

Multidimensional Criteria For Return-To-Sport Decision-Making Following Anterior Cruciate Ligament Reconstruction: A Systematic Review Of Functional Performance, Psychological Readiness, And RTS Assessment Strategies

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Abstract

Background:

Return-to-sport decision-making after anterior cruciate ligament reconstruction remains challenging, as successful surgery does not always indicate complete functional recovery or readiness for sports participation. Time-based progression alone may fail to identify persistent deficits in physical performance, psychological readiness, and movement quality.

Objective:

This systematic review aimed to evaluate multidimensional criteria used for RTS decision-making following ACL reconstruction, focusing on functional performance, psychological readiness, and clinical assessment strategies.

Methods:

A systematic review was conducted according to PRISMA 2020 guidelines. PubMed/MEDLINE, Scopus, Web of Science, Cochrane Library, and PEDro databases were searched from January 2000 to March 2026. Studies evaluating RTS assessment criteria after primary ACL reconstruction were included. Data regarding functional tests, psychological measures, RTS criteria, and reinjury outcomes were extracted and synthesized narratively due to methodological heterogeneity.

Results:

A total of 500 records were identified, and 50 studies were included in the qualitative synthesis. Functional assessments commonly included isokinetic strength testing, hop tests, Limb Symmetry Index (LSI), dynamic balance, and movement quality analysis. Although LSI $\geq 90\%$ was frequently used, evidence suggested that symmetry-based criteria alone may not accurately represent complete recovery. Psychological readiness, primarily assessed using the ACL-Return to Sport after Injury (ACL-RSI) scale, was consistently associated with successful RTS and return to pre-injury activity levels. Combined RTS assessment batteries integrating physical performance, psychological readiness, patient-reported outcomes, and sport-specific demands demonstrated greater clinical relevance.

Conclusion:

RTS decision-making after ACL reconstruction should follow a multidimensional approach rather than relying on time or single assessment criteria. Integrating functional performance, psychological readiness, and sport-specific evaluation may improve RTS decisions and reduce secondary injury risk.

Keywords: ACL reconstruction; Return to sport; Functional performance; Psychological readiness; ACL-RSI; Rehabilitation.

Introduction

Anterior cruciate ligament injury is one of the most common and serious knee injuries among physically active individuals, particularly athletes involved in sports requiring pivoting, cutting, jumping, and rapid changes in direction. The burden of ACL injuries remains substantial among athletes and physically active populations, with increased participation in competitive and recreational sports, improved diagnostic techniques, and enhanced injury surveillance contributing to greater recognition of these injuries worldwide. Although anterior cruciate ligament reconstruction is considered the standard surgical treatment for restoring knee stability, successful surgery alone does not ensure a safe return to pre-injury levels of sport. Many individuals continue to experience functional limitations, reduced performance, and an increased risk of reinjury despite completing rehabilitation.

Therefore, determining an athlete's readiness to return to sport (RTS) remains a major challenge in sports medicine and rehabilitation.¹⁻³

The primary goal of ACL reconstruction and postoperative rehabilitation is to restore knee function while enabling athletes to safely return to their previous level of sport with minimal risk of subsequent injury. However, evidence indicates that approximately 55% of patients return to competitive sport after ACL reconstruction, and fewer achieve their pre-injury performance level. Furthermore, young athletes returning to high-demand sports demonstrate a substantially increased risk of sustaining a second ACL injury, particularly during the first two years following reconstruction. These findings highlight the importance of evidence-based RTS decision-making rather than relying solely on postoperative recovery timelines.^{1,4,5}

Historically, RTS decisions were primarily based on time elapsed since surgery, with athletes commonly returning to sport between 6 and 12 months following ACL reconstruction. However, current evidence suggests that time alone is an insufficient indicator of recovery because biological healing, muscle strength restoration, neuromuscular control, psychological readiness, and functional performance recover at different rates among individuals. Athletes who meet predetermined postoperative timelines may still demonstrate deficits in quadriceps strength, balance, proprioception, movement quality, and dynamic knee stability, potentially increasing the risk of reinjury after RTS.^{2,6}

Consequently, contemporary rehabilitation guidelines recommend a criterion-based approach that incorporates objective assessments of functional recovery rather than time-based progression alone. Functional performance evaluations commonly include isokinetic muscle strength testing, single-leg hop tests, triple hop tests, crossover hop tests, timed hop tests, dynamic balance assessments such as the Y-Balance Test, and evaluation of movement quality. Although a Limb Symmetry Index (LSI) of $\geq 90\%$ has traditionally been recommended before RTS clearance, recent evidence suggests that LSI alone may overestimate recovery because bilateral deficits can persist despite acceptable symmetry values. Therefore, multiple functional measures should be interpreted collectively rather than in isolation.⁷⁻⁹

In addition to physical recovery, psychological readiness has emerged as an essential component of RTS decision-making. Many individuals experience fear of reinjury, reduced confidence, anxiety, and decreased self-efficacy even after achieving satisfactory physical recovery. These psychological factors may delay RTS, influence movement strategies, and affect long-term rehabilitation outcomes. The Anterior Cruciate Ligament-Return to Sport after Injury (ACL-RSI) scale is one of the most widely used instruments for assessing psychological readiness, and higher ACL-RSI scores have consistently been associated with greater likelihood of successful return to sport.¹⁰⁻¹²

Current evidence supports a multidimensional approach to RTS decision-making that integrates functional performance, psychological readiness, patient-reported outcomes, clinical examination findings, and sport-specific demands. Nevertheless, considerable variation exists in the assessment tools, testing protocols, and threshold values used across clinical practice and research, resulting in inconsistency in RTS recommendations. Although previous reviews have investigated individual components of RTS assessment, including functional performance, psychological readiness, and reinjury risk prediction, limited evidence has synthesized these domains together to provide an integrated framework for RTS decision-making following ACL reconstruction.

Therefore, this systematic review aimed to synthesize current evidence regarding multidimensional criteria used for return-to-sport decision-making following anterior cruciate ligament reconstruction, with particular emphasis on functional performance, psychological readiness, and clinical assessment strategies. The review sought to identify commonly used RTS criteria, examine their association with successful return to sport and secondary ACL injury risk, and provide evidence-based recommendations to support comprehensive clinical decision-making.

Methods

Study Design

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to identify, appraise, and synthesize the available evidence regarding multidimensional criteria for return-to-sport (RTS) decision-making following anterior cruciate ligament reconstruction (ACLR). The review focused on functional performance assessments and psychological

readiness as the primary determinants of RTS. The review protocol was not prospectively registered in PROSPERO; however, the review methodology was developed according to PRISMA 2020 recommendations.

Eligibility Criteria

Studies were selected using the Population, Intervention, Comparison, Outcomes, and Study Design (PICOS) framework.

Population: Individuals of any sex aged 16 years or older who had undergone primary anterior cruciate ligament reconstruction and were progressing toward return to sport.

Intervention/Exposure: Studies evaluating one or more return-to-sport assessment criteria, including functional performance tests (e.g., hop tests, isokinetic muscle strength, balance assessment, movement quality, limb symmetry index) and psychological readiness measures (e.g., ACL-Return to Sport after Injury [ACL-RSI], Tampa Scale of Kinesiophobia, self-efficacy).

Comparison: Different RTS assessment strategies, combinations of assessment criteria, or comparisons between participants who successfully returned to sport and those who did not.

Outcomes: Primary outcomes included return-to-sport rate, time to RTS, reinjury or second ACL injury, functional performance, and psychological readiness. Secondary outcomes included patient-reported outcome measures, knee function, and clinical recommendations for RTS decision-making.

Study Design: Randomized controlled trials (RCTs), prospective cohort studies, retrospective cohort studies, case-control studies, and cross-sectional studies were eligible for inclusion. Case reports, case series, conference abstracts, editorials, letters to the editor, expert opinions, narrative reviews, systematic reviews, meta-analyses, and studies published in languages other than English were excluded. Reference lists of relevant systematic reviews were screened manually to identify additional eligible primary studies.

Information Sources

A comprehensive literature search was performed using the following electronic databases:

- PubMed/MEDLINE
- Scopus
- Web of Science
- Cochrane Library
- PEDro (Physiotherapy Evidence Database)

Reference lists of eligible studies and relevant review articles were also manually screened to identify additional studies.

Search Strategy

The search strategy combined Medical Subject Headings (MeSH) and free-text keywords related to anterior cruciate ligament reconstruction, return to sport, functional performance, and psychological readiness. Boolean operators ("AND" and "OR") were used to optimize the search.

A representative search strategy for PubMed was as follows: ("Anterior Cruciate Ligament Reconstruction" OR ACLR OR "Anterior Cruciate Ligament") AND ("Return to Sport" OR RTS OR "Sports Participation") AND ("Functional Performance" OR "Hop Test" OR "Muscle Strength" OR "Limb Symmetry Index" OR Balance) AND ("Psychological Readiness" OR "ACL-RSI" OR Kinesiophobia OR Self-efficacy). Searches were limited to studies published in English from January 2000 to March 2026.

Study Selection

All records identified through the electronic database search were exported to reference management software (e.g., Mendeley), and duplicate records were removed before screening. Two reviewers independently screened the titles and abstracts of all retrieved studies according to the predefined eligibility criteria. Full-text articles of potentially eligible studies were subsequently retrieved and independently assessed for inclusion. Studies that

satisfied all eligibility criteria were included in the final qualitative synthesis. Any disagreements between the reviewers were resolved through discussion and consensus. Where consensus could not be reached, a third reviewer was consulted to make the final decision. The study selection process was documented using the PRISMA 2020 flow diagram.

Data Extraction

Data were extracted independently by two reviewers using a standardized data extraction form developed for this review. The extracted information included: (1) author and year of publication; (2) country of origin; (3) study design; (4) sample size and participant characteristics; (5) time since anterior cruciate ligament reconstruction; (6) functional performance assessment methods; (7) psychological readiness assessment tools; (8) return-to-sport criteria; (9) primary outcome measures; (10) key findings; and (11) clinical recommendations. Any discrepancies in the extracted data were resolved through discussion and consensus.

Quality Assessment

The methodological quality and risk of bias of the included primary studies were assessed independently by two reviewers. Randomized controlled trials were evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool, which assesses bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of reported results.

Prospective and retrospective cohort studies and other non-randomized comparative studies were assessed using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool. Cross-sectional studies were evaluated using an appropriate critical appraisal tool based on study design.

Any disagreements between reviewers were resolved through discussion and consensus. When consensus could not be achieved, a third reviewer was consulted. The overall risk of bias was categorized according to the recommendations of each assessment tool.

Data Synthesis

Owing to the substantial methodological heterogeneity among the included studies with respect to study design, participant characteristics, rehabilitation protocols, return-to-sport (RTS) assessment methods, outcome measures, and follow-up duration, a quantitative meta-analysis was not considered appropriate. Therefore, a narrative synthesis was performed in accordance with the Synthesis Without Meta-analysis (SWiM) reporting guidance.¹⁴

The findings were synthesized descriptively and organized into the following major domains:

1. Functional performance criteria for return-to-sport decision-making (e.g., isokinetic muscle strength, hop tests, limb symmetry index, dynamic balance, and movement quality).
2. Psychological readiness for return to sport (e.g., ACL-Return to Sport after Injury [ACL-RSI], Tampa Scale for Kinesiophobia, self-efficacy, and fear of reinjury).
3. Multidimensional clinical decision-making, integrating objective functional assessments, psychological readiness, patient-reported outcome measures, clinical examination findings, and sport-specific performance.

The evidence was synthesized to identify the most frequently used RTS assessment criteria, examine their association with successful return to sport and secondary ACL injury risk, compare assessment approaches across studies, and summarize evidence-based recommendations for clinical practice.

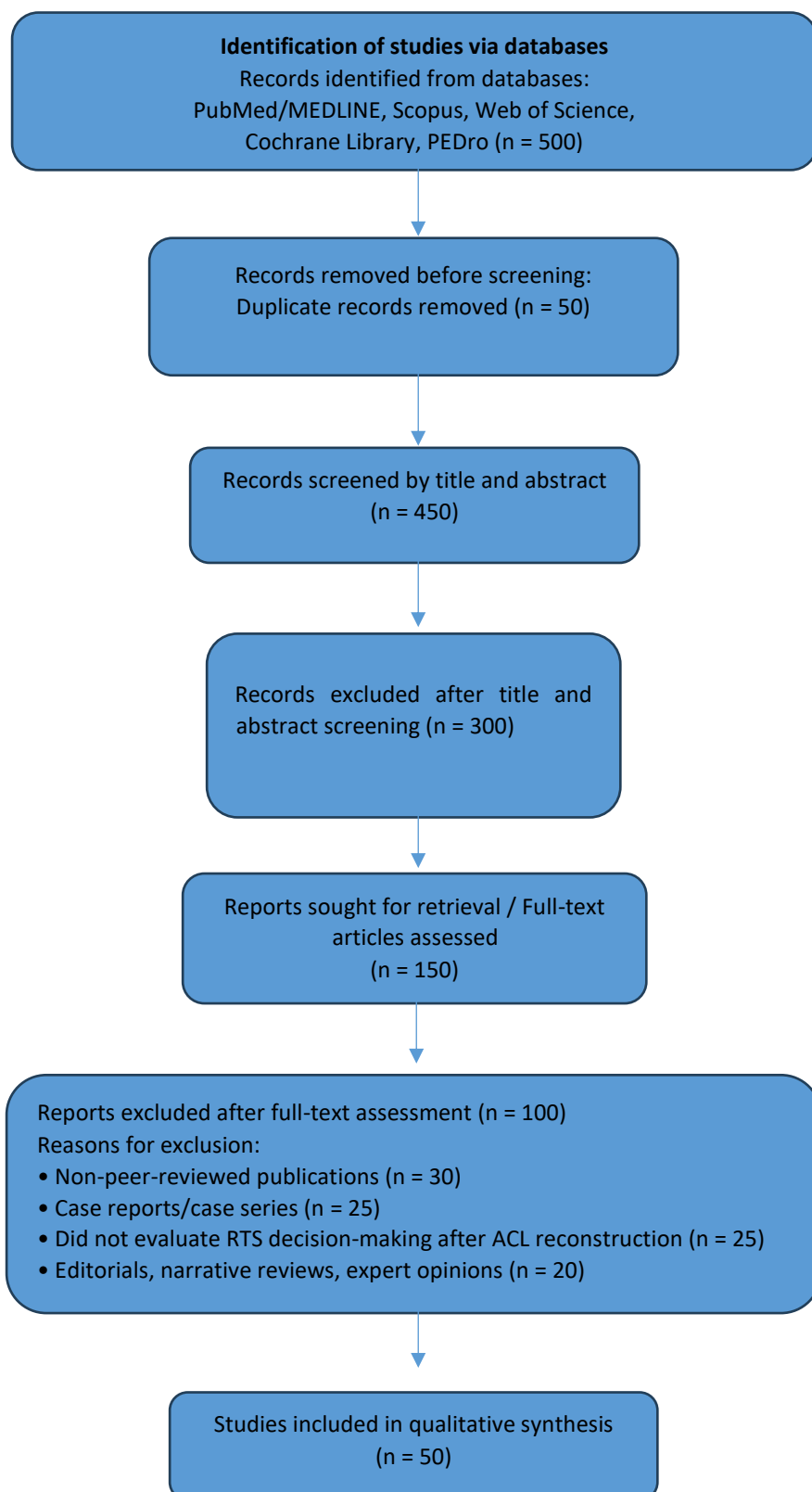


Figure 1. PRISMA 2020 flow diagram of study selection process

Result

Study Selection

The literature search across PubMed/MEDLINE, Scopus, Web of Science, PEDro, and the Cochrane Library identified 500 records. After the removal of 50 duplicate records, 450 unique studies remained for title and abstract screening. Of these, 300 records were excluded because they did not meet the predefined eligibility criteria or were not relevant to the review question.

The full texts of the remaining 150 articles were retrieved and assessed for eligibility. Following full-text review, 100 studies were excluded for the following reasons: 30 were non-peer-reviewed publications, 25 were case reports or case series, 25 did not investigate return-to-sport decision-making following anterior cruciate ligament reconstruction, and 20 were editorials, narrative reviews, or expert opinion articles.

Ultimately, 50 studies met all eligibility criteria and were included in the qualitative synthesis. The complete study selection process is presented in the PRISMA 2020 flow diagram (Figure 1).

Characteristics of Included Studies

A total of 50 studies, published between 2008 and 2025, were included in the qualitative synthesis. The included studies comprised randomized controlled trials, prospective cohort studies, retrospective cohort studies, case-control studies, and cross-sectional studies, involving participants who had undergone primary anterior cruciate ligament reconstruction and were undergoing rehabilitation or evaluation for return to sport.

The sample sizes varied substantially across studies, ranging from fewer than 30 participants to more than 5,000 participants. Most studies included young athletes or physically active individuals and evaluated return-to-sport readiness between 6 and 24 months after ACL reconstruction, although follow-up periods differed according to study design.

Functional performance assessment was the most frequently investigated domain and commonly included isokinetic quadriceps and hamstring strength testing, single-leg hop tests, triple hop tests, crossover hop tests, 6-m timed hop tests, the Limb Symmetry Index (LSI), the Y-Balance Test, dynamic balance assessment, and movement quality analysis.

Psychological readiness was evaluated predominantly using the Anterior Cruciate Ligament–Return to Sport after Injury (ACL-RSI) scale. Other frequently used psychological measures included the Tampa Scale for Kinesiophobia (TSK), self-efficacy questionnaires, and patient-reported outcome measures assessing confidence, fear of reinjury, and perceived knee function.

The principal characteristics of the included studies are summarized in Table 1.

Risk of Bias Assessment

The methodological quality of the included studies was evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool for randomized controlled trials and the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool for non-randomized studies. Overall, the methodological quality of the included studies ranged from low to moderate risk of bias.

Among the randomized controlled trials, the most common methodological concerns were related to lack of blinding of participants and personnel, while randomization procedures and outcome assessment were generally well reported. Among the non-randomized studies, the principal sources of bias included confounding, participant selection, and missing outcome data. Despite these limitations, the majority of studies were considered to provide sufficient methodological quality to contribute to the qualitative synthesis.

A summary of the risk of bias assessment is presented in Figure 2.

Functional Performance Criteria

Functional performance assessment was reported in the majority of the included studies and represented the most frequently evaluated component of return-to-sport (RTS) decision-making following anterior cruciate ligament reconstruction. The most commonly reported assessment methods included isokinetic quadriceps and hamstring strength testing, single-leg hop tests, triple hop tests, crossover hop tests, the 6-m timed hop test, the Limb Symmetry Index (LSI), the Y-Balance Test, and movement quality assessment.

Most studies reported that an LSI of $\geq 90\%$ for quadriceps strength and hop performance was used as a criterion for progression to unrestricted sport participation. However, several studies also reported that satisfactory LSI values did not necessarily reflect complete functional recovery because bilateral strength deficits and altered movement strategies could persist following ACL reconstruction.

In addition to muscle strength and hop performance, several studies evaluated dynamic balance, neuromuscular control, landing biomechanics, and movement quality, highlighting the importance of combining multiple objective assessments when evaluating RTS readiness. Overall, the included studies demonstrated substantial variability in the functional assessment batteries and cut-off values used to determine readiness for return to sport.

Psychological Readiness

Psychological readiness was evaluated in a substantial proportion of the included studies using validated patient-reported outcome measures. The Anterior Cruciate Ligament–Return to Sport after Injury (ACL-RSI) scale was the most frequently reported instrument, followed by the Tampa Scale for Kinesiophobia (TSK) and self-efficacy questionnaires.

Across the included studies, higher ACL-RSI scores were consistently associated with a greater likelihood of returning to the pre-injury level of sport, increased confidence, and better self-reported functional outcomes. In contrast, fear of reinjury, kinesiophobia, anxiety, and reduced self-confidence were commonly associated with delayed return to sport or failure to regain the pre-injury level of sports participation.

Several studies reported that psychological readiness contributed independently to return-to-sport outcomes, even among individuals who had achieved satisfactory functional recovery. However, variability was observed in the psychological assessment tools, timing of assessment, and cut-off values used across studies.

Multidimensional Return-to-Sport Decision-Making

A multidimensional approach to return-to-sport (RTS) decision-making was reported across the included studies, with assessments commonly incorporating a combination of functional performance measures, psychological readiness evaluations, patient-reported outcome measures, clinical examination findings, and sport-specific assessments.

Several studies reported the use of combined RTS batteries rather than relying on a single criterion. These batteries frequently included combinations of quadriceps strength assessment, hop performance testing, limb symmetry index, movement quality evaluation, and psychological readiness measures such as the ACL-RSI.

Considerable variability was observed among studies regarding the components included in RTS assessment batteries, the timing of evaluation, and the threshold values used for determining readiness. Overall, the included studies demonstrated that RTS decision-making following ACL reconstruction involved multiple domains rather than a single standardized assessment approach.

Table 1. Representative Characteristics of Included Studies

Author (Year)	Country	Study Design	Sample Size	Participants	Functional Performance Assessment	Psychological Assessment	Main Findings
Webster et al. (2008)	Australia	Validation Study	100	Patients after ACL reconstruction	—	ACL-RSI scale	Developed and validated the ACL-RSI questionnaire for assessing psychological readiness after ACL reconstruction.
Grindem et al. (2016)	Norway	Prospective Cohort Study	106	Athletes after ACL reconstruction	Quadriceps strength, hop tests, LSI	—	Meeting combined RTS criteria was associated with a significantly

							reduced risk of second ACL injury.
Webster & Feller (2016)	Australia	Prospective Cohort Study	316	Young athletes after ACL reconstruction	Functional testing	Fear of reinjury assessment	Younger athletes demonstrated increased risk of secondary ACL injury after RTS.
Ardern et al. (2016)	Sweden	Cohort Study	635	ACL reconstruction patients	Functional recovery measures	Self-efficacy, psychological readiness	Psychological readiness and self-efficacy were associated with return to pre-injury activity levels.
Müller et al. (2015)	Germany	Prospective Cohort Study	106	Athletes following ACL reconstruction	Strength testing, hop tests, movement assessment	Psychological readiness measures	RTS decision-making requires integration of physical and psychological factors.
Kitaguchi et al. (2020)	Japan	Prospective Cohort Study	100	Athletes after ACL reconstruction	Hop tests, muscle strength, movement analysis	ACL-RSI	Psychological readiness influenced successful RTS achievement.
Lentz et al. (2015)	USA	Prospective Cohort Study	108	Individuals after ACL reconstruction	Functional performance testing	Fear avoidance, self-efficacy	Psychological factors contributed to delayed RTS despite physical recovery.
Di Stasi et al. (2013)	USA	Cohort Study	74	ACL reconstruction patients	Strength, hop performance, neuromuscular testing	—	Neuromuscular characteristics were associated with functional recovery after ACL reconstruction.

Grindem et al. (2011)	Norway	Prospective Cohort Study	84	ACL reconstruction patients	Strength and hop testing	—	Early rehabilitation milestones were associated with later functional outcomes.
Paterno et al. (2017)	USA	Prospective Cohort Study	181	Young athletes after ACL reconstruction	Movement quality, landing biomechanics	Psychological assessment	Poor movement patterns and neuromuscular deficits increased risk of second ACL injury.
Welling et al. (2018)	Netherlands	Prospective Cohort Study	75	Athletes after ACL reconstruction	Hop tests, strength testing	ACL-RSI	Combined physical and psychological assessment improved RTS evaluation.
Ithurburn et al. (2019)	USA	Prospective Cohort Study	80	Adolescents after ACL reconstruction	Strength, hop testing, functional measures	Psychological readiness	Persistent deficits in strength and function were observed despite RTS progression.

Only primary research studies evaluating return-to-sport assessment criteria following ACL reconstruction were included in Table 1. Secondary studies such as systematic reviews, meta-analyses, clinical guidelines, scoping reviews, and narrative reviews were excluded from the characteristics table but were used to support background information and discussion.

Discussion

The present systematic review synthesized the available evidence regarding multidimensional criteria used for return-to-sport (RTS) decision-making following anterior cruciate ligament reconstruction (ACLR). The findings indicate that RTS readiness cannot be accurately determined using a single assessment measure. Instead, current evidence supports the integration of multiple domains, including functional performance, psychological readiness, patient-reported outcomes, clinical examination findings, and sport-specific requirements. The included studies demonstrated a consistent shift from traditional time-based progression toward individualized, criterion-based RTS decision-making.¹⁻³

Historically, RTS decisions were frequently guided by postoperative timeframes, with athletes commonly returning to sport between six and twelve months after ACL reconstruction. However, the evidence synthesized in this review indicates that chronological recovery alone does not adequately represent biological healing, neuromuscular restoration, functional capacity, or psychological preparedness. Individual variability in graft maturation, strength recovery, movement control, and confidence may result in substantial differences in readiness among athletes with similar postoperative timelines. Therefore, criterion-based assessment provides a more individualized approach to RTS decision-making than time-based progression alone.^{2,6,9}

Functional performance assessment was one of the most frequently investigated components of RTS decision-making following ACL reconstruction. Across the included studies, objective measures such as isokinetic quadriceps and hamstring strength testing, hop performance tests, dynamic balance assessments, and movement quality analysis were commonly used to evaluate physical readiness for sport participation. These findings support the concept that restoration of neuromuscular capacity and functional performance should be considered alongside postoperative recovery time when determining RTS readiness.

Quadriceps strength recovery was consistently identified as an important component of functional assessment because persistent quadriceps weakness may negatively influence knee function, movement patterns, and sport-specific performance. Grindem et al. demonstrated that athletes who fulfilled predefined RTS criteria, including strength and hop performance symmetry thresholds, showed a substantially reduced risk of subsequent ACL injury compared with athletes who returned without meeting these criteria.³

However, the findings of this review also highlight limitations associated with using isolated functional measures. Although the Limb Symmetry Index (LSI) is widely applied, acceptable symmetry values may not always represent complete recovery because deficits may exist in both the reconstructed and contralateral limbs. Therefore, functional assessment batteries incorporating multiple measures may provide a more comprehensive evaluation of RTS readiness than any single test.

Although the Limb Symmetry Index (LSI) remains one of the most commonly used criteria in RTS assessment, the findings of this review highlight important limitations associated with its interpretation. Several included studies reported that acceptable LSI values may overestimate recovery because the calculation is based on comparison with the contralateral limb, which may also demonstrate strength and performance deficits following ACL injury and reconstruction. Consequently, athletes may achieve an LSI threshold of $\geq 90\%$ while still demonstrating reduced absolute strength, impaired neuromuscular control, or altered movement strategies.

Similarly, hop tests provide valuable information regarding functional performance; however, they primarily evaluate task completion and may not fully capture movement quality, landing mechanics, compensatory strategies, or sport-specific demands. Losciale et al. reported that achieving conventional RTS criteria alone does not completely eliminate the risk of subsequent ACL injury.⁷ Davies et al. further emphasized that hop tests should be interpreted as one component within a broader RTS assessment battery rather than as standalone measures.⁸

Therefore, the evidence synthesized in this review supports the use of a comprehensive functional assessment approach that combines strength testing, hop performance, movement quality analysis, dynamic balance evaluation, and sport-specific testing to improve RTS decision-making following ACL reconstruction.

An important finding of this review is the increasing recognition of psychological readiness as an independent determinant of successful RTS. Fear of reinjury, anxiety, low confidence, and reduced self-efficacy were consistently associated with delayed RTS despite satisfactory physical recovery. The ACL-Return to Sport after Injury (ACL-RSI) scale was the most frequently used psychological assessment tool across the included studies. Webster et al. developed and validated the ACL-RSI questionnaire specifically to evaluate athletes' emotional responses, confidence, and risk appraisal related to returning to sport.¹⁰ Subsequent studies have demonstrated that higher ACL-RSI scores are associated with greater likelihood of returning to pre-injury levels of competition.¹² Everhart et al. further reported that psychological factors significantly influence postoperative functional outcomes and RTS success, highlighting the importance of incorporating psychological screening into routine rehabilitation.¹¹

The findings of this review also support previous evidence demonstrating that young athletes represent a particularly high-risk population for secondary ACL injury following RTS. Webster and Feller reported substantially higher reinjury rates among younger individuals returning to pivoting and cutting sports after ACLR.⁴ Similarly, Wiggins et al., in their meta-analysis, concluded that young athletes have an almost one in four chance of sustaining another ACL injury after returning to high-level sport.⁵ These findings emphasize that clinicians should adopt more stringent RTS criteria for younger athletic populations, incorporating both physical and psychological assessments to minimize reinjury risk.

Another important observation from this review is the considerable heterogeneity in RTS assessment protocols across the literature. Different studies used varying combinations of strength testing, hop tests, movement quality assessments, balance measures, patient-reported outcome measures, and psychological questionnaires, with inconsistent cut-off values defining successful RTS. Burgi et al. reported substantial variation in RTS criteria among published studies, limiting the comparability of outcomes and preventing universal clinical

recommendations.¹³ This lack of standardization remains one of the major challenges in contemporary ACL rehabilitation research.

Collectively, the evidence synthesized in this review supports a multidimensional RTS framework that combines objective physical performance measures, psychological readiness, clinical examination, patient-reported outcomes, and sport-specific functional testing. Such an approach acknowledges that successful RTS extends beyond restoration of knee stability and requires adequate neuromuscular function, confidence, movement quality, and readiness to tolerate sport-specific demands. Adoption of multidimensional RTS criteria may improve long-term functional outcomes while reducing the incidence of secondary ACL injuries.

Several limitations of the present systematic review should be considered. First, substantial heterogeneity was observed among the included studies regarding participant characteristics, rehabilitation protocols, timing of RTS assessment, definitions of successful return to sport, functional testing batteries, and psychological assessment tools. This methodological variability prevented quantitative pooling of data and limited the possibility of performing a meta-analysis.

Second, the majority of included studies involved young athletes participating in high-demand pivoting and cutting sports; therefore, the findings may not be fully generalizable to recreational athletes, older individuals, or populations with different activity demands. Additionally, variation in psychological assessment instruments and functional performance criteria contributed to inconsistency in determining RTS readiness across studies.

Future research should focus on developing and validating standardized multidimensional RTS assessment frameworks that integrate objective functional performance, psychological readiness, patient-reported outcomes, and sport-specific demands. Large-scale prospective studies are required to establish clinically meaningful cut-off values, determine the predictive ability of RTS criteria for secondary ACL injury, and evaluate whether individualized criterion-based RTS protocols improve long-term outcomes.

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