>a</sup>

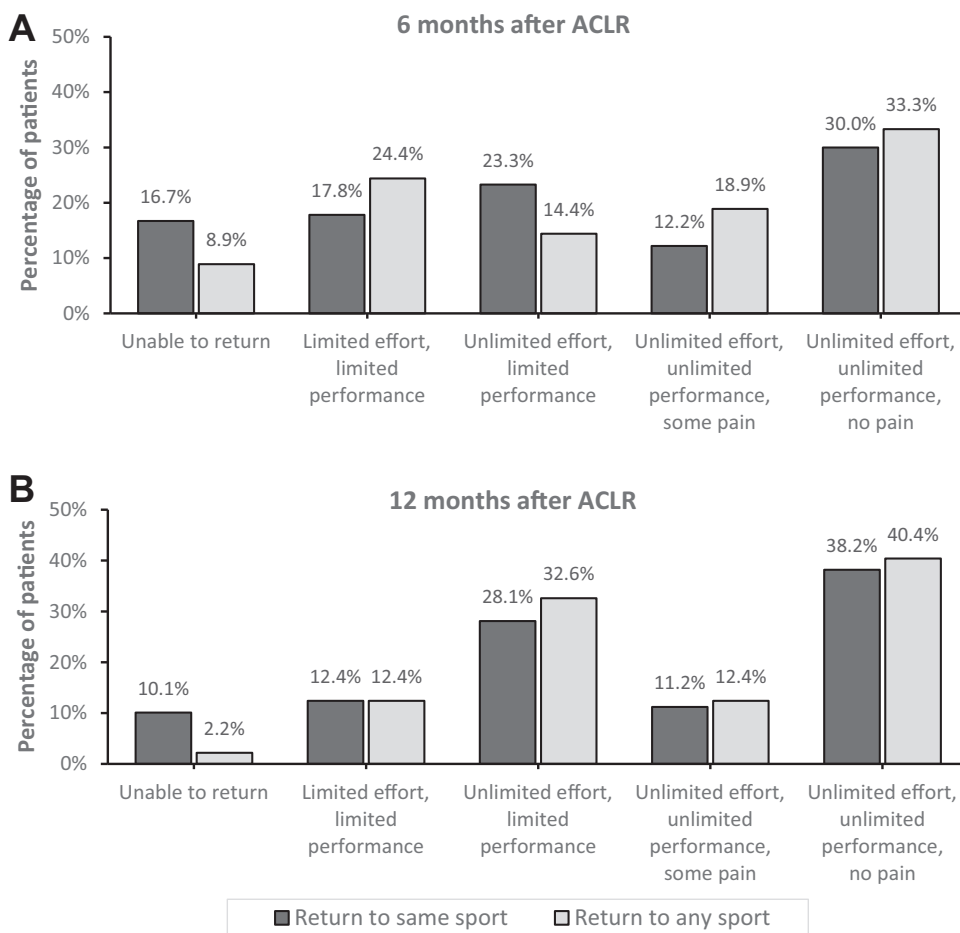
	Value
Patient and sports characteristics	
Age, y, mean $\pm$ SD	20.7 $\pm$ 5.6
Male sex	50 (56)
Race	
White	67 (74)
Black or African American	17 (19)
Other	6 (7)
BMI, mean $\pm$ SD	25.5 $\pm$ 4.6
Education, y, mean $\pm$ SD	13 $\pm$ 3.3
Primary sport	
Basketball	17 (19)
Football	20 (22)
Soccer	28 (31)
Skiing	5 (6)
Gymnastics/dance	5 (6)
Lacrosse	5 (6)
Other	10 (11)
Level of sport	
High school	46 (51)
Recreational	22 (24)
Amateur (team/club)	12 (13)
College/semipro/pro	10 (11)
Surgical characteristics	
Graft	
BTB autograft	74 (82)
Hamstring tendon autograft	16 (18)
Medial meniscus treatment	
No tear	60 (67)
Untreated tear	4 (4)
Repair	21 (23)
Excision	5 (6)
Lateral meniscus treatment	
No tear	44 (49)
Untreated tear	2 (2)
Repair	20 (22)
Excision	24 (27)

<sup>a</sup>Data are expressed as n (%) unless otherwise indicated. BMI, body mass index; BTB, bone–patellar tendon–bone; pro, professional; semipro, semiprofessional.

Based on the design of the original randomized controlled trial, sensitivity analyses by treatment group (cognitive-behavioral–based physical therapy and education) were conducted for all psychometric testing. The trial sample size was determined based on a clinically significant difference across groups in the primary outcomes of the KOOS–sport/recreation and Marx scores. Findings of the sensitivity analyses were consistent, and only data from the entire sample are reported. All analyses were performed using SPSS version 25 (IBM Corp). Statistical significance was set at  $P < .05$ .

### RESULTS

Follow-up rates were 100% (90/90) at 6 months and 99% (89/90) at 12 months. For test-retest, 77% (69/90) of



**Figure 1.** Distribution of SPORTS scores (return to same sport vs any sport) at (A) 6 months (n = 90) and (B) 12 months (n = 89) after anterior cruciate ligament reconstruction (ACLR). SPORTS, Subjective Patient Outcome for Return to Sports.

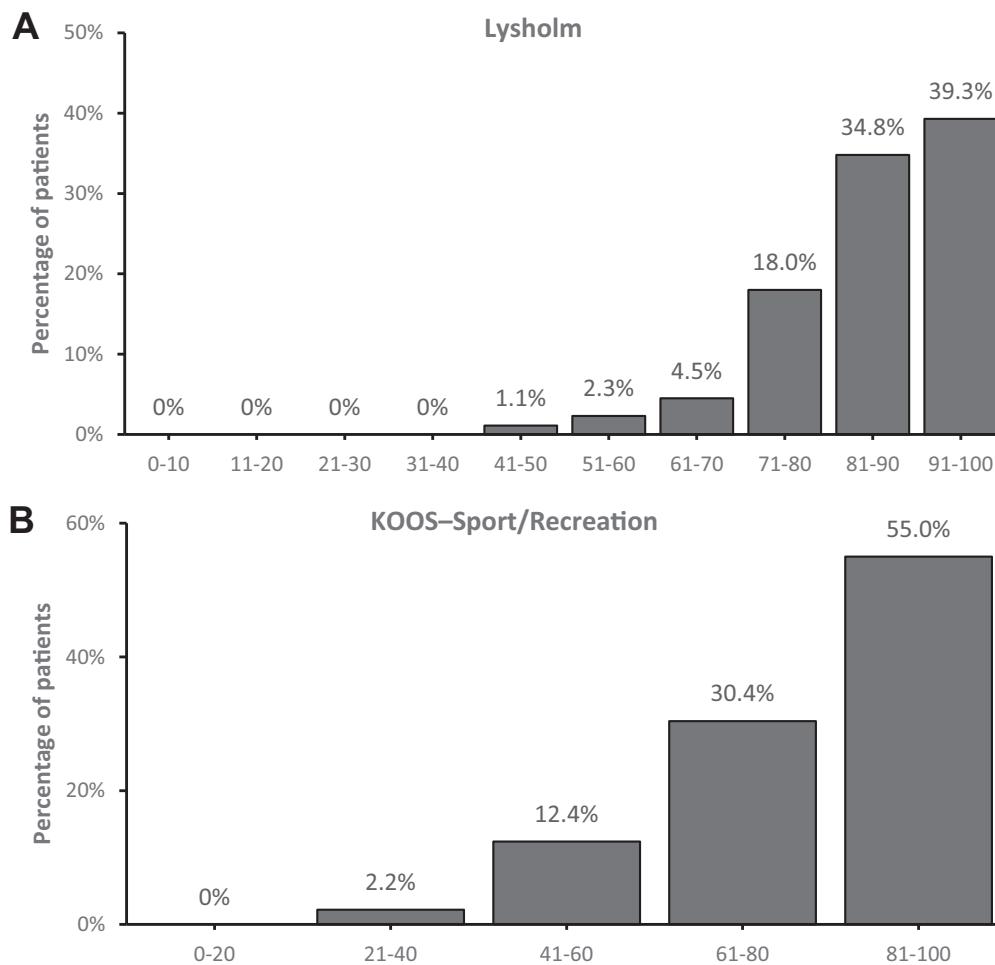
patients completed the SPORTS score twice within 4 weeks at the end of the follow-up period (ie, between 12 and 13 months after ACLR). The average age of the cohort was  $20.7 \pm 5.6$  years, and the majority were White (74%) and male (56%) (Table 2). Ten participants played a primary sport designated as other, which included baseball (n = 2), volleyball (n = 2), rugby (n = 2), golf (n = 1), rock climbing (n = 1), boxing (n = 1), and running (n = 1). The level of sport ranged from high school (51%) to recreational (24%) and collegiate or beyond (11%). Surgical techniques included bone–patellar tendon–bone autograft (82%) and hamstring tendon autograft (18%), with 67% and 49% having no medial or lateral meniscus treatment, respectively. No rehospitalizations or reinjuries were reported by participants after the ACLR procedure.

At 6 and 12 months after ACLR, respectively, 30% (27/90) and 38% (34/89) of participants returned to their same sport at the same level of effort and performance without pain, while 33% (30/90) and 40% (36/89) returned to any sport (Figure 1). For same sport and any sport, respectively, 17% (15/90) and 9% (8/90) were unable to return at 6 months, while 10% (9/89) and 2% (2/89) were unable to return at 12 months after ACLR. No significant differences

were found in the proportion of SPORTS score responses by sex at 6 or 12 months for same sport or any sport ( $P > .05$ ). Floor effects were not observed, while ceiling effects were slightly above the 33% threshold at 12 months. The Lysholm score had a ceiling effect of 39% (35/89), and the KOOS–sport/recreation score had an effect of 55% (49/89) at 12 months after ACLR (Figure 2).

Cross-tabulation of the SPORTS score for same sport demonstrated that 36% (32/89) of patients reported no change, 39% (35/89) improved, and 25% (22/89) were worse based on a change in scores between 6 and 12 months after ACLR (Figure 3). The proportion of patients who were worse (25%) was not significantly different from the proportion who improved (39%;  $P = .36$ ). For return to any sport, 35% (31/89) of patients demonstrated no change during the same time frame, 42% (37/89) improved, and 24% (21/89) were worse by 12 months. The proportion of patients who improved between 6 and 12 months (42%) was significantly higher than the proportion who were worse (24%;  $P = .02$ ).

Moderate convergent validity was observed at 6 months between the same and any sport SPORTS score and the KOOS–sport/recreation ( $r = 0.47$  for both), Lysholm ( $r = 0.35$  and  $0.33$ ), Marx ( $r = 0.35$  and  $0.33$ ), and Tegner



**Figure 2.** Distribution of (A) Lysholm and (B) Knee injury and Osteoarthritis Outcome Score (KOOS)–sport/recreation scores at 12 months after anterior cruciate ligament reconstruction ( $n = 89$ ).

( $r = 0.31$  and  $0.32$ ) scores ( $P < .001$ ). Correlation coefficients were also moderate at 12 months for the Tegner ( $r = 0.45$  and  $0.43$ ), Lysholm ( $r = 0.39$  for both), KOOS–sport/recreation ( $r = 0.38$  for both), and Marx ( $r = 0.31$  both) scores ( $P < .001$ ).

Fair to good test-retest reliability was found at 1 year for the same sport SPORTS score (ICC,  $0.58$  [95% CI,  $0.4$ - $0.72$ ]) and any sport SPORTS score (ICC,  $0.60$  [95% CI,  $0.43$ - $0.73$ ]). Of the 69 individuals who retested within 1 month, 55% ( $38/69$ ) and 61% ( $42/69$ ) recorded the same score at the second assessment, 32% ( $22/69$ ) and 22% ( $15/69$ ) reported an improvement, and 13% ( $9/69$ ) and 17% ( $12/69$ ) reported worse scores for same and any sport, respectively.

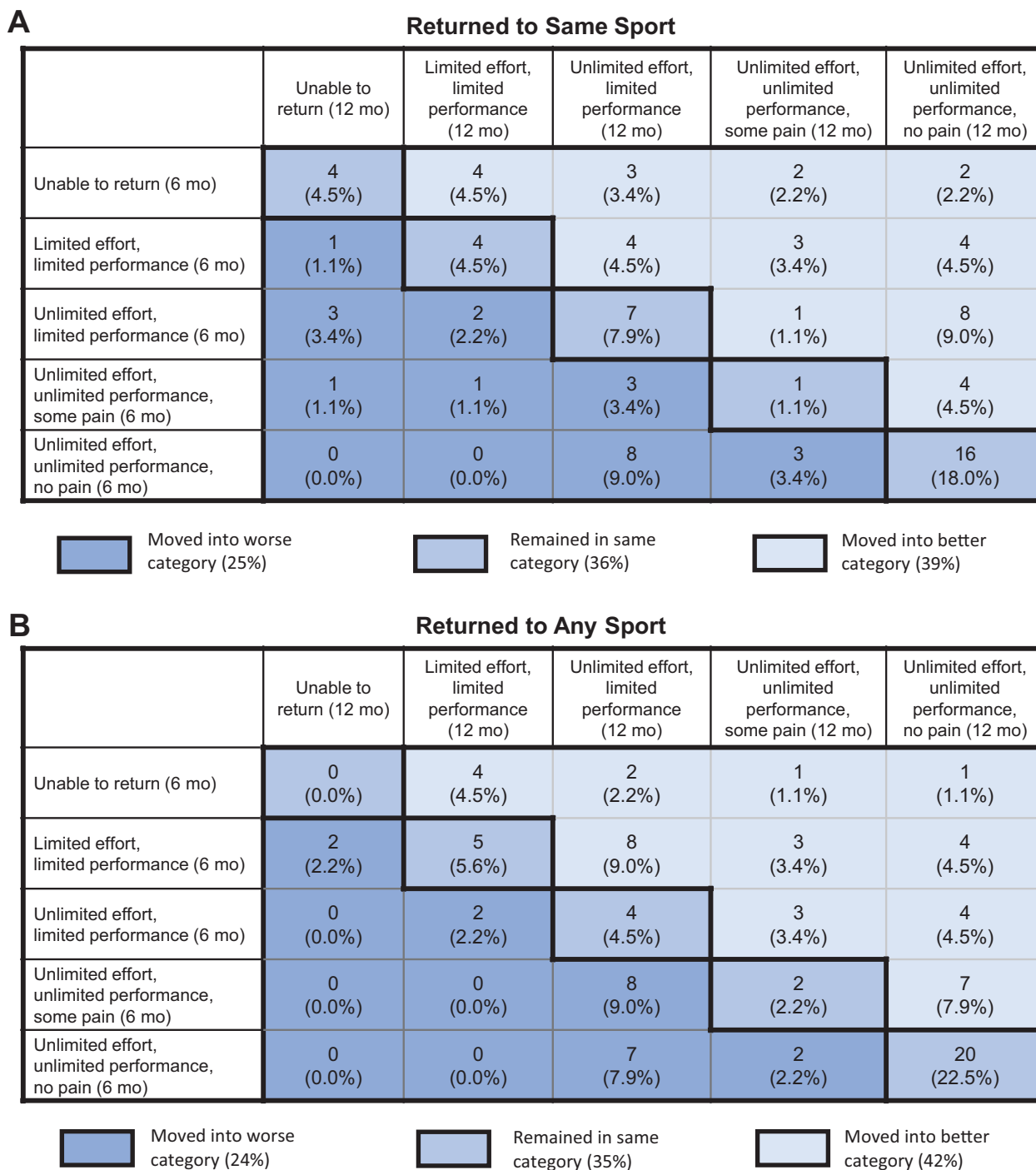
## DISCUSSION

The purpose of this study was to examine the psychometric properties of the SPORTS score and a modified version of the SPORTS score during the first postoperative year after ACLR. The findings suggest the floor effects are acceptable for both versions of the SPORTS score, while ceiling effects

at 12 months are slightly higher than a 33% threshold. The SPORTS scores demonstrated internal responsiveness, with approximately 64% of patients reporting a change in RTS (improved or worse) between 6 and 12 months after ACLR. Moderate correlations were found between the SPORTS score and the modified version and commonly used RTS-related measures (Tegner, Lysholm, KOOS–sport/recreation, and Marx scores). While lower than previous studies of the SPORTS score, test-retest reliability was fair to good at 1-year postoperatively. These findings support the use of the SPORTS score to assess RTS during the early phase of recovery after ACLR and demonstrate that specifying same sport or any sport does not have a meaningful effect on the instrument's psychometric properties.

In this study, 83% and 90% of patients returned to their same sport at 6 and 12 months, respectively, while 91% and 98% returned to any sport (SPORTS scores of 3, 6, 9, or 10). Studies by Erickson et al<sup>17</sup> and Lai et al<sup>26</sup> have reported RTS rates consistent with our preinjury sport findings. However, studies by Ardern et al<sup>5</sup> and Langford et al<sup>27</sup> have reported lower return to preinjury sport rates at 12 months,





**Figure 3.** Cross-tabulation of SPORTS scores ([A] same sport and [B] any sport) at 6 months and 12 months after anterior cruciate ligament reconstruction (n = 89).

ranging from 33% to 51%. From a measurement perspective, the higher rates found in this study may be because of the multiple response options that the SPORTS score offers to patients. Prior studies have commonly used a dichotomous RTS outcome (yes vs no)<sup>3,17,21,29</sup> or a multilevel outcome assessing attempt to return (yes vs no) in combination with the type of participation (training, practice,

competition).<sup>5,27,33</sup> The SPORTS score allows patients to consider effort, performance, and pain as part of a positive RTS. Forty-nine percent of patients in our study reported being able to return to the same sport at 12 months at the same level of effort and performance as before onset of impairment. A more nuanced assessment of RTS allows for a better understanding of an athlete's ability, which

has implications for training as well as rehabilitation efforts.

The SPORTS score had acceptable floor effects at 6- and 12-month follow-ups. These findings are consistent with those of prior work examining the SPORTS score in orthopaedic surgical populations such as those with shoulder instability<sup>9</sup> and recovering from ACLR<sup>10</sup> at longer-term follow-up. The ceiling effect for the SPORTS score was slightly above an acceptable threshold of 33% at 12 months (38% and 40%). However, the Lysholm and KOOS-sport/recreation scores demonstrated similar and higher ceiling effects at this same time point (39% and 55%, respectively). The ceiling effects for the SPORTS score as well as the Lysholm score and KOOS-sport/recreation scores found in this study are consistent with those in prior work by Blonna et al<sup>10</sup> at 5 to 10 years after ACLR. In addition, Rosso et al<sup>44</sup> found that 59.6% of patients had a SPORTS score of 9 or 10 (return to preinjury sport at same level of effort and performance with or without pain) at 3 to 4 years after ACLR. Previous literature has found that it is not uncommon for RTS-related measures, including the Lysholm, Marx, and KOOS-sport/recreation scores, to have ceiling effects in young, athletic populations.<sup>10,13,32,38</sup>

The SPORTS score for same and any sport appeared to be responsive and valid in terms of moderate correlations with other RTS-related measures. Approximately two-thirds of patients changed SPORTS score categories between 6 and 12 months after ACLR, with a significant increase noted between those who reported being improved compared with worse in relation to return to any sport. Stronger correlations were reported in previous validation work for the SPORTS score ( $r = 0.40-0.60$ ) in patients with shoulder instability.<sup>9</sup> However, moderate correlations were found by Blonna et al<sup>10</sup> between the SPORTS score and the Lysholm score and physical component score of the SF-36 in patients after ACLR. Stronger correlations in previous studies may be because of the longer follow-up of 4 to 10 years compared with 1 year in our study. Overall, moderate correlations are not surprising since the Tegner, Lysholm, KOOS-sport/recreation, and Marx scores were not developed to assess RTS but rather to assess related measures of activity level and knee function for the ACL-deficient knee.<sup>15,30,31,42,49</sup>

Fair to good test-retest reliability was found for the SPORTS scores at 6 and 12 months after ACLR. Our findings are inconsistent with earlier work by Blonna et al<sup>9,10</sup> who reported excellent test-retest reliability for the SPORTS score at an average of 7.3 years after ACLR (ICC, 0.967)<sup>10</sup> and at 4.6 years after surgery for isolated shoulder instability (ICC, 0.95).<sup>9</sup> One reason for this difference can be attributed to the time interval between assessments. While our study conducted the SPORTS score retest between 2 and 4 weeks, prior work utilized a 2-week interval.<sup>9,10</sup> In addition, RTS appears more variable during the first year after surgery, with prior studies suggesting that there are deficits in knee function and biological health of the knee joint for up to 2 years after ACLR.<sup>4,5,16,33</sup> Future studies examining the SPORTS score in surgical populations should consider a shorter time interval during the earlier phases of recovery.

## Limitations

Several limitations should be considered when interpreting results. The absence of a gold standard in assessing RTS after ACLR makes it difficult to determine the criterion validity of the SPORTS score. In addition, RTS functional testing data, such as the single-limb hop test, were not collected, so we could not compare the SPORTS score to objective assessments of effort or performance. Generalizability of study results needs to be considered in relation to the study's inclusion and exclusion criteria and a 67% recruitment rate (90/135). The follow-up rate for test-retest at 13 months post-ACLR was 77% (69/90); however, no significant differences in baseline characteristics were noted between those with complete and incomplete data. The SPORTS score demonstrated a high ceiling effect and fair to good test-retest reliability, which are weaknesses of the instrument. Prior testing of the SPORTS score<sup>9,10</sup> as well as the Tegner score,<sup>12</sup> Marx score,<sup>32,36</sup> and KOOS,<sup>46</sup> has demonstrated acceptable test-retest reliability (ICC, >0.70). Future work should consider assessing test-retest reliability over a shorter time frame (1-2 weeks) and modifying the SPORTS score item responses to include an answer choice relating to performing the same sport at a level of effort and performance better than before onset. Additional work may also be needed to assess the psychometric properties of the SPORTS score by level and type of sport.

## CONCLUSION

Results indicated that the 1-item SPORTS score is a reliable, responsive, and valid scale for RTS assessment in patients during the first postoperative year after ACLR. No differences in psychometric properties were found between the SPORTS score and the modified version. The SPORTS score appears to measure a different construct than well-established knee-specific measures such as the Tegner activity scale and Lysholm knee score, which indicates its ability to complement existing assessment protocols. Additional work is needed to assess the SPORTS score in other populations after orthopaedic surgery.

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