




Males have higher psychological readiness to return to sports than females after anterior cruciate ligament reconstruction: a systematic review and meta-analysis

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ABSTRACT

Objectives To examine sex differences in psychological readiness to return to sport following anterior cruciate ligament (ACL) reconstruction as well as to determine whether males and females separately fulfilled cut-off values (≥ 65) of psychological readiness necessary to return to sport.

Information sources Web of Science, Scopus and PubMed were comprehensively searched from inception to January 2024 to identify relevant studies.

Eligibility criteria Observational investigations that compared males and females with a history of ACL reconstruction concerning psychological readiness to return to sport.

Risk of bias Studies were rated using the Methodological Index for Non-Randomised Studies.

Included studies Only 11 reports fulfilled the eligibility criteria and were included in the quantitative analysis. A total of 2618 participants were subjected to the primary ACL reconstruction, out of 1631 males and 987 females. Psychological readiness to return to sport was evaluated approximately 9 ± 2.9 months following surgery.

Synthesis of results The main findings demonstrated that males had slightly higher psychological readiness to return to the sport than females (standardised mean difference 0.33; 95% CI 0.14 to 0.52; $p=0.0007$; $I^2=77\%$) after ACL surgery. In addition, the mean psychological readiness to return to the sport of males was 70.1 ± 8.8 points and of females 65.1 ± 8.8 points, indicating that both sexes exceeded recommendations necessary to return to sport.

Conclusion Males had slightly higher psychological readiness to return to sport than females approximately 9 ± 2.9 months after ACL reconstruction and both sexes exceeded the highlighted recommendations necessary to return to sport.

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INTRODUCTION

The anterior cruciate ligament (ACL) is a fibrous structure that originates on the medial wall of the lateral femoral condyle

WHAT IS ALREADY KNOWN ON THIS TOPIC?

- ⇒ Higher levels of psychological readiness to return to sport correlated with the increased rate of return to sport among individuals who were subjected to anterior cruciate ligament (ACL) reconstruction.
- ⇒ Available literature indicated that males return to sport at a significantly higher percentage compared with females following ACL surgery.
- ⇒ Sex differences with respect to the psychological readiness to return to sport in a population with a history of ACL reconstruction still need to be comprehensively synthesised.

WHAT THIS STUDY ADDS?

- ⇒ The present systematic review with meta-analysis provided evidence that males had slightly higher psychological readiness to return to the sport than females approximately 9 ± 2.9 months after ACL reconstruction.
- ⇒ The average values of psychological readiness to return to the sport of males and females were 70.1 points and 65.1 points, respectively, indicating that both sexes exceeded the recommendations (≥ 65) required to return to sport following ACL surgery.
- ⇒ Since the psychological readiness to return to the sport of females was only slightly above the highlighted cut-off values regarding return to sport, implementation of various psychological interventions is recommended in the future.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ The findings of the present study have robust practical implications, highlighting the role and relevance of sports psychologists with respect to the improvement of psychological readiness to return to sports of females who were subjected to ACL reconstruction.

and extends diagonally, attaching to the front part of the tibial joint surface. Its main function is related to the static stabilisation of the knee by preventing hyperextension of the

joint, forward movement of the tibia and rotatory movements of the knee.¹ It was established in the literature that ACL rupture is one of the most common knee injuries among athletes and physically active individuals.¹ Moreover, approximately 70% of ACL injuries result from non-contact incidents, while the remaining 30% are contact-related.² Since ACL has a crucial role in knee stabilisation and in cases of a complete ACL tear, physical therapy rehabilitation alone is not sufficient to neutralise the injury, most ACL tears are treated surgically using either autograft or allograft tendons.^{3 4} Over the past two decades, the number of ACL tears has increased by double, indicating that between 200 000 and 250 000 ACL injuries occur per year in the USA.^{5 6} At last, the annual expense for ACL reconstruction in the US health-care system averages around \$1 billion.¹

Briefly, there are several relevant phases regarding the return to sport after ACL reconstruction.⁷ More specifically, these aspects refer to criterion-based postoperative rehabilitation, return to sport testing, a careful shared decision-making process and gradual periodised reintegration into sport-specific activities.⁷ An adequate and thorough implementation of all highlighted phases is highly desirable with respect to improving the possibilities of returning to sport and reducing the reinjury rates of athletes after ACL surgery. In addition, available literature revealed that numerous factors affected the return to sport among athletes who were subjected to ACL reconstruction, including sex,⁸ age,⁹ sports participation¹⁰ and psychological factors.¹¹ It is shown that ACL rupture has a significant negative effect on the athlete's psychological aspects, which affects the overall recovery process.¹² In terms of return to sport after ACL reconstruction, the most relevant psychological factors are fear of reinjury and psychological readiness to return to sport.¹⁰ Most importantly, Podlog *et al*¹³ emphasised that 'psychological readiness to return to sport after injury reflects an individual's state of mental preparedness to resume sport-specific activities and is likely comprised of three dimensions, including cognitive appraisals (confidence, expectations, motivations, risk appraisals and internal or external pressures), affective (anxiety or fears about reinjury or movement and moods) and behavioural components (approach-avoidance behaviours to demonstrate physical function/neuromuscular control and engage in sport-specific tasks)'. Among several methods employed to evaluate psychological readiness to return to sport, the ACL-return to sport after injury (ACL-RSI) scale (Cronbach's alpha=0.92) was most frequently implemented.¹⁴ The scale consists of 12 items covering three domains: emotions, confidence and risk appraisal.¹⁵ The total score is an indicator of the athletes' readiness to return to sport.

The return-to-sport phenomenon has been extensively examined among athletes undergoing ACL reconstruction.^{6 16-18} More precisely, there is compelling evidence that indeed a high percentage of athletes return to sport and return to sport at the preinjury levels of competition

following ACL surgery. For instance, it was demonstrated that 83% of elite athletes with a history of ACL reconstruction successfully return to sport.¹⁷ Analogously, Ardern *et al*⁸ reported that 65% of athletes return to the preinjury levels of sports participation after surgery of ACL. Furthermore, as underlined, there is abundant evidence regarding the importance of sex in the return to sport in the ACL population.¹⁹⁻²² All studies are quite unambiguous, indicating that males return to sport at a markedly higher percentage compared with females who experienced ACL injury and underwent the reconstruction procedure. Specifically, a recently conducted investigation by Klemm *et al*²¹ emphasised that 74.9% of males and 65.4% of female athletes return to sport after ACL reconstruction. Additionally, it was also revealed that female sex was an independent negative predictor of return to sport in soccer players who underwent ACL surgery.¹⁹

Numerous studies explored the relationship between psychological readiness and return to sport among athletes who were subjected to ACL reconstruction.²³⁻²⁷ All available evidence suggested that psychological readiness was a strong positive predictor of return to sport after ACL surgery. It is also essential to highlight that several meta-analyses demonstrated that athletes who return to sport²⁸ and return to sport at the preinjury level of competition²⁹ following ACL reconstruction had noticeably higher values of psychological readiness compared with athletes who did not return to sport and did not return to sport at the preinjury level of participation, respectively. Most importantly, Webster and Feller³⁰ explored the cut-off values of psychological readiness required to return to sport in athletes who underwent ACL surgery. The authors revealed that the ACL-RSI values of ≥ 65 were considered indicators of successful recovery. In fact, individuals who passed the thresholds of psychological readiness had three times greater odds of returning to sport between 6 and 12 months following ACL reconstruction.³⁰

To date, to the best of the author's knowledge, several systematic reviews and meta-analyses thoroughly examined sex differences concerning outcomes closely related to the psychological readiness to return to sport, such as the overall return to sport rate,³¹ return to preinjury level of sport³² and physical activity level assessed with Tegner Activity Scale.³³ Therefore, the currently existing body of evidence referring to the disparities in psychological readiness to return to sport between males and females subjected to ACL reconstruction still needs to be comprehensively summarised. Additionally, considering that relevant literature indicates that psychological readiness is strongly related to the return to sport, comparing this phenomenon among males and females should have significant sex-specific implications concerning the return to sport in athletes with a history of ACL reconstruction. Thus, the primary objective of this study was to investigate sex differences in psychological readiness to return to sport among individuals who underwent ACL

surgery. The secondary goal was to examine whether males and females individually met the cut-off values (≥ 65), as suggested by Webster and Feller,³⁰ regarding the psychological readiness required to return to sport following ACL reconstruction. The authors hypothesised that (1) males would have significantly higher psychological readiness to return to sports relative to the females and that (2) only males would exceed the cut-off recommendations of psychological readiness necessary to return to sports (≥ 65).

METHODS

Study design and protocol registration

This systematic review with meta-analysis was performed according to all guidelines available in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.³⁴ The PRISMA checklist is given as an online supplemental file 2. The study protocol has been registered in the International Database of Prospectively Registered Systematic Reviews in Health and Social Care (PROSPERO, CRD42024497769). There were no amendments with respect to the registration of the study protocol. The registration of protocol occurred after a preliminary search was conducted, but before screening was completed and data extraction started.

Search strategy

Three electronic databases, including PubMed, Web of Science and Scopus, were thoroughly searched from inception to December 2023. Keywords were gathered via experts' opinions and relevant systematic reviews from the area of sports and medical sciences. A Boolean search syntax with operators 'AND' and 'OR' was employed during a search of each database and the following keywords were applied ('males' OR 'females' OR 'men' OR 'woman' OR 'sex' OR 'gender') AND ('psychological readiness to return to sport' OR 'ACL-RSI scale' OR 'return to play' OR 'return to sport' OR 'exercise psychology' OR 'sport psychology') AND ('anterior cruciate ligament' OR 'anterior cruciate ligament reconstruction' OR 'anterior cruciate ligament surgery' OR 'ACL injury' OR 'knee'). The full search strategy is provided in the online supplemental file 3. A search of Google Scholar and the reference lists of articles that fulfilled eligibility criteria was conducted in an attempt to provide additional evidence referring to the sex differences in psychological readiness for return to sport among individuals with a history of ACL reconstruction. Lastly, to ensure that all available studies are included, the search of databases was updated at the end of January 2024.

Selection process

Retrieved titles were saved, while duplicates were removed using the Zotero software V.6.0 (available at: <https://www.zotero.org/>).³⁵ The process of selecting literature was divided into three subsequent phases: (1) review of abstracts and titles; (2) estimation of the articles sought

for retrieval and (3) analysis of full-text records assessed for eligibility. The entire search process as well as a selection of studies were carried out independently by two reviewers (AR and SJ). Disagreements at any stage were resolved through discussion among the authors until a consensus was reached. Still, if it was not possible to reach an agreement between reviewers, the second investigator (MM) clarified all inconsistencies. It should also be noted that the reviewers were not blinded to the journals and authors of the articles during this process.

Eligibility criteria

Studies were estimated for eligibility based on the PICOS (P—participants, I—interventions, C—comparators, O—outcomes, S—study design) criteria³⁶: (P) examined population referred to the individuals who underwent ACL reconstruction. There were no limitations regarding demographic parameters and surgical variables of respondents, such as ACL reconstruction type or time since surgery; (I) considering that all trials were observational, no criteria related to the interventions were applied; (C) although no control group was observed, a comparison in psychological readiness to return to sport was conducted between males and females; (O) psychological readiness to return to sport was assessed as a main outcome using the original and short versions of the ACL-RSI scale and (S) observational studies, such as cohort, case-control, cross-sectional and case series, were eligible for inclusion. Additionally, studies that were not written in English language were not included. Likewise, systematic reviews and meta-analyses, not-peer-reviewed papers (preprints), case reports, editorials, books, PhDs or master's theses, not full-text available articles and qualitative studies were not considered adequate for inclusion in the present study. Finally, investigations were excluded if the ACL injury was treated non-surgically or if, in addition to the ACL rupture, other knee injuries were reported.

Data extraction

One independent reviewer (AO) retrieved all necessary data from the full-text articles included in the quantitative analysis using a Microsoft Excel template. All extracted data was reviewed by the second investigator (MM) (online supplemental file 4). The retrieved data was divided into the following categories: (1) authors and years of the records publications; (2) study design with the level of evidence; (3) demographic characteristics of the examined population, such as number of involved males and females, mean age and the competitive level of athletes; (4) surgical parameters included the ACL reconstruction type, follow-up period, and graft types and (5) estimated outcomes were referred to as the psychological readiness to return to sport that was evaluated with the ACL-RSI scale. It is indispensable to highlight that the follow-up period pertained to the time between the surgery of the ACL and the evaluation of psychological readiness to return to sport among athletes. In cases of missing data, corresponding authors of relevant

investigations were not contacted by email. Data was not extracted from the figures of the included studies.

Study risk of bias assessment

The evaluation of the methodological quality of the studies was performed by two reviewers (AO and VR) using the Methodological Index for Non-Randomised Studies (MINORS).³⁷ All inconsistencies among reviewers were resolved via discussion, while the third party (MM) was consulted for clarification if it was not possible to reach a consensus between them. The MINORS contains eight items for non-comparative studies and four additional items for comparative research. For each aspect, the following scores are given: 0 (not reported), 1 (reported but inadequate) and 2 (reported and adequate). The maximum overall score for non-comparative and comparative studies is 16 and 24, respectively. A higher score indicated higher study quality and a lower risk of bias. For non-comparative investigations, the overall quality score is interpreted in line with the established criteria: 0–4=verylow quality; 5–8=low quality; 9–12=moderate quality and 13–16=high quality.³⁸ Regarding comparative articles, the overall quality score was categorised as follows: 0–6=verylow quality; 7–12=low quality; 13–18=moderate quality and 19–24=high quality.³⁹

Data analysis

Data processing was carried out using Review Manager V.5.4 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark). Standardised mean differences (SMD) and 95% CI were calculated regarding sex disparities in psychological readiness for

return to sport among athletes with a history of ACL reconstruction. The interpretation of individual and pooled SMD was conducted based on Cohen's recommendations as trivial ($SMD < 0.2$), small ($0.2 \leq SMD < 0.5$), moderate ($0.5 \leq SMD < 0.8$) and large ($SMD \geq 0.8$).⁴⁰ A random-effects model with the Hartung-Knapp-Sidik-Jonkman adjustment has also been applied. Heterogeneity among studies was estimated using I^2 , with thresholds of 25%, 50% and 75% indicating low, moderate and high levels, respectively.⁴¹ The funnel plot graph determined publication bias in studies included in quantitative analysis. Differences between males and females relating to the analysed outcome were considered statistically significant if the p-value was < 0.05 .

RESULTS

Study selection

A comprehensive electronic search of PubMed, Web of Science and Scopus yielded a total of 770 records, while 388 duplicates were removed using Zotero software V.6.0. Further, concerning screening, 298 records were excluded after reviewing the titles and abstracts, and 84 full-text reports were assessed for eligibility. Two reviewers (AR and SJ) most commonly excluded reports if psychological readiness to return to sport was not evaluated outcome and if no sex comparison in the main outcome was reported (online supplemental file 5). No additional records were identified via a search of relevant citations or Google Scholar. In summary, 11 reports satisfied each eligibility criteria and were involved in the quantitative

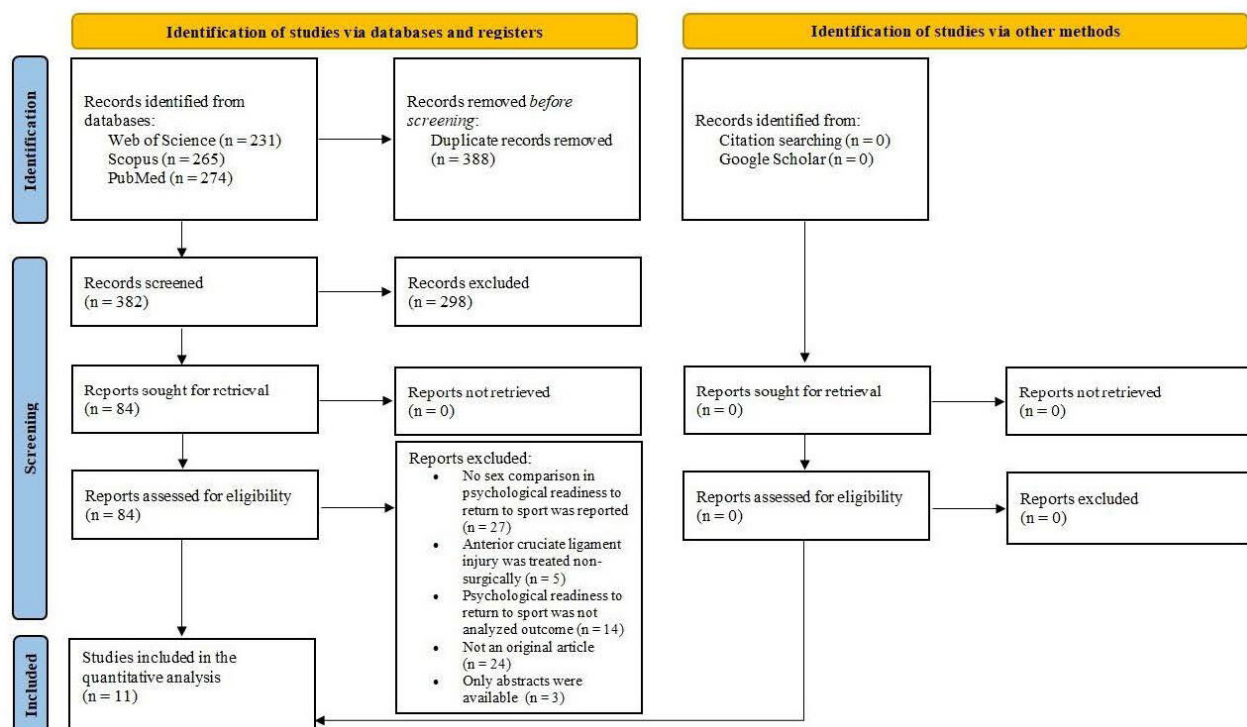


Figure 1 Preferred reporting items for systematic reviews and meta-analyses flow diagram depicts the overall search strategy.

analysis. The overall search strategy is available in the PRISMA flow diagram (figure 1).

Study characteristics

Investigations are available in the databases between 2019 and 2023. Studies were most commonly conducted in the USA^{42–45} and Australia^{46–49} as well as in European countries, such as Spain,⁵⁰ Sweden⁵¹ and France.⁵² In regard to study design, prospective cohort,^{43 45 48} retrospective cohort,⁴² case-control,^{46 47 52} cross-sectional^{44 51} and case series^{49 50} were recorded. Concerning level of evidence, level III^{42 44 46 47 51 52} was most commonly observed, while two studies reported level IV^{49 50} and three articles indicated level II^{43 45 48} of evidence. There were 2617 individuals with a history of primary ACL reconstruction, 1631 males and 986 females, with a mean age of 21.4±5.0 years. No differences in age between males and females were observed in studies that reported this variable separately.^{42–44} The range of respondents' age across all included studies was between 15.2±1.5 years and 30.0±4.2 years. Available literature addressed elite and recreational athletes,^{44 49 52} exclusively recreational athletes,^{46 51} and athletes who competed at the amateur level.⁵⁰ In addition, psychological readiness to return to sport was evaluated between 6 and 12 months following ACL surgery. Most importantly, according to the nine studies^{42–45 47–49 51 52} that clearly reported a follow-up period, psychological readiness to return to sport was assessed at a mean of 9±2.9 months following reconstruction. Hamstring autograft (n=2201) was most frequently applied out of graft sources. All details regarding study design, demographic and surgical variables are summarised in table 1.

Results of syntheses

Meta-analysis revealed that males had slightly higher psychological readiness to return to the sport than females following ACL reconstruction (SMD=0.33, 95% CI 0.14 to 0.52; p=0.0007; I²=77%). In addition, the range of psychological readiness to return to sport for males was between 47.3 points and 79.7 points, and for females it was between 44.2 points and 75.9 points. Taking into account data provided in the 11 studies,^{35–42 50–52} the average ACL-RSI score for males and females was 70.1±8.8 points and 65.1±8.8 points, respectively. The mean score of psychological readiness to return to sport of both sexes was above the cut-off recommendations required to return to sport (≥65). All the details regarding statistical analysis are depicted in figure 2. The funnel plot indicates that no publication bias among studies was observed (online supplemental file 6).

Risk of bias in studies

Since all investigations evaluated sex disparities in ACL-RSI scores, they were considered comparative. The range of overall quality scores was between 13 and 19, while the mean overall score of the included studies was 16.6±1.8. Therefore, the quality of each study, as well as the pooled quality score, is deemed as moderate. The major issues

were noted in items such as 'unbiased assessment of the study endpoint' and 'loss to follow-up less than 5%'. In contrast, the clearly stated aim, the inclusion of consecutive patients, prospective collection of data and endpoints appropriate to the aim of the study were the highest rated. The quality assessment of the involved studies is demonstrated in table 2.

DISCUSSION

Summary of main findings

The current meta-analysis aimed to (1) examine sex disparities in psychological readiness to return to sport among individuals who were subjected to the reconstruction of ACL and (2) determine whether separately males and females satisfied recommendations of psychological readiness required to return to sport following ACL surgery. Consistent with the first hypothesis, the obtained results demonstrated that males had slightly higher psychological readiness to return to sport relative to females after ACL reconstruction. Partially in agreement with the second hypothesis, both sexes exceeded the cut-off ACL-RSI score necessary to return to sport. Specifically, the mean values of psychological readiness to return to the sport of males were 70.1 points and of females 65.1 points, approximately at the 9-month follow-up period.

Comparisons with the evidence relating to the other psychological factors and self-reported outcomes

The main findings of this investigation are partially in accordance with the available scientific literature. Namely, evidence referring to the sex differences in fear of reinjury is quite inconclusive. More precisely, several studies did not reveal sex disparities,^{53 54} while in others,⁵⁵ females had a greater fear of reinjury compared with males. For instance, Lisee *et al*⁵⁴ suggest that males and females had similar values of fear of reinjury evaluated with the short form of the Tampa Scale of Kinesiophobia. Still, males have been less concerned in terms of environmental conditions in which sports activities were performed than females between 2 and 7 years after ACL surgery.⁵⁵ On the other hand, the obtained results of the present investigation are supported by the meta-analyses that addressed sex differences in self-reported outcomes, such as physical activity levels and function of the knee joint. In fact, males had substantially higher scores on the Tegner Activity Scale, Marx Activity Scale,³² and they also showed greater knee function assessed with the International Knee Documentation Committee³¹ and Lysholm³³ questionnaires relative to the females. The most relevant finding of this research is that males had slightly higher ACL-RSI scores compared with females after ACL surgery. Namely, 10 out of 11 included investigations indicated that males had higher psychological readiness to return to sport than females. More specifically, the range of mentioned differences across all studies was between 0.5 and 14.2 points. Only one investigation⁴⁵ reported that females had 0.8 points higher psychological readiness to

Table 1 Main characteristics of involved studies

Author (year)	Country	Study design (level of evidence)	Sample size (n)	Sex	Mean age (years)	Level of play	ACL reconstruction type	Follow-up period	Graft source
Beneito Pastor <i>et al</i> (2022) ⁵⁰	Spain	Case series (IV)	43	M=38 F = 5	24.7±8.0	Amateur athletes	NR	NR	NR
Cronström <i>et al</i> (2023) ⁵¹	Sweden	Cross-sectional (III)	143	M=71 F = 72	25.0±5.7	Recreational athletes	NR	12 months	Hamstring=113, patellar tendon=17 grafts and NR=13
Dombrowski <i>et al</i> (2023) ⁴²	USA	Retrospective cohort (III)	127	M=63 F = 64	M=20.1 ± 6.9 F=19.1±8.5	NR	Primary	8 months	BTB autograft=57, hamstring autograft=1 and allografts=12
Franck <i>et al</i> (2021) ⁵²	France	Case-control (III)	670	M=471 F=199	27.6±10.4	Elite and recreational athletes	Primary	6 months	BTB=52 and hamstring tendon=618 grafts
Kostyun <i>et al</i> (2021) ⁴³	USA	Longitudinal, prospective cohort (II)	93	M=42 F=51	M=15.1±1.5 F=15.3±1.4	NR	Primary	6 months	Hamstring autograft=93
Kuenze <i>et al</i> (2021) ⁴⁴	USA	Cross-sectional (III)	90	M=45 F=45	M=18.7±2.7 F=18.8±2.8	Elite and recreational athletes	Primary unilateral	6.9 months	Hamstring autograft=48 and patellar tendon=42
Manara <i>et al</i> (2022) ⁴⁶	Australia	Case-control (III)	626	M=474 F=152	30.0±4.2	Recreational athletes	Primary	NR	Hamstring tendon autograft=626
McPherson <i>et al</i> (2019) ⁴⁷	Australia	Case-control (III)	94	M=51 F=43	17.8±2.0	NR	Primary	12 months	Hamstring graft=86, patellar tendon graft=6 and other graft types (ie, synthetic graft, quadriceps tendon)=2
Milewski <i>et al</i> (2023) ⁴⁵	USA	Prospective cohort (II)	176	M=69 F=107	17.1±3.1	NR	Primary	6 months	BTB=31, hamstring=128, quadriceps=4 and iliotibial band=13 autografts
Webster and Feller (2021) ⁴⁸	Australia	Diagnostic cohort (II)	441	M=257 F=184	24.6±7.4	Non-elite athletes	Primary	12 months	Hamstring=338, patellar tendon=11, quadriceps=42 autografts and NR=50
Webster and Feller (2022) ⁴⁹	Australia	Case series (IV)	115	M=50 F=65	16.2±0.9	Elite and recreational athletes	Primary unilateral	12 months	Hamstring tendon graft=94 and NR=21
Summary of parameters					Mean age=21.4±5.0			9±2.9 months	

The age of the examined population is expressed as mean and SD.

ACL, anterior cruciate ligament; BTB, bone-patellar tendon-bone; F, female; M, male; NR, not reported.

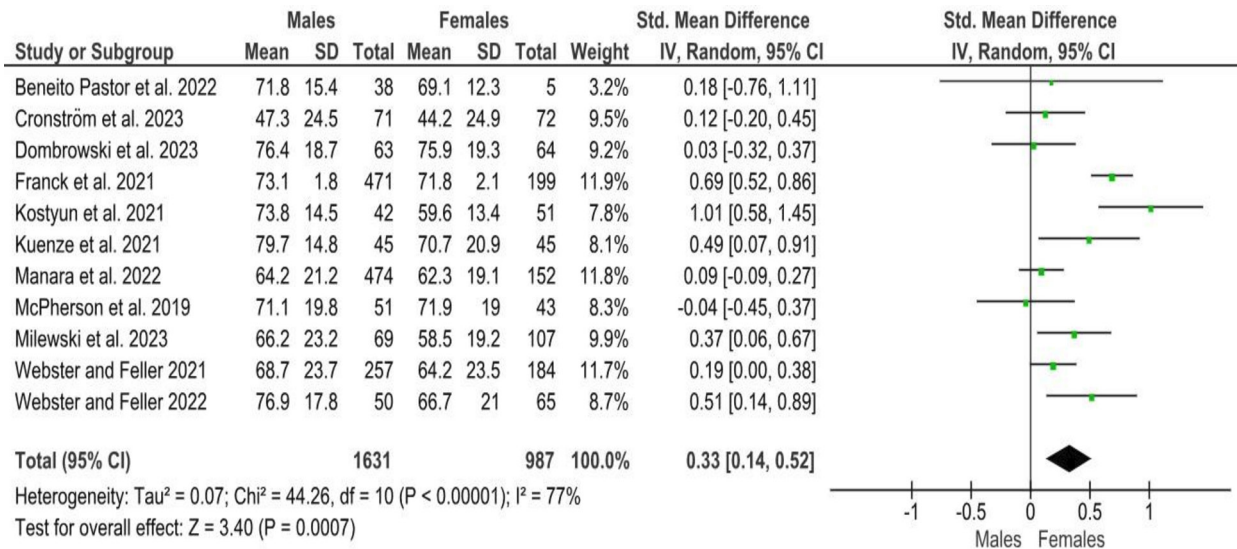


Figure 2 Sex differences in psychological readiness to return to sport among individuals who were subjected to the anterior cruciate ligament reconstruction.

return to sport relative to males. Overall, the obtained results of the present systematic review with meta-analysis suggested that males had on average 5 points greater ACL-RSI scores than females following ACL reconstruction. There are several possible explanations for the highlighted sexual disparities. Most importantly, convincing evidence indicated that particularly knee function^{56–58} and physical activity engagement⁵⁹ positively correlated ($r=0.60$ and $r=0.55$, respectively)^{56–57} with the psychological readiness to return to sport in the ACL population. Therefore, emphasised sex differences regarding physical activity and knee function may also explain why males had higher psychological readiness to return to the sport than females undergoing ACL surgery.

Practical significance of results

Available literature demonstrates that males return to sport after ACL reconstruction at a higher percentage compared with females. Likewise, there is evidence that psychological readiness positively correlated with a return to sport, indicating that athletes with a higher ACL-RSI score had an increased possibility of returning to sport following ACL surgery. Collectively, the reported sex disparities of the current meta-analysis provided one possible explanation for why males return to sport at a higher percentage than females after ACL reconstruction. Furthermore, the findings of this study are particularly meaningful for sports psychologists. Namely, besides that, sex disparities in psychological readiness to return to sport were observed in favour of males, the mean values of ACL-RSI scores of females were only slightly above the cut-off recommendations required to return to sport in the ACL population. For all these reasons, the implementation of psychological interventions that will increase the psychological readiness to return to the sport of females is warranted in the future. In other words, cooperation between sport psychologists,

physiotherapists and strength and conditioning coaches appears necessary to improve ACL-RSI scores of females and consequently potentially increase the percentage of females that return to sport following ACL reconstruction. Nonetheless, taking into account the mean values of psychological readiness to return to the sport of males, it is also necessary to emphasise that they also could have certain benefits with respect to the administration of psychological interventions. Of note, the revealed mean differences of 5 points in favour of males regarding the assessed outcome are substantially lower than the existing minimally important changes of 13.4 points and 15.1 points for the original and short versions of the ACL-RSI scale, respectively⁴⁸; therefore, the findings of the present study are not considered clinically meaningful. Interestingly, the obtained results could be associated with the return to sports time in individuals with a history of ACL reconstruction. It was demonstrated that the psychological readiness to return to sport was evaluated approximately 9 ± 2.9 months after surgery. Hence, recorded sex differences are probably relevant for sports in which return to sport time following ACL reconstruction is around 9 months, such as soccer^{60–62} and basketball.⁶³ Overall, more studies are necessary to verify this assumption.

Strengths and limitations

There are certain strengths of the presented research that should be emphasised. This is the first meta-analysis that summarised available scientific evidence that addressed the sex differences in psychological readiness to return to sport following ACL surgery, significantly extending and deepening the current body of knowledge pertaining to this phenomenon. In addition, the obtained results have robust practical implications and are useful, particularly for sports psychologists, as well as for physiotherapists and strength and conditioning coaches. Almost every

Table 2 Quality evaluation of the included investigations

Author (year)	Clearly stated aim	Inclusion of consecutive patients	Prospective collection of data	Endpoints appropriate to the aim of the study	Unbiased assessment of the study endpoint	Follow-up period appropriate to the aim of the study	Loss to follow-up less than 5%	Prospective calculation of the study size	An adequate control group	Contemporary groups	Baseline equivalence of groups	Adequate statistical analyses	Overall quality score
Beneito Pastor <i>et al</i> (2022) ⁵⁰	2	1	1	2	0	1	0	1	1	1	1	2	13
Cronström <i>et al</i> (2023) ⁵¹	2	2	2	1	0	2	0	2	1	1	1	2	16
Dombrowski <i>et al</i> (2023) ⁴²	2	2	2	2	0	1	0	1	2	2	2	1	17
Franck <i>et al</i> (2021) ⁵²	2	2	2	2	0	2	0	2	2	2	1	1	18
Kostyun <i>et al</i> (2021) ⁴³	2	2	2	2	0	2	1	1	2	2	2	1	19
Kuenze <i>et al</i> (2021) ⁴⁴	2	2	1	1	0	2	0	2	1	2	2	2	17
Manara <i>et al</i> (2022) ⁴⁶	2	2	1	1	0	0	1	2	1	1	2	2	15
McPherson <i>et al</i> (2019) ⁴⁷	2	1	2	2	0	2	1	1	2	2	1	1	17
Milewski <i>et al</i> (2023) ⁴⁵	2	1	2	2	0	2	0	1	1	2	1	1	15
Webster and Feller (2021) ⁴⁸	2	2	2	2	0	2	1	2	1	2	1	2	19
Webster and Feller (2022) ⁴⁹	2	2	2	2	0	2	0	1	1	2	1	2	17
Summary of quality	*	*	*	*	*	*	*	*	*	*	*	*	16.6±1.8

*Each item is scored 0 (not reported), 1 (reported but inadequate) and 2 (reported and adequate). The maximum overall score for comparative studies is 24.

study was published within the last 2 or 3 years. Therefore, the findings and evidence of the present systematic review with meta-analysis can be considered indeed innovative and actual.

In addition to the mentioned strengths of the study, several limitations need to be taken into account during the interpretation of the revealed sex disparities regarding psychological readiness to return to sport. Although 2618 individuals who underwent ACL reconstruction participated in this meta-analysis, an apparent inequality of numbers of males and females was observed (1631 vs 987, respectively). Moreover, I^2 was 77%, indicating a high level of heterogeneity among studies included in the quantitative analysis. Likewise, it is necessary to acknowledge that the overall average methodological quality of all studies was moderate. It should also be noted that data extraction was conducted independently by one reviewer. Additionally, sensitivity analysis and certainty of evidence assessment were not performed. A literature search was conducted only via three electronic databases, potentially limiting the number of identified studies. At last, since the current investigation involved only observational studies, level III evidence was most frequently recorded.

Perspectives

This investigation provided several indeed interesting future directions. First, based on the ACL reconstruction types, it is recommended to evaluate differences in psychological readiness to return to sport between males and females who were subjected to the revision of the ACL surgery. Second, in the future, sex disparities should be explored among athletes with a history of ACL reconstruction who are older than 30 years. Third, since this investigation only included a reconstructed population, it would be interesting to examine the differences in psychological readiness to return to the sport between surgically and non-surgically treated respondents with a history of ACL injuries, including the role of sex. Finally, examining psychological readiness to return to sport exclusively in a sample of elite athletes with a history of ACL injury and reconstruction represents a valuable future direction.

CONCLUSION

The present systematic review with meta-analysis found that males had an average of 5 points higher psychological readiness to return to sport than females following ACL reconstruction. Moreover, the mean ACL-RSI score of males was 70.1 points and of females 65.1 points, indicating that both sexes exceeded recommendations necessary to return to sport. In general, the results obtained are useful, especially for sports psychologists, as well as for physiotherapists and strength and conditioning coaches, emphasising that various psychological interventions aimed to increase psychological readiness to return to sport of females who were subjected to ACL reconstruction are warranted. Additionally, revealed differences between males and females in psychological

readiness to return to sport are potentially relevant for sports in which return to sport time after ACL surgery is approximately 9 months. Investigating sex disparities in the analysed outcome among exclusively elite athletes with a history of ACL reconstruction represents a valuable recommendation for future studies.

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