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Review

The Impact of Psychological Factors on Return to Sports after Anterior Cruciate Ligament Reconstruction: A Systematic Review

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Abstract: The rehabilitation of those who have undergone anterior cruciate ligament reconstruction (ACL-R) is a complex process that involves many factors. Physical ability recovery is not the only factor in the return to sport; psychosocial factors such as anxiety, pain response, self-esteem, locus of control, and fear of re-injury also play an important role. A systematic search was conducted on the PubMed, Medline, Cochrane, CINAHL and Embase databases using the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). No randomized controlled trials (RCTs) were identified. The Methodological Index for Non-Randomized Studies (MINOR) was used to assess the quality of the identified non-RCT studies. A total of 308 studies were identified, of which 32 met the eligibility criteria. The results of these studies were obtained using the KOOS (ADL, Sport, QoL), ACL, TSK-11, K-SES, questionnaires/interviews, and other scales as instrumental approaches. This systematic review and meta-analysis revealed that psychological factors have a significant influence on the post-anterior cruciate ligament reconstruction outcomes of athletes. Fear of re-injury and pain were the primary factors that limited return to sport, whereas self-efficacy, psychological will, and age were associated with better functional outcomes and were essential for male and young patients. Clinicians should focus on both physical and psychological components to optimize rehabilitation.

Keywords: Anterior Cruciate Ligament (ACL); depression; sports; systematic review; return to play

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1. Introduction

The reconstruction (ACL-R) of the anterior cruciate ligament (ACL) represents one of the most frequent procedures in sports medicine [1–3]. Every year in Western countries, approximately 40 out of every 100,000 individuals undergo ACL-R [4]. This is estimated to be 250,000 cases in Europe and the United States alone [5]. ACL stabilizes the knee by preventing the tibia from sliding anteriorly in relation to the femur [6,7]. The primary objectives of ACL-R are to enable a return to all pre-injury activities and to improve the health-related quality of life (HRQoL) of the patient by restoring the full biomechanics of the knee following injury [1]. Despite the treatment, athletes who suffer an ACL injury do not successfully return to their pre-trauma level of activity. This is due to surgery, the psychological impact of the injury on the patient's life, and the patient's perception of the knee function [8,9].

Recent reviews have shown that only 54% of patients who have undergone ACL reconstruction are able to return to the same level of sports activity that they were participating

in prior to the injury [10]. Athletes who do not return to any competitive level are instead around 15% or 20% [11].

Psychological effects, such as anxiety, depression, and fear of reinjury, need to be considered along with the physical effects that are often experienced by patients' post-serious sports injury [12,13]. Studies have shown that the primary reason why return rates to competitive and amateur sports are low when there are no deficits or complications following ACL-R, is the fear of re-injury [14–18].

Fear and anxiety of a high degree can lead to a decreased adherence to the rehabilitation process [19]. Having strong self-efficacy and low fear of a potential re-injury is essential for optimal rehabilitation following an ACL-R [20]. Thus, a comprehensive analysis of the patient must include not only the traditional objective assessments from a medical point of view but also the psychological state of the individual. This should be the primary factor in determining the potential outcomes associated with resuming sports activities [21]. The physical effects of ACL-R are described in numerous studies; however, there is not a large number of studies in the literature on the role that psychological components may have on an individual's ability to return to sport after the ACL-R intervention [11].

The aim of this systematic review was to evaluate the psychosocial factors associated with return to sport following anterior cruciate ligament reconstruction.

2. Materials and Methods

The preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines were employed to enhance the reporting of the review (Figure 1) [22].

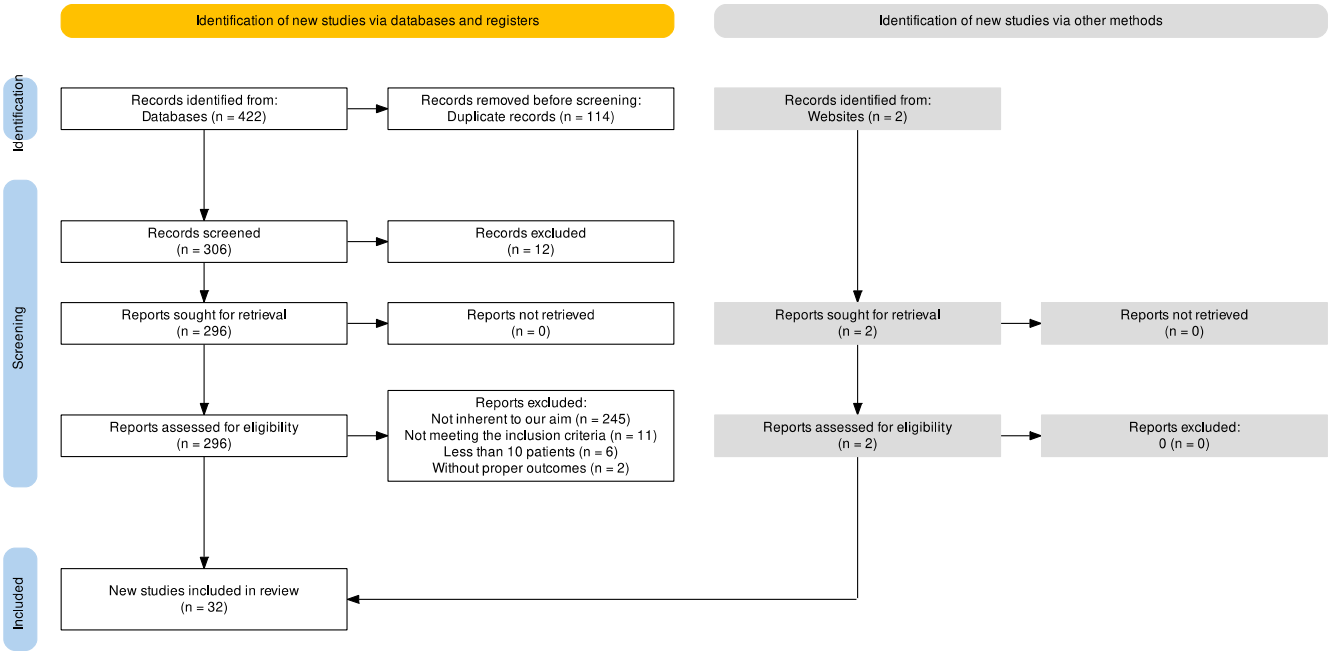

Figure 1. PRISMA flow diagram.

2.1. Eligibility Criteria

The research question was formulated using a PICOS approach: Patient (P); Intervention (I); Comparison (C); Outcomes (O) and Study design (S) [23].

The exclusion criteria included: non-validated studies, non-human studies, and studies with a treatment group of less than 10 patients.

2.2. Search

A systematic review was conducted in November 2020. A comprehensive search of the databases PubMed, Medline, Cochrane, CINAHL, and Embase databases was conducted

from the inception to November 2020 with the English language constraint. The following keywords were used isolated and combined: anterior cruciate ligament; wounds and injuries; reconstructive surgical procedures; repairability; tears; lacerations; quality of life; fear; adaptation; psychological; self-efficacy; psychology; anxiety. All the keywords were searched isolated and combined with their MeSH terms. More studies were searched among the reference lists of the selected papers.

2.3. Study Selection and Data Collection

Two authors (FD and MB) initially conducted a search for the article using a previously described search strategy. All abstracts were read, after which the full article was reviewed if, after discussion between the two independent reviewers, it could not be unequivocally excluded based on the title and abstract. The full text of all papers not excluded based on abstract or title was evaluated. The number of articles excluded or included was registered and reported in a PRISMA flowchart (Figure 1) following the rules by Liberati et al. [24].

2.4. Quality Assessment

The Methodological Index for Non-Randomized Studies (MINORS) was used for quality assessment [25]. This score consists of 12 items: clearly stated aim; inclusion of consecutive patients; prospective data collection; endpoints appropriate to study aim; unbiased assessment of study endpoint; follow-up period appropriate to study aim; <5% lost to follow up; prospective calculation of study size; adequate control group; contemporary groups; baseline equivalence of groups and adequate statistical analyzes. The reviewers individually evaluated these items. The MINORS items were scored 0 if not reported, 1 when reported but inadequate, and 2 when reported and adequate. The ideal global score was 20 for NRCTs. The simplicity of MINORS comprising only 12 items makes this item readily usable by both readers and researchers. The reliability of this score has already been demonstrated [25]. Two reviewers independently evaluated (FD/MB) the potential risk of bias in the studies using the MINORS.

2.5. Data Synthesis and Analysis

Data were extracted and organized using Microsoft Excel. Relevant study characteristics extracted included study, year, design, location, aim, sport and sport participation level, sample age and size, instrument(s) or approach(s), social and/or contextual factor, and study result. Considering the heterogeneity of the included studies, only seven articles (Ardern et al. (2016), Ardern et al. (2014), Fältström et al. (2013), Hamrin et al. (2017), Kvist et al. (2005), Mars Group (2019), and Muller et al. (2016)) [16,26–30] were included in the meta-analysis. The calculation of the overall mean from studies (or cohorts) reporting a single mean using the inverse variance method for pooling was performed for the Knee Injury and Osteoarthritis Outcome Score (KOOS), which is divided into KOOS Sport and KOOS Quality of Life (QoL), Tampa Scale of Kinesiofobia-11 (TSK-11), Knee-Self Efficacy Scale (K-SES), and Anterior Cruciate Ligament Quality of Life (ACL QoL) scores. The K-SES is a self-administered questionnaire and consists of two subscales: knee self-efficacy present (present), consisting of 18 items, and knee self-efficacy future (future), consisting of 4 items. Patients rate each item on an 11-point Likert scale, ranging from 0 = not at all certain to 10 = very certain. The ACL-QOL score is a disease-specific patient-reported outcome measure that assesses patients with ACL-deficient and reconstructed knees. The ACL-QOL has demonstrated validity, responsiveness, and reliability.

The inverse variance weighting was used for pooling. To assess the heterogeneity between the studies, the I^2 statistic was used. Since the I^2 statistic was >50% [31], the random effect model was used. Meta-regression was performed to evaluate the correlation between the return to sport (KOOS Sport score) and psychological factors (KOOS QoL, TSK-11, K-SES, and ACL QoL scores). In all studies, $p < 0.05$ was considered statistically significant. All statistical analyses were performed using R software version i368 3.6.1.

3. Results

3.1. Study Selection

According to the PRISMA protocol, a flow-chart diagram showing the selection process of the studies was reported (Figure 1). A total of 306 studies were found, to which articles identified through other sources (N = 2) were added, for a total of 308 selected articles. From these 308 studies, articles that were not in the English language (N = 4) and articles published before 2000 (N = 8) were excluded. From the total of 296, studies were excluded through the title, abstract, and the complete reading of the article, because they were not considered relevant to our objective (N = 245). Validated studies (N = 9) and non-human articles (N = 2) were not included. In addition, studies with <10 patients per treatment group were also excluded (N = 6). From the total of 45 final studies, those unavailable due to the absence of material were eliminated (N = 10). Finally, articles that did not have functional and psychological outcomes were excluded (N = 2). After this trial, 32 articles were eligible for this study. The research question was formulated using a PICOS approach (Table 1).

Table 1. PICOS-approach.

P	Patients with ACL lesions
I	Patients undergoing ACL-R
C	Patients not undergoing ACL-R
O	Evaluate the quality of life and the psychological factors that influence the return to sport
S	Randomized control trials (RCT) and non-randomized controlled studies (NRCT) such as prospective (PS), retrospective (RS), Cross-sectional (CS), observational studies (OS), case-series (CS), and case-control (CC) studies were included.

3.2. Studies and Patients Characteristics

All studies included in this review were published from 2005 to 2020. No RCTs eligible for the study were found. Selected articles included case series [26,32,33], cross sectional [6,8,12,16,27,29,34–38], case control [14,20,39,40], cohort [30,41–45], qualitative [46,47], and others [5,28,48–50]. The data found on the mean follow-up are not adequate for calculating statistical values. These characteristics have been reported in Table 2.

The level of sporting participation of the patients present in the review includes both amateur and elite sports (Table 3).

Table 2. Characteristics of the included studies.

	Year	Location	Type of Study/LOE	Follow-Up Mean (Range)	Conclusion
Ardern et al. [26]	2016	Sweden Australia	CS IV	3 y (1–7 y)	People who reported higher knee-related self-efficacy and quality of life were more likely to be satisfied with the outcome of ACL reconstruction.
Ardern et al. [27]	2014	Australia Sweden	CrS III	35 m (12–81 m)	Psychological readiness to return to sport and recreation was the factor most strongly associated with returning to the preinjury activity.
Ardern et al. [12]	2012	Australia	CrS III	- (2–7 y)	The gender, the timing of surgery following injury, and the level of sport the athletes returned to may be associated with fear of re-injury following surgery.

Table 2. *Cont.*

	Year	Location	Type of Study/LOE	Follow-Up Mean (Range)	Conclusion
Arden et al. [40]	2013	Australia	CC III	- (4–12 m)	Psychological responses before surgery and in early recovery were associated with returning to the preinjury level of sport at 12 months.
Baez et al. [34]	2020	USA	CrS III	5 y -	Psychological factors, specifically injury-related fear and self-efficacy, were associated more significantly than functional outcomes with return to sport and physical activity levels.
Beischer et al. [39]	2019	Sweden	CC III	8–12 m -	Regardless of age, athletes who had returned to the sport and athletes with more symmetrical muscle function had a stronger psychological profile.
Burland et al. [47]	2018	USA	Q	1 y -	After ACL-R, the decision to return to sport was largely influenced by psychosocial factors.
Chmielewski et al. [35]	2008	USA	CrS IV	- (12 w-1 y)	Fear of movement/reinjury levels appears to decrease during ACL reconstruction rehabilitation.
DiSanti et al. [36]	2018	USA	CrS III	5.5±1.4 m	Early identification of athletes at risk of persistent psychosocial barriers and the establishment of peer mentoring groups can be key components for improving mental and physical readiness for Revised Trauma Score (RTS).
Fältström et al. [41]	2013	Sweden	Ch III	- (2–5 y)	Patients with bilateral ACL injuries reported poorer knee function and quality of life compared with those who had undergone unilateral ACL reconstruction.
Filbay et al. [46]	2016	Australia	Q	- (5–20 y)	Activity preferences, lifestyle modifications, and fear of re-injury influenced the quality of life in people with knee symptoms following ACLR.
Filbay et al. [37]	2017	Australia	CrS IV	9 ± 4 (5–20 y)	Many individuals experience long-term quality of life (QOL) impairment following ACL-R.
Hamrin et al. [28]	2017	Sweden	PO II	10 w, 4, 8, 12, 18, and 24 m and then yearly up to 5 y	Patients who returned to sports after ACL-R had better subjective knee function and higher self-efficacy of knee function.
Hart et al. [38]	2020	Canada Australia USA	CrS III	1 y (11–15)	Evaluating and considering knee confidence, fear of movement, and psychological readiness should be an important part of comprehensive post-ACLR rehabilitation.
Kvist et al. [16]	2005	Sweden	CrS III	- 3–4 y)	Fear of re-injury must be considered in the rehabilitation and evaluation of the effects of an ACL reconstruction.
Langford et al. [48]	2009	Australia	PL II	3, 6 and 12 m	During rehabilitation, there are significant psychological differences regarding sport resumption between athletes who do and do not resume competitive sport 12 months following ACL reconstruction.
Lind et al. [5]	2012	Denmark	R IV	6 y (2–9 y)	The subjective outcome of the scores indicate significant knee impairment with low scores in sports and quality of life.

Table 2. *Cont.*

	Year	Location	Type of Study/LOE	Follow-Up Mean (Range)	Conclusion
Lentz et al. [14]	2015	USA	CC III	- (6 m and 1 y)	Elevated pain-related fear of movement/reinjury, quadriceps weakness, and reduced IKDC score distinguish patients who are unable to return to preinjury sports participation.
Mars Group [29]	2019	USA	CrS III	2 y -	Participation in either a single or multiple sports in the 2 years after ACL revision surgery was found to be significantly associated with higher PROMs.
McPherson et al. [45]	2019	Australia	Ch II	- (2–4 y)	Younger patients with lower psychological readiness are at higher risk for a second ACL injury after returning to sport.
Muller et al. [30]	2016	USA	Ch II	3.4 ± 1.3 y (1–5 y)	This study has identified PASS threshold values for the IKDC-SKF and the KOOS subscales.
Ninković et al. [6]	2015	Serbia	CrS III	1 y -	The overall life quality a year after the ACL-R does not differ in relation to either the gender of the subjects or the type of sports activity.
Paterno et al. [42]	2018	USA	PCh II	- (1–2 y)	Patients with greater self-reported fear were less active.
Piussi et al. [20]	2020	Sweden	CC III	10 w, 4, 8, and 12 m	Patients who recovered strength and symmetry 12 months after ACL-R correlated with upper knee self-efficacy and higher quality of life.
Patel et al. [43]	2019	USA UK	RCh III	50 m (24–224 m)	A significant number of non-elite athletes did not perform RTS after ACL reconstruction, and this was affected by a combination of activity level, sport, self-reported knee instability, and psychosocial factors.
Ross et al. [49]	2017	South Africa UK	MM	- (12–36 m)	Modifiable fears including pain, mode and length of rehabilitation, and psychological factors should be considered during rehabilitation to potentially improve the return to sport rate.
Ross et al. [17]	2010	USA	-	31.7 ± 16.2 m	These results suggest that fear-avoidance beliefs following ACLR can potentially adversely influence functional levels in activities of daily living and sports.
Tengman et al. [8]	2014	Sweden	CrS III	20 y	The decreased knee function, knee-related physical activity level, and jump capacity may be associated with fear of movement also in the long-term perspective.
Thomee et al. [50]	2007	Sweden	P II	3 m, 6 m,1 y	Self-efficacy belief may be of major importance for the outcome of rehabilitation after sports-related injuries.
Tjion et al. [32]	2015	Canada	CS IV	(2–10 y)	Recognizing and addressing the psychological factors and lifestyle changes can contribute to the patient's decision to return to sports.

Table 2. *Cont.*

	Year	Location	Type of Study/LOE	Follow-Up Mean (Range)	Conclusion
Vega et al. [33,44]	2019	USA	Ch II	1 y -	The PASS question identifies individuals who have experienced clinically successful ACLR with high sensitivity.
Webster et al. [33]	2019	Australia	CS IV	5.3 y (2.5–10 y)	Fear of reinjury was the most common reason cited for failure to return to sport after the second reconstruction.

The most used outcome scales reported were KOOS (ADL, sport, QoL) 56.2%, ACL 32.3%, International Knee Documentation Committee (IKDC) 21.9%, TSK-11 28.1%, K-SES 25%, and questionnaires/interviews 32.3%. Other scales used in a lower percentage are Marx Activity Score, Tegner Activity Scale, Perceived Available Support in Sport (PASS), Activities of Daily Living (ADL), Emotional Responses of Athletes to Injury Questionnaire (ERAIQ), Single Assessment Numeric Evaluation (SANE), Veterans RAND 12-item Health Survey (VR-12), Multidimensional Health Locus of Control (MHLC-C), Strategies for Self-Regulated Learning (SRLC), A Fear-Avoidance Beliefs Questionnaire (FABQ), modified Disablement in the Physically Active-Mental Summary Component (MDPA-MSC), Likert Scale, Hospital Anxiety and Depression Scale (HADS), Sport Anxiety Scale (SAS), and Pain Catastrophizing Scale (PCS).

Table 3. Characteristics of patients.

Study	Sample Size	Mean Age	Sport and Sport Participation Level
Ardern et al. [26]	177 (100 men and 70 women)	18–45 y	62% playing sub-elite competitive sport. 24% participated in active recreation. 16% playing élite sport.
Ardern et al. [27]	164 -	18–45 y	sub-elite competitive level (64%). elite competitive level (15%). Recreational level (21%).
Ardern et al. [12]	209 (88 woman and 121 men)	- 31.7 ± 9.7	Australian football (n = 60, 29%), netball (n = 40, 19%), basketball (n = 32, 15%), and soccer (n = 23, 11%).
Arden et al. [40]	187 -	–	Recreational or competitive level.
Baez et al. [34]	40 (24 woman and 16 men)	18–35 y 24.3 ± 4.1	–
Beischer et al. [39]	384 (50% women) and 271 athletes (52% women)	15–30 y	Athletes.
Burland et al. [47]	12 (6 men and 6 women)	16–44 y 24 ± 8	Competitive athletics.
Chmielewski et al. [35]	97 (60 men and 37 women)	Group 1: 26.2 ± 9.2 Group 2: 25.3 ± 11.0 Group 3: 24.0 ± 7.7	-
DiSanti et al. [36]	10 (6 women and 4 men)	15–18 y 16.8 ± 1.1	basketball (n = 2), soccer (n = 2), football (n = 2), volleyball (n = 1), skiing (n = 83 1), ice hockey (n = 1), and lacrosse (n = 1)
Fältström et al. [41]	147 (42% female)	18–45 y 28.5 ± 8.2	Soccer, Handball, Basketball, Floorball, Downhill skiing, Motor sport, Other sport.
Filbay et al. [46]	17 (10 women and 7 men)	18–25 y	-
Filbay et al. [37]	162 -	- 38 ± 9	Athletes.

Table 3. *Cont.*

Study	Sample Size	Mean Age	Sport and Sport Participation Level
Hamrin et al. [28]	157 (77 women and 80 men)	15–30 y	-
Hart et al. [38]	118 -	18 -50 y	Pivoting sport.
Kvist et al. [16]	84 62 patients (74%) answered the questionnaires (34 men and 28 women).	16–35 y	soccer, handball, ice hockey, floorball, or American football.
Langford et al. [48]	87 (55 men 32 women)	18–40 y	Competitive sport.
Lind et al. [5]	128 (50% men)	- 32	-
Lentz et al. [14]	73 -	15–50 y	Recreational sport.
Mars Group [29]	1205 -	12–65 y	Baseball/softball, Basketball, Football, Gymnastics, Skiing, Soccer, Volleyball, Other.
McPherson et al. [45]	329 -	132 $\leq$20 y and 197 $\geq$20 y	-
Muller et al. [30]	251 -	14–50 y (26.1 $\pm$ 9.9)	Light sports activity, moderate sports activity, moderate sports activity, strenuous sports activity.
Ninković et al. [6]	185 (146 men and 39 women)	-	Professional/amateur athletes.
Paterno et al. [42]	40 -	10–25 y	high-level athletic activity: pivoting and cutting.
Piussi et al. [20]	328 (120 men 37%)	15–65 y 27.8 $\pm$ 10	-
Patel et al. [43]	78 (46 men)	16–50 y 31.5 y	Non-élite athletes.
Ross et al. [49]	112 (78 men and 34 women)	15–50 y	Athletes.
Ross et al. [17]	48 (34 men and 14 women)	- 20.6 $\pm$ 1.2	required military and athletic activities.
Tengman et al. [8]	103 (65 men and 28 women)	17–28 y 23	Soccer, alpine, other sport.
Thomee et al. [50]	33 (15 women and 18 men)	17–55 y 29.2	Baseline physical activity.
Tjion et al. [32]	31 (22 men and 9women)	18–40	Soccer, football, ultimate frisbee, basketball, hockey, and others. A level: recreational, varsity high school, varsity college/university, paid professional.
Vega et al. [33,44]	300 patients	300 completed follow-ups: 26.2 mage (24.8–27.6)	Athletes.
Webster et al. [33]	107 (62 men and 45 women)	- 2	football, netball, basketball, and soccer.

3.3. Quality Assessment

All studies are NRCTs. The MINORS tool was adopted to assess the quality of evidence of the included papers. Among these studies, 23 studies [5,6,8,14,20,26–30,33–35,38–41,43–46,48,49] had a low risk of bias; while nine studies [12,16,17,32,36,37,42,47,50] had a high risk of bias. The MINORS was reported in Table 2. Except for the paper of [16], all studies included in the meta-analysis had a low risk of bias.

3.4. Results of the Meta-Analysis

To find the overall mean of KOOS Sport (mean 66.8 [95% CI 45.6; 88.1]) and KOOS QoL (mean 57.9 [95% CI 38.2; 77.6]), seven studies (10 cohorts) were included. To calculate the overall mean of TSK-11 (mean 31.4 [95% CI 23.6; 39.1]), K-SES (mean 6.8 [95% CI 4.5; 9]) and ACL QoL (mean 6.4 [95% CI 4.1; 8.7]), three studies (4 cohorts) were included (Figures 2–6).

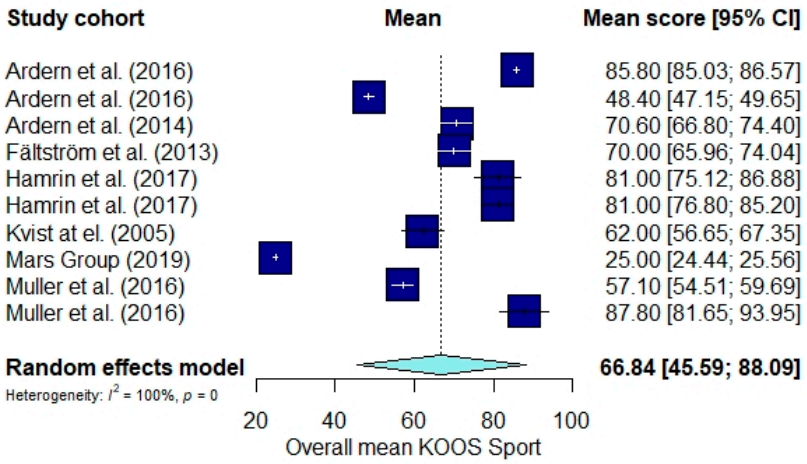

Figure 2. Overall mean Knee Injury and Osteoarthritis Outcome Score (KOOS) Sport [16,26–30,41].

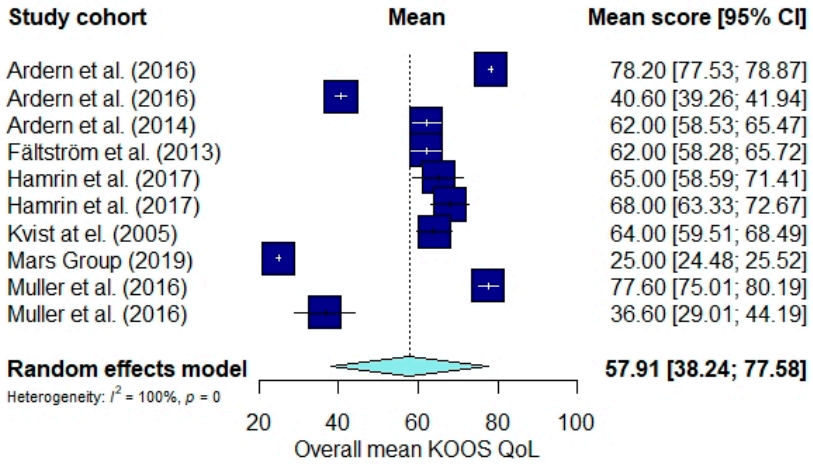

Figure 3. Overall mean Knee Injury and Osteoarthritis Outcome Score Quality of Life (KOOS QoL) [16,26–30,41].

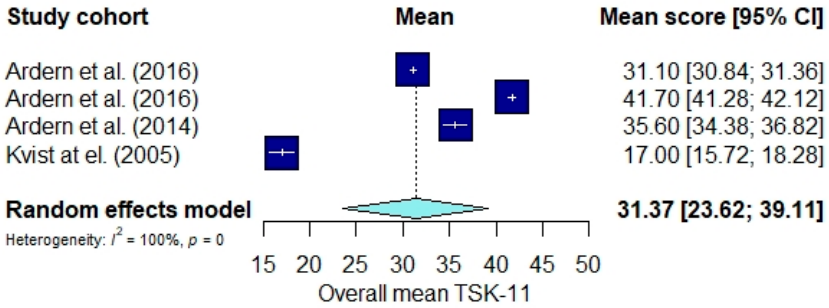

Figure 4. Overall mean Tampa Scale of Kinesiofobia-11 (TSK-11) [16,26,27].

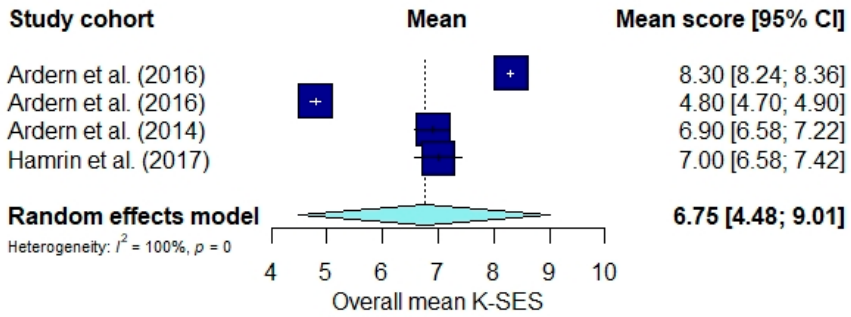

Figure 5. Overall mean Knee-Self Efficacy Scale (K-SES) [26–28].

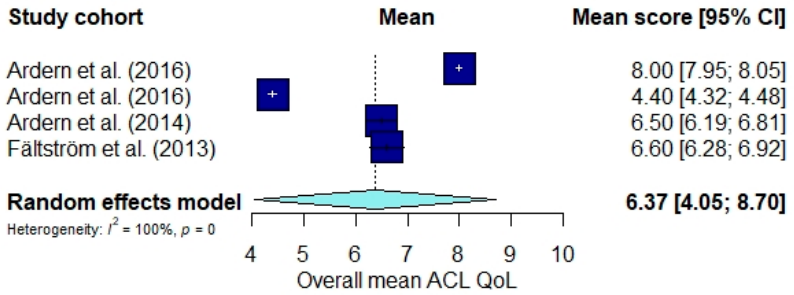

Figure 6. Overall mean Anterior Cruciate Ligament Quality of Life (ACL QoL) scores [26,27,41].

The meta-regression found a statistically significant correlation between the return to sport (KOOS Sports score) and three psychological factors (KOOS QoL, $p = 0.0025$; K-SES, $p < 0.001$; and ACL QoL, $p < 0.001$). As the KOOS Sports score increased, the value of the psychological scores increased (Figures 7–9).

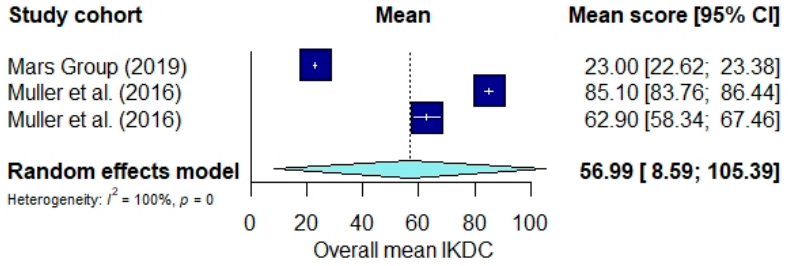

Figure 7. Overall mean International Knee Documentation Committee (IKDC) [29,30].

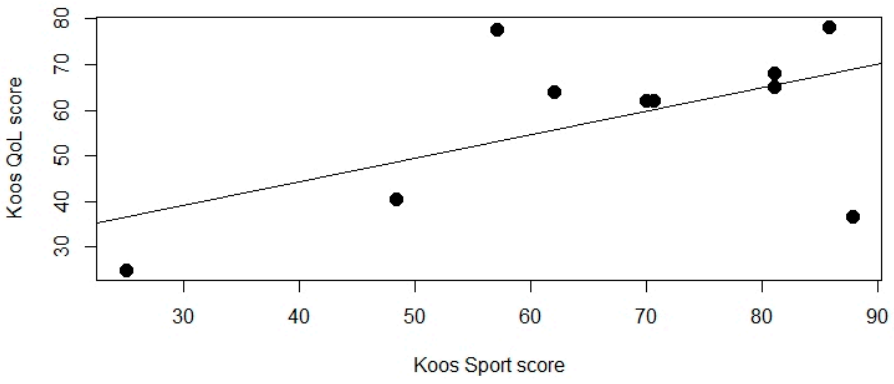

Figure 8. Knee Injury and Osteoarthritis Outcome Score Quality of Life (KOOS QoL).

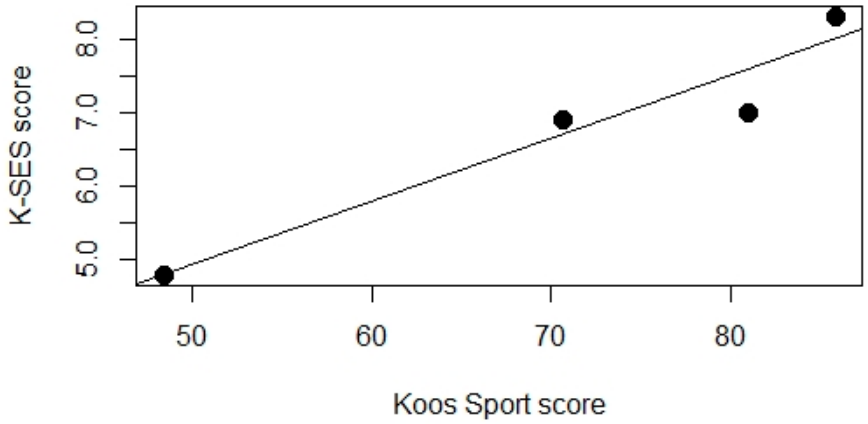

Figure 9. Knee-Self Efficacy Scale (K-SES) Score.

No statistically significant correlation between KOOS Sport and TSK-11 score was found ($p = 0.7274$).

4. Discussion

The cruciate ligament rupture represents one of the most common injuries in the athlete's population. The stability of the knee can only be effectively recovered following ACL-R reconstruction surgery [43] with the primary aim being to return to their pre-injury daily and sporting activities [6].

Engaging in physical activity on a regular basis has been associated with an enhanced quality of life, a reduction in depressive symptoms, and a decrease in obesity rates [46]. Nonetheless, physical and psychological preparation to return to sport does not always coincide [51]. Psychological factors have become increasingly recognized as important parameters for determining an athlete's ability to return to sports after surgery. In the study conducted by M. Xiao et al., psychological parameters were recorded using the ACL-Return to Sports Injury scale, Knee Self-Efficacy Scale (K-SES), and Tampa Scale of Kinesiophobia (TSK/TSK-11). [52] Another study by L. N. Erickson et al., to determine whether psychological readiness for sport and knee self-efficacy assessed early (3 months) after anterior cruciate ligament reconstruction is predictive of self-reported functional results, quadriceps strength, and knee mechanics during running upon return to sports training (6 months), used these two scores: ACL-RSI and K-SES [53].

In the last 25 years, subjective scales have been developed to assess the psychological aspect of an athlete's decision to return to physical activity and training [32,54]. The ACL-RSI is considered to be highly correlated with the level of participation in physical activities prior to ACL reconstruction, due to its ability to evaluate the psychological readiness for returning to sports and leisure activities [27,38,47].

Existing studies have demonstrated that age constitutes a key factor for the early return to sport [41,55]. Several studies have indeed shown that, compared to adults, teenagers have a stronger psychological profile, with greater awareness of their self-efficacy and greater motivation to achieve their goals [39,54,56]. The organization of daily life, work-related duties, family commitments, and the general lifestyle are only a few of the reasons explaining why adults are less likely to return to pre-injury sports [10,15,32,43]. Female patients reported worse KOOS than male patients, reporting that also gender could represent a co-leading factor [41,57].

In a meta-analysis of 2011 [15]., Ardern's reported that of 5770 participants (with a mean follow-up of 41.5 months), 82% had returned to some type of sports participation, 63% returned to their pre-injury level of participation, and 44% returned to competitive sports at the final follow-up. Moreover, Ardern and colleagues showed that psychological factors such as fear of re-injury (19%), problems with the function of the reconstructed knee (13%), and fear of losing work with re-injury (11%) were the most cited personal reasons by participants for changing or ceasing postoperative sports participation. These findings

may explain the discrepancy between satisfactory physical outcomes and the rate of return to sport. In 2014, another study by Ardern et al. [27] reported that the rate of return to some types of sport and pre-injury sport level after ACL-R was 81% and 65%, respectively. Instead, the rate of return to competitive sport after ACL-R was 55%. In this study, the authors concluded that these effects were also achieved by consideration and management of psychological factors, which are among the most useful modifiable elements in favor of patients' quality of life and return to sport. An example of an intervention that can help athletes return to sport after surgery involves the use of health coaching, motivational interviewing, and cognitive-behavioral strategies to address and manage factors that could impede such return, such as fear of re-injury and pain.

In the present study, the meta-analysis considered 7 of the 32 studies included in the systematic review. The results were consistent with existing research. It was observed that as KOOS sport levels increased, there was an increase in KOOS QoL, KSES, and ACL QoL, suggesting that a return to sport participation is associated with improved postoperative psychological functioning. At the same time, in fact, a reduction in KOOS QoL is accompanied by a decrease in KOOS sport, ACL QoL, and KSES. According to the results of the present study, it seems that the parameters of physical and psychological health are closely linked and influenced by each other.

A holistic rehabilitation experience with a robust psychological support system is an effective way to facilitate a successful return to sports. Participants in these studies have indicated that providing support throughout the recovery period can have a positive effect on confidence [34]. Support to ACL patients should also come from teammates, coaches, and family members, but especially from medical personnel [40,50,58].

This study has some limitations. In some cases, participants who already returned to sport did not see the need to attend follow-up appointments, thinking that their progress was already satisfactory. On the other hand, patients who felt dissatisfied with their results preferred not to show up for follow-up [15,27,59].

Return to sport after ACL-R surgery is considered a key indicator of success. However, it is not possible to determine exactly whether patients with improved function are able to participate in sports activities or whether it is sports participation that leads to increased function [29,58,60].

The results of the reviewed studies indicate that to maximize the athlete's chances of regaining pre-injury performance levels, both their physical and psychological conditions should be addressed during rehabilitation [40,61,62].

Thus, to meet the desired therapeutic objectives, it is essential to identify and address any psychological and social impediments that may impede the patient's rehabilitation progress and that may affect the patient's decision to return to the same level of physical activity [47,63].

5. Conclusions

This systematic review and meta-analysis investigated the impact of psychological factors on patients' post-anterior cruciate ligament reconstruction. Indeed, our meta-analysis results support the notion that psychological and environmental influence patients' ability to resume sports activities following surgical ACL reconstruction (a positive correlation between KOOS sport and KOOS QoL, KSES, and ACL QoL was observed).

Hence, to support athletes' resumption of sport, clinicians should focus on not only the physical components but also strive to resolve all aspects of rehabilitation [48].

In order to reduce injury-related apprehension and bolster population self-efficacy in the future, research should investigate the efficacy of psychoeducation techniques [34].

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Abbreviations

Case Series	CS
Cross sectional	CRS
Case control	CC
Qualitative	Q
Cohort	Ch
Prospective	P
Prospective Observation	PO
Prospective Longitudinal	PL
Retrospective	R
Prospective cohort	PCh
Retrospective cohort	RCh
Mixed Methods	MM
Knee Injury and Osteoarthritis Outcome Score	KOOS Sport
Quality of Life	QoL
Tampa Scale of Kinesiofobia-11	TSK-11
Knee-Self Efficacy Scale	K-SES
Anterior Cruciate Ligament Quality of Life	ACL QoL
International Knee Documentation Committee	IKDC
Perceived Available Support in Sport	PASS
Activities of Daily Living	ADL
Emotional Responses of Athletes to Injury Questionnaire	ERAIQ
Single Assessment Numeric Evaluation	SANE
Veterans RAND 12-item Health Survey	VR-12
Multidimensional Health Locus of Control	MHLC-C
Strategies for Self-Regulated Learning	SRLC
A Fear-Avoidance Beliefs Questionnaire	FABQ
Modified Disablement in the Physically Active-Mental Summary Component	MDPA-MSC
Hospital Anxiety and Depression Scale	HADS
Sport Anxiety Scale	SAS
Pain Catastrophizing Scale	PCS

References

1. Filbay, S.R.; Ackerman, I.N.; Russell, T.G.; Macri, E.M.; Crossley, K.M. Health-related quality of life after anterior cruciate ligament reconstruction: A systematic review. *Am. J. Sports Med.* **2014**, *42*, 1247–1255. [CrossRef]
2. Longo, U.G.; Nagai, K.; Salvatore, G.; Cella, E.; Candela, V.; Cappelli, F.; Ciccozzi, M.; Denaro, V. Epidemiology of Anterior Cruciate Ligament Reconstruction Surgery in Italy: A 15-Year Nationwide Registry Study. *J. Clin. Med.* **2021**, *10*, 223. [CrossRef]
3. Longo, U.G.; Salvatore, G.; Ruzzini, L.; Ambrogioni, L.R.; de Girolamo, L.; Viganò, M.; Facchini, F.; Cella, E.; Candela, V.; Ciccozzi, M.; et al. Trends of anterior cruciate ligament reconstruction in children and young adolescents in Italy show a constant increase in the last 15 years. *Knee Surg. Sports Traumatol. Arthrosc.* **2020**, *29*, 1728–1733. [CrossRef] [PubMed]
4. Longo, U.G.; Viganò, M.; Candela, V.; de Girolamo, L.; Cella, E.; Thiebat, G.; Salvatore, G.; Ciccozzi, M.; Denaro, V. Epidemiology of Posterior Cruciate Ligament Reconstructions in Italy: A 15-Year Study. *J. Clin. Med.* **2021**, *10*, 499. [CrossRef] [PubMed]

5. Lind, M.; Lund, B.; Faunø, P.; Said, S.; Miller, L.L.; Christiansen, S.E. Medium to long-term follow-up after ACL revision. *Knee Surg. Sports Traumatol. Arthrosc.* **2011**, *20*, 166–172. [CrossRef] [PubMed]
6. Ninkovic, S.; Avramov, S.; Harhaji, V.; Obradovic, M.; Vranjes, M.; Milankov, M. Influence of different levels of sports activities on the quality of life after the reconstruction of anterior cruciate ligament. *Med Rev.* **2015**, *68*, 116–121. [CrossRef]
7. Longo, U.; Rizzello, G.; Berton, A.; Fumo, C.; Maltese, L.; Khan, W.; Denaro, V. Synthetic Grafts for Anterior Cruciate Ligament Reconstruction. *Curr. Stem Cell Res. Ther.* **2013**, *8*, 429–437. [CrossRef]
8. Tengman, E.; Olofsson, L.B.; Nilsson, K.G.; Tegner, Y.; Lundgren, L.; Häger, C.K. Anterior cruciate ligament injury after more than 20 years: I. Physical activity level and knee function. *Scand. J. Med. Sci. Sports* **2014**, *24*, e491–e500. [CrossRef]
9. Longo, U.G.; Rizzello, G.; Frnaceschi, F.; Campi, S.; Maffulli, N.; Denaro, V. The architecture of the ipsilateral quadriceps two years after successful anterior cruciate ligament reconstruction with bone-patellar tendon-bone autograft. *Knee* **2014**, *21*, 721–725. [CrossRef]
10. Anand, B.S.; Feller, J.A.; Richmond, A.K.; Webster, K.E. Return-to-Sport Outcomes After Revision Anterior Cruciate Ligament Reconstruction Surgery. *Am. J. Sports Med.* **2016**, *44*, 580–584. [CrossRef] [PubMed]
11. Burland, J.P.; Toonstra, J.L.; Howard, J.S. Psychosocial Barriers After Anterior Cruciate Ligament Reconstruction: A Clinical Review of Factors Influencing Postoperative Success. *Sports Health A Multidiscip. Approach* **2019**, *11*, 528–534. [CrossRef]
12. Ardern, C.L.; Taylor, N.F.; Feller, J.A.; Webster, K.E. Fear of re-injury in people who have returned to sport following anterior cruciate ligament reconstruction surgery. *J. Sci. Med. Sport* **2012**, *15*, 488–495. [CrossRef] [PubMed]
13. Maffulli, N.; Margiotti, K.; Longo, U.G.; Loppini, M.; Fazio, V.M.; Denaro, V. The genetics of sports injuries and athletic performance. *Muscle Ligaments Tendons J.* **2013**, *3*, 173–189. [CrossRef]
14. Lentz, T.A.; Zeppieri, G.; George, S.Z.; Tillman, S.M.; Moser, M.W.; Farmer, K.W.; Chmielewski, T.L. Comparison of Physical Impairment, Functional, and Psychosocial Measures Based on Fear of Reinjury/Lack of Confidence and Return-to-Sport Status After ACL Reconstruction. *Am. J. Sports Med.* **2014**, *43*, 345–353. [CrossRef] [PubMed]
15. Ardern, C.L.; Webster, K.E.; Taylor, N.F.; Feller, J.A. Return to the preinjury level of competitive sport after anterior cruciate ligament reconstruction surgery: Two-thirds of patients have not returned by 12 months after surgery. *Am. J. Sports Med.* **2011**, *39*, 538–543. [CrossRef]
16. Kvist, J.; Ek, A.; Sporrstedt, K.; Good, L. Fear of re-injury: A hindrance for returning to sports after anterior cruciate ligament reconstruction. *Knee Surg. Sports Traumatol. Arthrosc.* **2005**, *13*, 393–397. [CrossRef]
17. Ross, M.D. The relationship between functional levels and fear-avoidance beliefs following anterior cruciate ligament reconstruction. *J. Orthop. Traumatol.* **2010**, *11*, 237–243. [CrossRef]
18. De Mozzi, P.; Longo, U.G.; Galanti, G.; Maffulli, N. Bicuspid aortic valve: A literature review and its impact on sport activity. *Br. Med Bull.* **2008**, *85*, 63–85. [CrossRef]
19. Turk, D.C.; Wilson, H.D. Fear of Pain as a Prognostic Factor in Chronic Pain: Conceptual Models, Assessment, and Treatment Implications. *Curr. Pain Headache Rep.* **2010**, *14*, 88–95. [CrossRef]
20. Piussi, R.; Beischer, S.; Thomeé, R.; Senorski, E.H. Superior knee self-efficacy and quality of life throughout the first year in patients who recover symmetrical muscle function after ACL reconstruction. *Knee Surg. Sports Traumatol. Arthrosc.* **2020**, *28*, 555–567. [CrossRef]
21. Ochiai, S.; Hagino, T.; Tonotsuka, H.; Haro, H. Prospective analysis of health-related quality of life and clinical evaluations in patients with anterior cruciate ligament injury undergoing reconstruction. *Arch. Orthop. Trauma Surg.* **2011**, *131*, 1091–1094. [CrossRef]
22. Neal, R.; Haddaway, M.J.P.; Pritchard, C.C.; McGuinness, L.A. *PRISMA2020: An R package and Shiny App for Producing PRISMA 2020-Compliant Flow Diagrams, with Interactivity for Optimised Digital Transparency and Open Synthesis*; Wiley: Hoboken, NJ, USA, 2020; Volume 18.
23. Methley, A.M.; Campbell, S.; Chew-Graham, C.; McNally, R.; Cheraghi-Sohi, S. PICO, PICOS and SPIDER: A comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. *BMC Health Serv. Res.* **2014**, *14*, 579. [CrossRef] [PubMed]
24. Liberati, A.; Altman, D.G.; Tetzlaff, J.; Mulrow, C.; Gotzsche, P.C.; Ioannidis, J.P.A.; Clarke, M.; Devereaux, P.J.; Kleijnen, J.; Moher, D. The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Healthcare Interventions: Explanation and Elaboration. *BMJ Clin. Res. Ed.* **2009**, *339*, b2700. [CrossRef] [PubMed]
25. Slim, K.; Nini, E.; Forestier, D.; Kwiatkowski, F.; Panis, Y.; Chipponi, J. Methodological index for non-randomized studies (*minors*): Development and validation of a new instrument. *ANZ J. Surg.* **2003**, *73*, 712–716. [CrossRef] [PubMed]
26. Ardern, C.L.; Österberg, A.; Sonesson, S.; Gauffin, H.; Webster, K.E.; Kvist, J. Satisfaction with Knee Function After Primary Anterior Cruciate Ligament Reconstruction Is Associated With Self-Efficacy, Quality of Life, and Returning to the Preinjury Physical Activity. *Arthrosc. J. Arthrosc. Relat. Surg.* **2016**, *32*, 1631–1638.e3. [CrossRef]
27. Ardern, C.L.; Österberg, A.; Tagesson, S.; Gauffin, H.; Webster, K.E.; Kvist, J. The impact of psychological readiness to return to sport and recreational activities after anterior cruciate ligament reconstruction. *Br. J. Sports Med.* **2014**, *48*, 1613–1619. [CrossRef]
28. Hamrin Senorski, E.; Samuelsson, K.; Thomeé, C.; Beischer, S.; Karlsson, J.; Thomeé, R. Return to knee-strenuous sport after anterior cruciate ligament reconstruction: A report from a rehabilitation outcome registry of patient characteristics. *Knee Surg. Sports Traumatol. Arthrosc.* **2017**, *25*, 1364–1374. [CrossRef]

29. MARS Group; Bigouette, J.P.; Owen, E.C.; Lantz, B.A.; Hoellrich, R.G.; Huston, L.J.; Haas, A.K.; Allen, C.R.; Anderson, A.F.; Cooper, D.E.; et al. Relationship Between Sports Participation After Revision Anterior Cruciate Ligament Reconstruction and 2-Year Patient-Reported Outcome Measures. *Am. J. Sports Med.* **2019**, *47*, 2056–2066. [CrossRef]
30. Muller, B.; Yabroudi, M.A.; Lynch, A.; Lai, C.-L.; Van Dijk, C.N.; Fu, F.H.; Irrgang, J.J. Defining Thresholds for the Patient Acceptable Symptom State for the IKDC Subjective Knee Form and KOOS for Patients Who Underwent ACL Reconstruction. *Am. J. Sports Med.* **2016**, *44*, 2820–2826. [CrossRef]
31. Higgins, J.P.T.; Thompson, S.G. Quantifying heterogeneity in a meta-analysis. *Stat. Med.* **2002**, *21*, 1539–1558. [CrossRef]
32. Tjong, V.K.; Murnaghan, M.L.; Nyhof-Young, J.M.; Ogilvie-Harris, D.J. A qualitative investigation of the decision to return to sport after anterior cruciate ligament reconstruction: To play or not to play. *Am. J. Sports Med.* **2014**, *42*, 336–342. [CrossRef]
33. Webster, K.E.; Feller, J.A.; Kimp, A.J.; Whitehead, T.S. Low Rates of Return to Preinjury Sport After Bilateral Anterior Cruciate Ligament Reconstruction. *Am. J. Sports Med.* **2019**, *47*, 334–338. [CrossRef] [PubMed]
34. Baez, S.E.; Hoch, M.C.; Hoch, J.M. Psychological factors are associated with return to pre-injury levels of sport and physical activity after ACL reconstruction. *Knee Surg. Sports Traumatol. Arthrosc.* **2020**, *28*, 495–501. [CrossRef] [PubMed]
35. Chmielewski, T.L.; Jones, D.; Day, T.; Tillman, S.M.; Lentz, T.A.; George, S.Z. The Association of Pain and Fear of Movement/Reinjury With Function During Anterior Cruciate Ligament Reconstruction Rehabilitation. *J. Orthop. Sports Phys. Ther.* **2008**, *38*, 746–753. [CrossRef]
36. DiSanti, J.; Lisee, C.; Erickson, K.; Bell, D.; Shingles, M.; Kuenze, C. Perceptions of Rehabilitation and Return to Sport Among High School Athletes With Anterior Cruciate Ligament Reconstruction: A Qualitative Research Study. *J. Orthop. Sports Phys. Ther.* **2018**, *48*, 951–959. [CrossRef] [PubMed]
37. Filbay, S.R.; Ackerman, I.N.; Russell, T.G.; Crossley, K.M. Return to sport matters-longer-term quality of life after ACL reconstruction in people with knee difficulties. *Scand J. Med. Sci. Sports* **2017**, *27*, 514–524. [CrossRef] [PubMed]
38. Hart, H.F.; Culvenor, A.G.; Guermazi, A.; Crossley, K.M. Worse knee confidence, fear of movement, psychological readiness to return-to-sport and pain are associated with worse function after ACL reconstruction. *Phys. Ther. Sport* **2020**, *41*, 1–8. [CrossRef]
39. Beischer, S.; Senorski, E.H.; Thomeé, C.; Samuelsson, K.; Thomeé, R. How Is Psychological Outcome Related to Knee Function and Return to Sport Among Adolescent Athletes After Anterior Cruciate Ligament Reconstruction? *Am. J. Sports Med.* **2019**, *47*, 1567–1575. [CrossRef]
40. Ardern, C.L.; Taylor, N.F.; Feller, J.A.; Whitehead, T.S.; Webster, K.E. Psychological Responses Matter in Returning to Preinjury Level of Sport After Anterior Cruciate Ligament Reconstruction Surgery. *Am. J. Sports Med.* **2013**, *41*, 1549–1558. [CrossRef]
41. Fältström, A.; Hägglund, M.; Kvist, J. Patient-Reported Knee Function, Quality of Life, and Activity Level After Bilateral Anterior Cruciate Ligament Injuries. *Am. J. Sports Med.* **2013**, *41*, 2805–2813. [CrossRef]
42. Paterno, M.V.; Flynn, K.; Thomas, S.; Schmitt, L.C. Self-Reported Fear Predicts Functional Performance and Second ACL Injury After ACL Reconstruction and Return to Sport: A Pilot Study. *Sports Health A Multidiscip. Approach* **2018**, *10*, 228–233. [CrossRef]
43. Patel, N.K.; Sabharwal, S.; Hadley, C.; Blanchard, E.; Church, S. Factors affecting return to sport following hamstrings anterior cruciate ligament reconstruction in non-elite athletes. *Eur. J. Orthop. Surg. Traumatol.* **2019**, *29*, 1771–1779. [CrossRef]
44. Vega, J.F.; Jacobs, C.A.; Strnad, G.J.; Farrow, L.; Jones, M.; Miniaci, A.; Parker, R.D.; Rosneck, J.; Saluan, P.; Williams, J.S.; et al. Prospective Evaluation of the Patient Acceptable Symptom State to Identify Clinically Successful Anterior Cruciate Ligament Reconstruction. *Am. J. Sports Med.* **2019**, *47*, 1159–1167. [CrossRef] [PubMed]
45. McPherson, A.L.; Feller, J.A.; Hewett, T.E.; Webster, K.E. Psychological Readiness to Return to Sport Is Associated With Second Anterior Cruciate Ligament Injuries. *Am. J. Sports Med.* **2019**, *47*, 857–862. [CrossRef] [PubMed]
46. Filbay, S.R.; Crossley, K.M.; Ackerman, I.N. Activity preferences, lifestyle modifications and re-injury fears influence longer-term quality of life in people with knee symptoms following anterior cruciate ligament reconstruction: A qualitative study. *J. Physiother.* **2016**, *62*, 103–110. [CrossRef] [PubMed]
47. Burland, J.P.; Toonstra, J.; Werner, J.L.; Mattacola, C.G.; Howell, D.M.; Howard, J.S. Decision to Return to Sport After Anterior Cruciate Ligament Reconstruction, Part I: A Qualitative Investigation of Psychosocial Factors. *J. Athl. Train.* **2018**, *53*, 452–463. [CrossRef]
48. Langford, J.L.; Webster, K.E.; Feller, J.A. A prospective longitudinal study to assess psychological changes following anterior cruciate ligament reconstruction surgery. *Br. J. Sports Med.* **2009**, *43*, 377–378. [CrossRef]
49. Ross, C.A.; Clifford, A.; Louw, Q.A. Factors informing fear of reinjury after anterior cruciate ligament reconstruction. *Physiother. Theory Pr.* **2017**, *33*, 103–114. [CrossRef]
50. Thomeé, P.; Währborg, P.; Börjesson, M.; Thomeé, R.; Eriksson, B.I.; Karlsson, J. Self-efficacy, symptoms and physical activity in patients with an anterior cruciate ligament injury: A prospective study. *Scand. J. Med. Sci. Sports* **2007**, *17*, 238–245. [CrossRef]
51. Ardern, C.L. Anterior Cruciate Ligament Reconstruction-Not Exactly a One-Way Ticket Back to the Preinjury Level: A Review of Contextual Factors Affecting Return to Sport After Surgery. *Sports Health* **2015**, *7*, 224–230. [CrossRef]
52. Xiao, M.; van Niekerk, M.; Trivedi, N.N.; Hwang, C.E.; Sherman, S.L.; Safran, M.R.; Abrams, G.D. Patients Who Return to Sport After Primary Anterior Cruciate Ligament Reconstruction Have Significantly Higher Psychological Readiness: A Systematic Review and Meta-analysis of 3744 Patients. *Am. J. Sports Med.* **2022**, 3635465221102420. [CrossRef] [PubMed]
53. Erickson, L.N.; Jacobs, C.A.; Johnson, D.L.; Ireland, M.L.; Noehren, B. Psychosocial factors 3-months after anterior cruciate ligament reconstruction predict 6-month subjective and objective knee outcomes. *J. Orthop. Res.* **2022**, *40*, 231–238. [CrossRef] [PubMed]

54. Gomez-Espejo, V.; Olmedilla, A.; Abenza-Cano, L.; Garcia-Mas, A.; Ortega, E. Psychological readiness to return to sports practice and risk of recurrence: Case studies. *Front. Psychol.* **2022**, *13*, 905816. [CrossRef]
55. Berton, A.; Longo, U.G.; Candela, V.; Fioravanti, S.; Giannone, L.; Arcangeli, V.; Alciati, V.; Berton, C.; Facchinetti, G.; Marchetti, A.; et al. Virtual Reality, Augmented Reality, Gamification, and Telerehabilitation: Psychological Impact on Orthopedic Patients' Rehabilitation. *J. Clin. Med.* **2020**, *9*, 2567. [CrossRef] [PubMed]
56. Abrams, G.D.; Harris, J.D.; Gupta, A.K.; McCormick, F.M.; Bush-Joseph, C.A.; Verma, N.N.; Cole, B.J.; Bach, B.R., Jr. Functional Performance Testing After Anterior Cruciate Ligament Reconstruction: A Systematic Review. *Orthop. J. Sports Med.* **2014**, *2*, 2325967113518305. [CrossRef] [PubMed]
57. Maffulli, N.; Longo, U.G.; Testa, V.; Oliva, F.; Capasso, G.; Denaro, V. Italian translation of the VISA-A score for tendinopathy of the main body of the Achilles tendon. *Disabil. Rehabil.* **2008**, *30*, 1635–1639. [CrossRef]
58. Longo, U.G.; King, J.B.; Denaro, V.; Maffulli, N. Double-bundle arthroscopic reconstruction of the anterior cruciate ligament: Does the evidence add up? *J. Bone Jt. Surg. Br.* **2008**, *90*, 995–999. [CrossRef] [PubMed]
59. Maffulli, N.; Longo, U.G. Conservative management for tendinopathy: Is there enough scientific evidence? *Rheumatology* **2008**, *47*, 390–391. [CrossRef]
60. Longo, U.G.; Buchmann, S.; Franceschetti, E.; Maffulli, N.; Denaro, V. A systematic review of single-bundle versus double-bundle anterior cruciate ligament reconstruction. *Br. Med Bull.* **2012**, *103*, 147–168. [CrossRef]
61. Maffulli, N.; Longo, U.G. How do eccentric exercises work in tendinopathy? *Rheumatology* **2008**, *47*, 1444–1445. [CrossRef]
62. Maffulli, N.; Longo, U.G.; Denaro, V. Anterior cruciate ligament tear. *N. Engl. J. Med.* **2009**, *360*, 1463. [PubMed]
63. Longo, U.G.; Ciuffreda, M.; Casciaro, C.; Mannering, N.; Candela, V.; Salvatore, G.; Denaro, V. Anterior cruciate ligament reconstruction in skeletally immature patients: A systematic review. *Bone Jt. J.* **2017**, *99-B*, 1053–1060. [CrossRef] [PubMed]