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## PSYCHOLOGICAL CONSEQUENCES OF SPORTS INJURIES IN ADOLESCENTS

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## ABSTRACT

**Background:** Sports injuries carry not only physical consequences but a broad spectrum of psychological sequelae that may permanently affect adolescent functioning. Systematic psychological support for injured adolescent athletes remains markedly underimplemented in clinical practice and sport governance.

**Aim:** To review current evidence on the psychological consequences of sports injuries in adolescents, with emphasis on mood disorders, PTSD symptoms, athletic identity disruption, kinesiophobia, and psychological readiness to return to sport.

**Material and methods:** Narrative review of literature from 2017 to 2026, encompassing systematic reviews, meta-analyses, prospective cohort studies, and qualitative investigations on psychological sequelae of sports injuries in adolescents aged 10–19 years.

**Results:** Sports injuries are associated with significantly elevated risk of depression, anxiety, and PTSD. A meta-analysis of 84 studies ( $n = 221,095$ ) confirmed a bidirectional relationship between mental health and injury risk ( $OR = 1.54$ ; 95% CI 1.13–2.10). Post-injury depression rates were 23% in females vs. 8.8% in males. ACL-RSI scores increased from 55 to 71 between 6 and 12 months post-reconstruction, exceeding the minimal important change threshold (15.8 vs. 13.4). High kinesiophobia (TSK-11  $>19$ ) at return to sport was associated with a 13-fold increased risk of repeat ACL injury. PTSD avoidance symptoms were present in  $>87\%$  of young athletes after ACL rupture; athletes aged 15–21 showed significantly greater PTSD severity than those under 14.

**Conclusions:** Rehabilitation of injured adolescent athletes must integrate structured psychological assessment alongside physical recovery. Acute post-injury mental health screening is essential. Evidence-based strategies — imagery training, goal setting, cognitive reframing, CBT, and psychologically informed practice — show promise but require further evaluation in paediatric populations.

**Keywords:** sports injuries, adolescents, mental health, athletic identity, return to sport, kinesiophobia, PTSD, ACL reconstruction

## 1. Introduction

Adolescence — conventionally defined as the period between 10 and 19 years of age — is a developmental stage characterised by accelerating physical growth, progressive neurological maturation, and intensifying engagement with social roles. Sport participation during this period reaches its quantitative and qualitative peak: globally, the majority of organised youth sport occurs in this age window, with participation rates estimated between 55% and 70% in high-income countries across North America and Europe. Competition at regional, national, and international levels places substantial physical and psychological demands on young athletes, demanding not only physical conditioning but cognitive and emotional regulation capacities that are still in active development.

Sports injuries are among the most prevalent adverse health events affecting adolescent athletes. While the physical dimensions of these injuries — pain, functional limitation, and protracted rehabilitation — are well understood, their psychological consequences have received comparatively less systematic attention from clinicians and sport organisations. Accumulating

evidence indicates that injuries occurring during adolescence trigger psychological responses that may persist long after tissue healing is complete, and that these responses in turn affect the trajectory of recovery itself [1].

A landmark systematic review and meta-analysis by Chow et al., published in 2026 and comprising 84 studies with a combined sample of 221,095 adolescents, confirmed a statistically significant bidirectional relationship between sports injury and mental health [1]. That study demonstrated not only that sustaining a sports injury is associated with worse mental health outcomes (Fisher's  $Z_r = 0.34$ ; 95% CI 0.17–0.50), but also that pre-existing poor mental health constitutes an independent risk factor for injury occurrence (OR = 1.54; 95% CI 1.13–2.10,  $p < 0.01$ ) [1]. This bidirectionality challenges the traditional linear model of injury management, in which psychological consequences are considered secondary phenomena addressed only after physical recovery has been achieved.

The scale of the problem is further underscored by epidemiological data. In the United States alone, approximately one in five children and adolescents aged 12–17 received a mental or behavioural health diagnosis in 2023; among elite young athletes, rates of clinically relevant anxiety and depression exceed 30% [2]. Sports-specific injuries — particularly anterior cruciate ligament (ACL) ruptures, concussions, and severe musculoskeletal trauma — carry especially pronounced psychological burdens in adolescents [3]. A systematic review by Park et al. encompassing 19 studies identified depression, post-traumatic stress disorder (PTSD), anxiety, and athletic identity disruption as the principal psychological outcomes following sports injuries in adolescents and young adults [3].

The consequences of inadequately addressed psychological sequelae are far-reaching. Fear of reinjury, reduced self-efficacy, depressive symptoms, and disrupted athletic identity independently predict whether an athlete returns to sport, their performance level upon return, and their risk of sustaining a subsequent injury [4,5]. Research consistently demonstrates that injuries sustained during adolescence may impair quality of life into adulthood, increasing the long-term risk of PTSD, depression, and anxiety in individuals whose self-concept was largely organised around their athlete role [4].

This paper provides a narrative review of the psychological consequences of sports injuries in adolescents. The review covers the epidemiology of the psychological burden; dominant theoretical models of injury response; specific outcome domains including depression, anxiety, PTSD, athletic identity disruption, fear of reinjury, and reduced psychological readiness to return to sport; the unique consequences of sport-related concussion; the bidirectional mental health–injury relationship; modifying factors such as sex, age, and sport specialisation; the role of social and academic support systems; available psychological interventions; and barriers to their implementation. The paper concludes with a synthesis, clinical recommendations, and directions for future research.

## **2. Epidemiology of Sports Injuries and Their Psychological Burden in Adolescents**

Adolescent athletes sustain sports injuries at rates meaningfully higher than those observed in adult competitors. Data from Chow et al. indicate an injury exposure rate of 1.94 per 1,000 athletic exposures in adolescents, compared with 0.72 per 1,000 exposures in adults — a nearly threefold difference attributable to the combined effects of immature musculoskeletal

structures, more intensive training relative to biological maturity, and lower baseline psychological resilience [1]. This elevated injury rate has been observed across multiple sports, but contact and collision sports — including football, basketball, wrestling, and rugby — consistently report the highest per-exposure incidence.

Among the most clinically significant injuries in adolescent athletes are ACL ruptures, which have become a leading concern in paediatric sports medicine over the past two decades. Approximately 250,000 ACL reconstructions (ACLR) are performed annually in the United States, with a substantial and growing proportion occurring in patients under 18 years of age. A narrative review by Vutescu et al. found that between 24% and 35% of young athletes who have undergone ACLR report clinically significant fear of reinjury, and that approximately one third sustain a graft rupture or contralateral ACL tear within two years of returning to sport [5]. This rate of structural failure in adolescents is considerably higher than that observed in older populations and reflects both biomechanical and psychological factors — physical immaturity of the reconstructed joint combined with premature or psychologically unprepared return to high-demand sport [5].

Sport-related concussion (SRC) represents a second major injury category with substantial psychological implications. SRC accounts for a disproportionate share of total injury burden in youth contact sports, and the developing brain of the adolescent is thought to be more vulnerable to its effects than the mature adult brain [27]. The prevalence of clinically significant post-concussion psychological symptoms — including depression, irritability, anxiety, and sleep disturbance — is well documented and will be addressed in detail in Section 9.

A systematic review of qualitative research by Sheehan et al. encompassing 16 studies and 216 participants confirmed that, regardless of injury type, adolescents experience a complex mixture of responses throughout their recovery [12]. Positive states — motivation to rehabilitate and optimism about returning — coexist with fear of reinjury, social isolation, and depressive reactions that vary in intensity across the recovery timeline [12]. Depression, the most extensively studied psychological outcome, tends to peak in the immediate post-injury period and subsequently decline as rehabilitation progresses, though for a subset of athletes clinically relevant symptoms persist beyond the expected recovery window [3]. Crucially, peer motivation — the social facilitation provided by teammates and fellow athletes — is a critical determinant of willingness to persist with rehabilitation in this population [12].

Sport specialisation further amplifies the psychological burden of injury. The growing trend toward early single-sport focus is associated with elevated injury rates, burnout, and pre-existing vulnerabilities in emotional regulation [17]. Daley et al. noted that young athletes who are pressured to perform to excessively high standards from an early age may develop maladaptive perfectionistic traits or overtraining behaviours, rendering them psychologically less equipped to cope with the disruption that injury inevitably brings [17]. Brenner et al. similarly identified inadequate sleep, social isolation, and reduced family time as consequences of early specialisation that cumulatively reduce the individual's coping resources at precisely the moment when injury demands them most [25].

**Table 1.** Summary of core source studies included in this review.

| Author (Year) [ref.]   | Study design                      | N / Population            | Age                                | Injury type                                       | Key psychological findings                                                                                                                                                                                                                                   |
|------------------------|-----------------------------------|---------------------------|------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chow et al. (2026) [1] | Systematic review + meta-analysis | 84 studies; n = 221,095   | Adolescents 10–19 years            | Various sports injuries; sport-related concussion | Injury → worse mental health (Zr = 0.34); concussion → Zr = 0.19; poor mental health → injury risk (OR = 1.54, 95% CI 1.13–2.10); adolescents: 1.94 vs 0.72/1,000 exposures vs adults; mechanisms: athletic identity, social support, optimism, hardiness    |
| Xu et al. (2025) [2]   | Narrative review                  | Multiple studies reviewed | 12–17 years (elite/youth)          | Primarily ACL; musculoskeletal                    | 1 in 5 adolescents with mental/behavioural diagnosis; anxiety/depression >30% in elite; PTSD clusters: avoidance 87.5%, intrusion 83.3%, hyperarousal 75%; high fear → 13× second ACL risk; interventions: goal setting, imagery, self-talk, CBT, relaxation |
| Park et al. (2023) [3] | Systematic review                 | 19 articles               | Paediatric and adolescent athletes | Various musculoskeletal sports injuries           | Depression peaks immediately post-injury; athletes 15–21y more likely PTSD than <14y; high athletic identity = risk factor; 19 screening tools identified; no interventional studies in paediatric post-injury population                                    |
| Jeong & Li (2024) [4]  | Narrative review                  | Multiple studies reviewed | Adolescent                         | Knee injuries; general                            | Female depression 23% vs male 8.8%; 5 QoL themes: relationships,                                                                                                                                                                                             |

|                             |                          |                           |                               |                           |                                                                                                                                                                                                                                                                                                    |
|-----------------------------|--------------------------|---------------------------|-------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             |                          |                           | athletes                      | sports injuries           | uncertainty/fear, mood, stress/pressure, energy; positive reframing only strategy linked to increased RTS + decreased kinesiphobia in athletes <20y                                                                                                                                                |
| Vutescu et al. (2021) [5]   | Narrative review         | Multiple studies reviewed | Young athletes (paediatric)   | ACL rupture / ACLR        | 24–35% report fear of reinjury; 1-pt ACL-RSI increase → 2× odds RTS; ACL-RSI > 55 predicts RTS; TSK-11 > 19 → 13× second ACL tear within 24 months; 1/3 sustain graft/contralateral rupture within 2 years; elite → 2× odds RTS vs non-elite                                                       |
| Webster & Feller (2022) [6] | Prospective cohort study | 115 athletes ≤17 years    | ≤17 years (mean not reported) | ACL reconstruction (ACLR) | ACL-RSI: 55 → 71 (6→12 months post-ACLR); mean change 15.8 points (above MIC of 13.4); emotions subscale AUC = 0.73 (p = .009); 33% returned to competition at 12 months; females scored lower than males at both timepoints; 2-factor structure (emotions + risk appraisal) unique to adolescents |

ACL — anterior cruciate ligament; ACLR — ACL reconstruction; ACL-RSI — ACL Return to Sport after Injury scale; AUC — area under the receiver operating characteristic curve; MIC — minimal important change; PTSD — post-traumatic stress disorder; QoL — quality of life; RTS — return to sport; TSK-11 — Tampa Scale of Kinesiophobia (11-item version); Zr — Fisher's Z-transformed correlation coefficient.

### 3. Psychological Models of Response to Sports Injury

Understanding the psychological consequences of sports injuries requires a theoretical framework that acknowledges the complex interaction between cognitive appraisal, emotional response, and behavioural outcome. Several conceptual models have been proposed and have informed research in this domain, though no single framework has achieved universal adoption across the sports medicine and sports psychology literature.

The Stress and Athletic Injury model, building on general stress theory, posits that the psychological response to injury is mediated by the athlete's cognitive appraisal of the stressor: the same objective injury may elicit vastly different psychological responses depending on the perceived severity of the injury, its implications for athletic identity, the coping resources available to the athlete, and the social support environment in which recovery takes place. This framework has been refined to incorporate athletic identity — the degree to which an individual defines themselves through their athletic role — as a key moderating variable that amplifies the perceived threat of injury [7].

Rogers et al. described the cyclical nature of the mental health–injury relationship, noting that pre-existing mental health disorders not only increase vulnerability to injury but also portend poorer physical and psychological outcomes once an injury has occurred: prolonged recovery times, increased injury recurrence rates, lower rates of return to sport, and diminished performance upon return [7]. This feedback loop — in which inadequately managed psychological distress compounds physical impairment, which in turn perpetuates psychological distress — is particularly consequential in the developing adolescent, who exhibits greater neuroplasticity but also greater vulnerability to sustained psychological stress than the adult athlete [7].

The Common-Sense Model of Self-Regulation, applied by Little et al. to the experience of fear following ACL injury, proposes that athletes form cognitive representations of their injury — its identity, timeline, consequences, causes, and controllability — which then drive emotional and behavioural responses [19]. This model explains why fear of reinjury persists even in athletes whose physical recovery is objectively complete: the cognitive representation of threat remains active independently of the objective tissue state, and it may be reinforced by external messages, social comparisons, and previous experiences of injury-related harm [19]. Five contextual factors were identified as contributors to persistent fear: external messages from clinicians and peers, the inherent difficulty and duration of rehabilitation, perceived threat to identity and independence, socioeconomic barriers to comprehensive care, and ongoing psychological obstacles that persisted beyond expected recovery timelines [19].

Piepiora et al. situate sport psychology within the broader framework of physical culture sciences, noting that it addresses both theoretical mechanisms — including research, diagnosis, and intervention design — and practical mechanisms including mental training [29]. This disciplinary framing reinforces the argument that psychological care for injured athletes is not an optional supplement but an integral component of a coherent scientific approach to athlete health [29]. Taken together, these theoretical perspectives emphasise that psychological responses to sports injury are shaped not by the physical event alone, but by the athlete's pre-injury psychological profile, cognitive construal of the injury, social context of recovery, and the degree to which their self-concept is organised around athletic participation [29].

#### **4. Depression and Anxiety Following Sports Injuries in Adolescents**

Depression and anxiety are the most extensively documented psychological consequences of sports injuries in adolescents, and their prevalence in this population substantially exceeds estimates derived from non-injured youth. A narrative review by Jeong and Li found that depressive symptoms occurred in 23% of female athletes following injury, compared with 8.8%

in male athletes — a differential of nearly three to one that underscores the importance of sex as a moderating variable [4]. Neither proportion falls below clinically relevant thresholds, and the absolute prevalence of post-injury depression in male adolescent athletes already considerably exceeds general population norms for that age group [4].

The relationship between injury and depressive symptomatology is partly mediated by disruption to daily functioning. Injured adolescents commonly report impaired relationships with teammates and peers, heightened uncertainty and fear regarding their recovery, persistent low mood, elevated stress related to performance expectations from coaches and parents, and profoundly reduced energy — a constellation that maps closely onto the five qualitative domains of health-related quality of life identified by Jeong and Li: relationships, uncertainty and fear, mood, stress and pressure, and energy [4]. These disruptions are mutually reinforcing: social isolation precipitated by exclusion from team training intensifies mood disturbances, which in turn reduce the motivational resources and energy required to engage meaningfully in rehabilitation [4].

Xu et al. highlighted that elite young athletes face anxiety and depression rates exceeding 30%, a figure reflecting both the elevated demands of competitive environments and the inadequacy of existing mental health support structures within elite sport [2]. Post-injury anxiety manifests across multiple dimensions that require careful clinical distinction: performance anxiety upon anticipated return to sport, social anxiety related to perceived judgment by coaches, peers, and parents, and health anxiety about prognosis and the risk of reinjury [2,28]. These forms of anxiety frequently co-occur and may superficially resemble ordinary adjustment difficulty, but they carry meaningful risk of chronification if left unaddressed, particularly in adolescents who lack the metacognitive skills to recognise and articulate their own distress [28].

The temporal trajectory of depressive symptoms offers important clinical guidance. Park et al. found that depressive symptoms peak immediately after injury and decrease progressively over the course of rehabilitation, designating the acute post-injury period as the window of greatest psychological vulnerability [3]. This finding has direct implications for the timing of psychological screening and intervention: assessment immediately following injury — and repeated during the first weeks of rehabilitation — is most likely to capture athletes who require support at the moment of their greatest need [3]. The same review noted a striking absence of published interventional studies targeting psychological outcomes specifically in the paediatric post-injury population, a gap that underscores how far clinical practice lags behind the acknowledged importance of psychological care in this context [3].

The distinction between an adjustment disorder with depressed mood — a time-limited response to an identifiable stressor that remits as the stressor resolves — and a major depressive episode represents an important clinical consideration. While many injured adolescents experience significant but self-limiting distress that resolves with physical recovery, a subset develop persistent depression that does not remit spontaneously and that requires targeted clinical intervention. Dzieciatkowska et al. described how emotional reactions including sadness, social isolation, anger, and loss of motivation actively exacerbate mental health difficulties while simultaneously impeding physical healing, creating a cycle of distress in which inadequate psychological support becomes a barrier to recovery outcomes in both domains [28]. Prolonged or intense emotional reactions may escalate to major depressive

disorder, anxiety disorders, disordered eating, or substance misuse — outcomes that extend the clinical burden well beyond the injury period itself [28].

### **5. Post-Traumatic Stress Disorder Following Sports Injuries in Adolescents**

While the discourse around sports injury psychology has historically focused on depression and anxiety, accumulating evidence indicates that post-traumatic stress disorder constitutes a genuine and underappreciated consequence of severe sports injuries in adolescents. PTSD, as defined in DSM-5, requires exposure to an actual or threatened traumatic event, followed by intrusion symptoms, persistent avoidance, negative alterations in cognition and mood, and marked alterations in arousal and reactivity — all persisting for more than one month and causing significant functional impairment. Severe sports injuries — particularly those involving sudden, unexpected trauma such as ACL rupture — have the potential to meet the threshold for a traumatic event exposure, particularly in athletes for whom sport constitutes a primary life domain.

Padaki et al. assessed PTSD symptomatology in 24 consecutive patients aged 21 years or younger (mean age  $14.5 \pm 2.7$  years) following acute ACL rupture, using the Horowitz Impact of Event Scale – Revised (IES-R), a validated instrument measuring intrusion, avoidance, and hyperarousal [8]. The findings were clinically striking: more than 87.5% of participants experienced avoidance symptoms, 83.3% acknowledged symptoms of intrusion, and 75% had symptoms of hyperarousal [8]. The proportion of participants experiencing symptoms across all three clusters — while drawn from a small case series that warrants cautious interpretation — signals a substantially elevated prevalence of PTSD-spectrum symptomatology following severe sports injuries in young athletes.

Padaki et al. identified several variables associated with greater emotional trauma severity: athletes aged 15 to 21 years experienced significantly higher PTSD symptom scores than those younger than 15 ( $P = .033$ ); female athletes experienced significantly greater emotional trauma than males ( $P = .017$ ); and patients with high athletic identities showed a trend toward greater trauma severity that did not reach statistical significance ( $P = .14$ ) [8]. These data converge with findings from Park et al., who similarly identified mid-to-late adolescence (15–21 years) as a particularly vulnerable developmental window for post-traumatic psychological responses following sports injuries [3].

The three PTSD symptom clusters have specific and directly clinically relevant manifestations within the rehabilitation context. Avoidance behaviours — a hallmark of PTSD — may cause an athlete to disengage from rehabilitation activities perceived as painful, threatening, or reminiscent of the injury event, thereby directly and measurably undermining physical recovery [8]. Intrusive thoughts and memories of the injury may disrupt sleep, concentration, and motivation, reducing the cognitive and emotional resources available for rehabilitation engagement [8,3]. Hyperarousal may manifest as excessive vigilance about the injured body part — constant monitoring for signs of pain or instability — which paradoxically increases the likelihood of guarded movement patterns and compensatory biomechanics that elevate the risk of secondary injury [8].

Xu et al. confirmed in their review that high post-injury fear — a construct with substantial overlap with PTSD-related hyperarousal and avoidance — is associated with a 13-fold increase

in the risk of sustaining a second ACL tear [2]. This striking epidemiological association emphasises that untreated post-traumatic psychological responses are not merely a welfare concern but a patient safety issue with measurable impact on injury recurrence rates [2]. Sub-threshold PTSD symptomatology, even when it does not meet full diagnostic criteria, can impair athletic performance, rehabilitation adherence, and social functioning — and it may persist undetected within sport cultures that normalise high pain tolerance and discourage open discussion of psychological distress [2,29].

## **6. Athletic Identity and Its Disruption Following Sports Injury**

Among the psychological variables that determine the severity and trajectory of post-injury distress in adolescent athletes, athletic identity occupies a central position. Athletic identity is conventionally measured using the Athletic Identity Measurement Scale (AIMS), a validated self-report instrument assessing the extent to which an individual identifies with the role of athlete, the importance of sport to their sense of self, and their perception of others' acknowledgment of their athletic role. High scores on the AIMS are associated with greater commitment to sport, higher training investment, and stronger motivation — but also with greater vulnerability when injury disrupts the athlete role.

A systematic review and meta-aggregation by Liu et al. encompassing 24 qualitative studies synthesised findings into two overarching themes: "athletic identity disruption" (represented in 17 studies) and "athletic identity reconstruction" (represented in 7 studies) [15]. The disruption theme captured the loss of self-concept that occurs when physical limitations, withdrawal from competition, and psychological distress strip an athlete of their primary social identity [15]. Disruption was characteristically associated with feelings of loss comparable to bereavement, social isolation, reduced self-worth, and confusion about future life direction, particularly when athletic involvement had previously dominated the athlete's social world and daily schedule to the exclusion of other interests and relationships [15]. The reconstruction theme, less frequently documented in the literature, described processes by which some athletes rebuilt their sense of self through engagement in alternative roles — coaching, volunteering, or participation in new sporting or non-sporting activities [15].

Brewer and Chatterton reviewed 23 studies examining athletic identity specifically in young athletes, producing a nuanced account of the construct's dual nature [16]. High athletic identity was associated with: reluctance to report injury-related symptoms and a tendency to conceal distress from coaches and medical staff; a cultural endorsement of playing through pain and injury; intensified physical and psychological symptoms after injury; and over-adherence to rehabilitation protocols [16]. These manifestations of vulnerability coexist, however, with evidence of motivational strength: athletes with high athletic identity also demonstrate elevated engagement in rehabilitation, higher levels of injury-related coping skills, and better functional and return-to-sport outcomes [16]. This duality implies that clinical interventions should not aim to reduce athletic identity per se, but rather to help athletes harness its motivational benefits while mitigating tendencies toward symptom concealment and exclusive self-definition through performance [16].

Park et al. identified high athletic identity as one of the principal risk factors for depressive symptoms in the paediatric post-injury population, alongside injury severity and female sex [3].

The mechanism is relatively well understood: when sport constitutes the primary organising domain of an adolescent's self-concept, injury-induced exclusion from sport functions as a fundamental threat to identity, triggering responses that parallel those described in bereavement literature — denial, anger, bargaining, depression, and acceptance — each of which carries distinct implications for rehabilitation engagement [3,15].

The developmental specificity of athletic identity disruption deserves particular emphasis. Identity formation — the process of establishing a coherent and stable sense of self across multiple life domains — is a central task of adolescence. When athletic identity is disproportionately dominant, injury may precipitate identity foreclosure: a state in which the athlete cannot conceive of a meaningful self outside of sport [26]. Piątek et al. identified identity foreclosure as one of the primary psychological barriers to competitive return in athletes who have otherwise achieved full physical recovery, noting that kinesiophobia and identity foreclosure operate synergistically to produce a "return-to-sport gap" — a sustained absence from competition despite medical clearance, driven by psychological rather than physical impediment [26].

## **7. Fear of Reinjury and Kinesiophobia**

Fear of reinjury is among the most clinically consequential psychological outcomes following sports injuries in adolescents. It is operationally distinct from general anxiety in that it is specifically directed toward the possibility of sustaining another injury, and it encompasses several distinct components: fear of acute pain, fear of permanent functional limitation or reduced athletic capacity, and fear of the personal, social, and professional consequences of being unable to return to one's sport at the pre-injury level [11].

Hsu et al. provided a comprehensive overview of the implications of fear of reinjury on rehabilitation outcomes, concluding that elevated fear negatively affects the recovery of physical impairments, reduces self-reported functional capacity, and prevents successful return to sport [10]. Their review identified psychologically informed practice — a rehabilitation approach that systematically measures and addresses psychological factors alongside physical impairments at every stage — as the recommended standard of care for athletes presenting with high fear of reinjury [10]. This approach does not require specialist psychological input for every patient, but rather trains rehabilitation specialists to screen for fear, recognise its manifestations in physical behaviour, and respond with evidence-informed communication and exercise modification.

Kvist and Grävare Silbernagel elaborated on the theoretical dimensions of movement-related fear in sports medicine, arguing that for athletes, fear associated with sports injury extends beyond the risk of another traumatic event to encompass the fear of permanent underperformance and the prospect of lifelong pain or disability [11]. This expanded understanding positions fear as a multidimensional psychological response: an athlete who has cognitively accepted that reinjury risk is manageable may nonetheless remain psychologically unable to commit to full athletic participation because of concerns about their capacity to perform at a level consistent with their pre-injury self-concept [11].

The construct of kinesiophobia — an excessive, irrational, and debilitating fear of physical movement and activity arising from a perceived vulnerability to painful injury or reinjury —

represents the extreme end of the fear-of-movement spectrum and has particularly strong associations with return-to-sport outcomes [22]. The Tampa Scale of Kinesiophobia (TSK-11) is the most widely used measure of this construct in athlete populations, providing an 11-item self-report assessment of avoidance beliefs and movement-related fear. A threshold score greater than 19 at the time of medical clearance for return to sport has been associated with a 13-fold increase in the likelihood of sustaining a second ACL tear within 24 months [5], a finding with direct implications for return-to-sport decision-making: kinesiophobia assessment should be a mandatory, not optional, component of safe return protocols.

Vutescu et al. documented that between 24% and 35% of young athletes who have undergone ACLR report clinically significant fear of reinjury [5]. Nedder et al., in a systematic review of 63 studies with 38 meeting inclusion criteria, confirmed that kinesiophobia and fear of reinjury are the most frequently observed psychological outcomes following ACLR, and that they impede return to sport, alter measurable knee biomechanics including landing patterns and muscle activation, and potentially increase re-rupture risk through the generation of compensatory movement strategies [9]. Critically, Nedder et al. identified targeted interventions capable of meaningfully reducing kinesiophobia: imagery training to re-establish positive movement associations, knee bracing to restore proprioceptive confidence, and kinesiotaping to provide tactile feedback that reduces perceived joint instability [9]. These findings establish fear as a modifiable clinical target rather than a fixed psychological trait.

Russell et al. followed 39 athletes prospectively after ACLR, finding that 52% had returned to sport by 9 months post-surgery [23]. Those who returned demonstrated a linear decrease in reinjury anxiety between 4 and 9 months post-surgery, whereas non-returners showed an initial decrease from 4 to 6 months followed by a plateau — a pattern suggesting that stagnation in anxiety reduction during the latter phase of rehabilitation is a meaningful clinical signal that distinguishes eventual returners from non-returners [23]. Reinjury anxiety and perceived limitations of ability were identified as the psychological constructs that most clearly differentiated these groups and were proposed as specific intervention targets [23].

Qualitative research by Little et al. illuminated the contextual underpinnings of fear in ACL-injured individuals, identifying five thematic contributors: external messages from clinicians and coaches about the fragility of the reconstructed knee; the inherent difficulty and duration of rehabilitation; perceived threat to identity and independence; socioeconomic barriers to comprehensive care; and ongoing psychological barriers persisting beyond expected recovery timelines [19]. A sixth theme — positive coping strategies — represented a potential counterweight to fear, encompassing cognitive reframing, active problem-solving, and the deliberate cultivation of realistic but constructive beliefs about the recovered knee [19]. This biopsychosocial model of fear formation emphasises that kinesiophobia is not a simple fear response to a physical event but an emergent product of personal, social, and environmental factors across the entire injury journey [19].

## **8. Psychological Readiness to Return to Sport**

Psychological readiness to return to sport (RTS) has emerged as a distinct and measurable clinical construct that integrates emotional responses to injury, appraisal of reinjury risk, and self-confidence regarding the injured body part into a composite index of an athlete's

preparedness to resume full competitive participation. It is now recognised as an independent predictor of RTS outcomes that complements, but cannot be replaced by, objective physical performance criteria such as limb symmetry indices and strength ratios [5,6].

The ACL-Return to Sport after Injury scale (ACL-RSI) is the most widely validated instrument for measuring psychological readiness in athletes following ACLR. In adult and adolescent populations, it provides a score from 0 to 100 reflecting the athlete's emotional responses, risk appraisal, and confidence. Vutescu et al. reported that a single-point increase in ACL-RSI score is associated with a twofold increase in the odds of returning to sport, and that a threshold score of 55 or above is predictive of successful RTS [5]. Furthermore, elite-level athletes demonstrated approximately twice the odds of returning to sport compared with non-elite athletes — a differential that reflects not only motivational differences but also the divergent social, financial, and identity-based pressures associated with athletic competition at different performance levels [5].

Webster and Feller conducted a longitudinal study of 115 adolescent athletes aged 17 years or younger who had undergone ACLR, administering the ACL-RSI at 6 and 12 months post-surgery [6]. Mean ACL-RSI scores increased significantly from 55 at 6 months to 71 at 12 months, representing a mean change of 15.8 points — a value exceeding the established minimal important change (MIC) of 13.4 points, confirming that the psychological improvement observed over this interval was clinically meaningful and not merely statistical noise [6]. However, only 33% of participants had returned to competitive sport at 12 months post-surgery, highlighting the striking gap between objectively improving psychological readiness and actual competitive return in this population [6].

Notably, Webster and Feller found that the ACL-RSI demonstrated a two-factor structure in adolescents — comprising emotions and risk appraisal subscales — that differs from the three-factor structure previously validated in adult populations (which additionally distinguishes a confidence subscale) [6]. The emotions subscale demonstrated significantly better predictive accuracy for RTS than the risk appraisal subscale, with a receiver operating characteristic area under the curve of 0.73 ( $p = .009$ ), compared with 0.59 ( $p = .09$ ) for the confidence subscale [6]. This structural difference suggests that emotional processing of the injury experience — rather than rational evaluation of reinjury probability — is the more diagnostically informative dimension of psychological readiness in adolescents, a finding consistent with the emotional intensity and self-regulatory immaturity characteristic of this developmental period.

Female athletes consistently reported lower ACL-RSI scores than their male counterparts at both 6 and 12 months post-surgery, reflecting the systematically greater psychological burden documented across multiple outcome domains in female adolescent athletes [6]. Nedder et al. reinforced the clinical importance of formal psychological readiness assessment by noting that current clinical practice guidelines for ACLR rehabilitation, despite formally acknowledging the role of psychological factors, rarely incorporate patient-reported outcome measures or standardised readiness instruments as routine components of rehabilitation monitoring [9]. This gap between guideline acknowledgement and clinical implementation represents a systemic barrier to comprehensive rehabilitation in the adolescent athlete population [9].

## 9. Sport-Related Concussion and Its Psychosocial Consequences in Adolescents

Sport-related concussion (SRC) is a form of mild traumatic brain injury characterised by transient neurological dysfunction following biomechanical forces applied to the head or body. It accounts for a substantial and growing proportion of injury burden in youth contact and collision sports, and the psychosocial consequences it generates in adolescents are distinct from — though partially overlapping with — those observed following musculoskeletal injuries. Of particular significance is that the effect size for the concussion–mental health association, while statistically significant ( $Z_r = 0.19$ ; 95% CI 0.08–0.30), is smaller than the equivalent association for general sports injuries ( $Z_r = 0.34$ ) [1], suggesting that the psychological burden of SRC is real but more circumscribed than that of major musculoskeletal trauma.

A narrative review by Szczerba et al. synthesised current evidence on the epidemiology and long-term outcomes of SRC across youth and adult populations [27]. Younger athletes were found to be more vulnerable to prolonged recovery and persistent neurocognitive impairment than older individuals, a difference likely attributable to ongoing brain development and greater susceptibility of the immature central nervous system to diffuse axonal injury [27]. A history of prior concussion consistently emerges as one of the most significant risk factors for subsequent injury and adverse long-term outcomes, with cumulative concussion exposure linked to persistent cognitive deficits and heightened risk of mental health disorders in later life [27]. Importantly, neurocognitive impairments may persist beyond the resolution of clinical symptoms — a finding that challenges traditional symptom-based return-to-play protocols and raises concerns about the adequacy of current RTS criteria in adolescent sport [27].

A systematic review by Rice et al. examining SRC and mental health outcomes in elite athletes identified 27 studies meeting inclusion criteria, of which 19 (70.4%) examined depression as a primary outcome [18]. Cross-sectional retrospective studies and studies including a control comparison group consistently supported an association between concussion exposure and depressive symptoms, though several studies reported that these symptoms resolved in the medium term (approximately one month post-injury) [18]. Evidence for anxiety as a concussion outcome was less consistent, and insufficient studies were available to draw firm conclusions about other mental health domains such as PTSD or disordered eating in the elite concussed athlete [18]. The predominantly North American and male sample compositions of the included studies limit the generalisability of these findings to female and non-Western populations [18].

Qualitative research by Valovich McLeod et al. explored the psychosocial dimensions of SRC through semistructured interviews with 12 interscholastic athletes (4 girls, 8 boys; mean age  $15.7 \pm 1.7$  years) conducted between 15 and 30 days post-injury [14]. Participants described increasing difficulty with emotional regulation — including heightened irritability, frustration, and emotional lability — as well as disruption to their academic roles through concentration difficulties, fatigue, and reduced processing speed, and disruption to their social identities through the experience of "letting the team down" and feeling unable to contribute to their sport [14]. A particularly clinically significant finding was that participants described active efforts to minimise or mask symptoms to avoid being perceived differently by their peers and coaches — a form of deliberate symptom concealment driven by social stigma and fear of academic or

competitive consequences [14]. This behaviour directly undermines accurate clinical assessment and highlights the importance of educational programmes that normalise help-seeking and symptom disclosure in concussed adolescent athletes [14].

The behavioral and psychological consequences of paediatric SRC were reviewed by Wilmoth et al. across a literature encompassing 604 studies, 11 of which were specific to sport [13]. The review identified behavioural disturbances that at least temporarily disrupt daily life, alongside subclinical anxiety and depressive symptoms that may be present but remain below clinical thresholds in many affected students [13]. Social and academic consequences were less clearly delineated across studies due to methodological heterogeneity, but student-athletes were identified as a uniquely vulnerable subgroup, given the central role of athletic identity and team membership in their social lives [13].

Sleep disturbance represents a frequently overlooked but clinically significant psychosocial consequence of SRC in adolescents. A study by Wilkes et al. examining 4,469 concussion patients aged 5 to 18 found that 67% reported new sleep disturbance following their injury — a higher rate than previously documented in the literature [24]. In multivariate analyses, female sex (OR = 1.43; 95% CI 1.25–1.64), new sleep disturbance (OR = 1.37; 95% CI 1.18–1.60), and absence of a previous concussion diagnosis (OR = 1.31; 95% CI 1.15–1.52) were among the strongest independent predictors of prolonged recovery past 28 days [24]. Sleep disturbance emerged as the second strongest individual predictor of prolonged concussion recovery after female sex, underscoring its clinical importance as a target for post-concussion management and further investigation [24].

The implications of SRC for academic functioning add a further dimension to the psychological burden experienced by adolescent athletes. Valovich McLeod et al. advocated for the development of formal academic adjustment policies in secondary school settings, enabling concussed student-athletes to receive structured support for concentration difficulties, extended deadlines, and reduced workload during the recovery period [14]. Wilmoth et al. similarly identified academic difficulties as one of several psychosocial domains affected by paediatric SRC, though the evidence base for specific school-based interventions in this population remains limited and represents a priority area for future research [13].

## **10. The Bidirectional Relationship Between Mental Health and Sports Injuries**

The recognition that the relationship between sports injuries and mental health is bidirectional — rather than a straightforward causal sequence from physical event to psychological outcome — represents one of the most clinically consequential conceptual advances in sports injury psychology. This bidirectional model acknowledges that poor mental health constitutes an independent risk factor for injury, creating a cycle in which psychological and physical vulnerability mutually reinforce each other across time [1,7].

Chow et al. provided the most robust quantitative evidence for this bidirectionality to date [1]. Their systematic review and meta-analysis, encompassing 84 studies and 221,095 adolescent participants, demonstrated that sports injuries were associated with meaningfully worse mental health outcomes, with a pooled effect size of  $Z_r = 0.34$  (95% CI 0.17–0.50) for general sports injuries and  $Z_r = 0.19$  (95% CI 0.08–0.30) for SRC specifically [1]. In the opposite direction, poor mental health was associated with an increased risk of sports injury occurrence (OR =

1.54; 95% CI 1.13–2.10,  $p < 0.01$ ), though this estimate was attenuated to a non-significant OR = 1.10 following trim-and-fill analysis to correct for potential publication bias — indicating that while the direction of effect is consistent, the magnitude may be somewhat inflated by selective publication of positive findings [1].

Chow et al. identified four psychosocial mechanisms through which mental health may mediate injury risk in adolescent athletes: disruption of athletic identity (which may reduce attention to safety and body signals), inadequate social support (which impairs stress buffering), low optimism (associated with passive coping and reduced effort in injury prevention activities), and reduced psychological hardiness (which diminishes resilience to the demands of training and competition) [1]. Each of these mechanisms suggests a pathway through which clinicians might intervene preventively — supporting mental health not merely as a welfare concern but as a physiologically relevant injury prevention strategy.

The mechanisms through which mental health disorders increase injury risk are biologically and behaviourally plausible. Athletes experiencing depression or anxiety may demonstrate impaired attentional capacity and reduced proprioceptive awareness — both of which are associated with elevated injury risk during dynamic athletic tasks. Chronic psychological stress elevates cortisol levels, impairing tissue healing and neuromuscular coordination. Reduced motivation associated with depression may lead to reduced warm-up compliance, inadequate recovery between training sessions, and tolerance of biomechanically dangerous movement patterns that a psychologically healthy athlete would correct. Rogers et al. described these interconnections through a framework in which the inability to separate physical and mental health creates an internally reinforcing cycle of vulnerability [7].

Piepiora et al. provide a broader disciplinary framing for this cycle, situating the psychological dimensions of injury within the theoretical and practical tasks of sport psychology as a discipline within physical culture sciences [29]. Their analysis reinforces the argument that psychological care for injured athletes — including prevention-oriented mental health screening — requires systematic scientific and clinical investment rather than ad hoc, reactive responses [29].

## **11. Gender, Age, and Other Modifying Factors**

Psychological responses to sports injuries in adolescents are systematically moderated by several demographic and sport-specific factors. Among these, biological sex, age at the time of injury, level of athletic identity, and degree of sport specialisation have the most consistent empirical support across the literature reviewed.

The influence of sex on post-injury psychological outcomes is pervasive and consistent across outcome domains. Jeong and Li documented that female athletes are nearly three times more likely to experience depressive symptoms following injury than male athletes (23% vs 8.8%) [4]. Webster and Feller found that female adolescent athletes consistently scored lower on the ACL-RSI at both 6 and 12 months post-ACLR, indicating systematically lower psychological readiness to return to sport [6]. Padaki et al. reported significantly greater emotional trauma in female ACL patients compared with males ( $P = .017$ ) [8]. In the concussion literature, female athletes demonstrate a 43% higher odds of prolonged recovery beyond 28 days, even after controlling for other clinical variables [24].

Lisee et al. conducted a qualitative study of 12 male and 13 female high school athletes at approximately 6 months post-ACLR, finding that males reported a stronger sense of internal locus of control and relied primarily on positive self-reinforcement as a coping strategy, whereas females described balancing internal and external control orientations and placing greater value on external support systems, including peer relationships and coach feedback [20]. Female athletes more closely monitored their emotional states throughout recovery and were more sensitive to perceived fluctuations in rehabilitation progress [20]. The authors concluded that gender-specific psychological interventions — addressing the different locus of control orientations and social support needs of male and female athletes — may be warranted after ACLR [20]. These sex differences in coping orientation reflect not merely biological factors but the differential social expectations, help-seeking norms, and emotional expression cultures that characterise male and female athletes in competitive sport environments.

Age at the time of injury is a second major moderating variable. Padaki et al. found that athletes aged 15 to 21 years experienced significantly greater PTSD symptom severity than those under 15 ( $P = .033$ ) [8]. Park et al. similarly identified mid-to-late adolescence as the developmental period of greatest susceptibility to post-traumatic psychological responses [3]. This age-dependency is conceptually coherent: mid-to-late adolescence coincides with the consolidation of athletic identity as a primary component of self-concept, the period during which social stakes of competitive sport participation are highest, and a neurodevelopmental phase during which emotional regulation capacities are still maturing and vulnerability to stress-induced mood disruption is elevated.

Sport specialisation introduces a further layer of psychological risk. Daley et al. described how early single-sport specialisation exposes young athletes to chronic stressors — elevated training loads, social isolation, heightened performance expectations, and inadequate recovery — that predispose them to burnout, depression, anxiety, and shame when athletic performance falls short of internalised standards [17]. Athletes pressured to perform to excessively high standards may develop maladaptive perfectionistic traits or overtraining behaviours, compounding the psychological consequences of eventual injury [17]. Brenner et al. identified inadequate sleep, decreased family time, and impaired academic performance as consequences of specialisation that cumulatively deplete the adolescent's psychological resources for coping with injury [25]. Among protective factors, participation in multiple sports, psychological resilience, and mental toughness have been identified as buffering variables that moderate the severity of post-injury psychological responses in the paediatric population [3].

## **12. Social Support, School Functioning, and the Role of External Factors**

Sports injuries disrupt adolescent athletes across multiple life domains simultaneously. While the psychological and physical dimensions of injury are most extensively studied, the social and academic consequences represent equally important aspects of the post-injury experience and may, in turn, influence recovery trajectories in ways that are not captured by clinical psychological instruments alone.

Peer relationships and social integration are frequently disrupted by sports injuries. Injured adolescents are excluded from the primary social contexts through which they previously engaged — team training, competition, and the social activities that accompany sport

participation — at precisely the developmental moment when peer belonging is a central psychological need [12]. Sheehan et al. documented that social isolation is a near-universal feature of the post-injury experience in adolescents, and that peer motivation — the social facilitation provided by teammates and fellow athletes — is a critical determinant of willingness to persist with rehabilitation [12]. When this peer context is removed by injury, the motivational infrastructure supporting rehabilitation engagement is substantially weakened [12].

The role of coaches, medical staff, and family members in shaping the post-injury experience deserves particular emphasis. Walker et al. identified "interaction with others" as one of five major organising themes in the rehabilitation experience following ACLR, noting that interactions with coaches and teammates presented both barriers and facilitators to rehabilitation adherence [21]. Positive coach behaviours — acknowledgment of the athlete's psychological state, realistic communication about recovery timelines, and maintenance of the athlete's sense of team belonging — functioned as meaningful facilitators [21]. Conversely, pressure from coaches to return prematurely, or marginalisation within the team during the recovery period, functioned as psychological barriers that compounded distress and reduced confidence in the safety of return [21]. The participant observation captured in the memorable quotation "such a massive part of rehab is between the ears" reflects a growing athlete-level awareness that psychological factors are central to rehabilitation success — even as clinical systems lag in providing structured support [21].

Academic functioning represents a frequently underaddressed area of post-injury impact, particularly following SRC. Valovich McLeod et al. found that adolescent athletes following concussion experienced increasing difficulty with concentration, fatigue, and academic role performance, and that they often received inadequate institutional support for these challenges during recovery [14]. The authors advocated for formal academic adjustment policies in secondary school settings — including extended deadlines, reduced workload, and exemption from examinations during acute recovery — to ensure that concussed student-athletes receive appropriate academic support without the added stress of academic penalty [14]. Wilmoth et al. similarly documented academic difficulties as one of several psychosocial domains affected by paediatric SRC, though specific evidence for school-based interventions in this population remains limited and represents a priority area for future research [13].

Social support functions as a universal protective factor in the post-injury context. Piątek et al. identified social support as a key mediator facilitating post-traumatic growth — the positive psychological change experienced by some athletes as a consequence of struggling with significant adversity [26]. This finding suggests that social support does not merely buffer the harmful effects of injury-related distress but may actively promote adaptive psychological change, resilience, and enhanced coping capacity in athletes who receive adequate support from their social environment during recovery [26].

### **13. Psychological Interventions and Support Strategies**

Despite the substantial and well-documented burden of psychological distress following sports injuries in adolescents, the evidence base for targeted psychological interventions in this specific population remains limited. Park et al. found no published interventional studies targeting psychological outcomes in children and adolescents following sports injuries — a gap

that underscores the significant discrepancy between the acknowledged importance of psychological care and the availability of empirically validated treatment protocols specific to paediatric athlete populations [3]. Notwithstanding this limitation, the broader sports psychology and sports medicine literature identifies several intervention strategies with evidence of efficacy in general athlete populations that are applicable, at least in principle, to injured adolescents.

Goal setting is among the most widely recommended psychological strategies for injured athletes. It involves the collaborative establishment of short-, medium-, and long-term rehabilitation objectives that provide structure, maintain motivation, and give the athlete measurable milestones during what may otherwise feel like an indefinite period of enforced inactivity [2]. Effective goal setting in the rehabilitation context requires careful calibration of challenge level — goals that are too ambitious generate frustration and reduced self-efficacy, while goals that are too easily attained fail to sustain engagement. For adolescent athletes, who may lack the self-regulatory maturity to generate appropriate goals independently, guided goal-setting with a clinician, coach, or sport psychologist is recommended [2].

Mental imagery encompasses several distinct and complementary applications within the rehabilitation context, each targeting a different mechanism of psychological and functional recovery [2]. Healing imagery — the deliberate visualisation of tissue repair and biological recovery processes — aims to enhance perceived physiological healing and reduce anxiety about injury severity. Rehabilitation imagery involves the mental rehearsal of correct technique in therapeutic exercises, maintaining motor representations during the physical absence from sport. Performance imagery rehearses sport-specific movement patterns to preserve motor memories during the period of physical restriction, reducing the cognitive demands of skill re-acquisition upon return. Pain management imagery uses guided visualisation to reduce the subjective intensity of pain experience, which may otherwise inhibit rehabilitation participation [2]. These modalities are frequently combined within structured psychological rehabilitation protocols, and their application requires minimal specialist input when delivery is integrated into standard physiotherapy sessions.

Self-talk — the deliberate use of internal verbal cues to guide cognition and behaviour during rehabilitation — has been shown to improve rehabilitation adherence, reduce anxiety, and maintain self-efficacy in athletes who might otherwise disengage from rehabilitation when progress appears slow or non-linear [2]. Instructional self-talk (focused on correct technique execution) and motivational self-talk (focused on effort and persistence) serve complementary functions across the rehabilitation trajectory. Physiological modulation techniques — including progressive muscle relaxation (PMR) and diaphragmatic breathing — address the somatic manifestations of anxiety and hyperarousal, which are particularly relevant in athletes presenting with PTSD symptomatology following severe injuries [2].

Cognitive reframing — the deliberate reconceptualisation of injury-related challenges as opportunities for learning, personal growth, or the development of non-athletic skills — deserves particular emphasis as a coping strategy with a distinctive evidence profile. Jeong and Li identified positive reframing as the only coping strategy that was simultaneously associated with increased RTS rates, decreased kinesiophobia, and improved postoperative satisfaction in athletes under 20 years of age following knee surgery [4]. This breadth of benefit — spanning

psychological readiness, fear reduction, and patient satisfaction — distinguishes positive reframing from more narrowly targeted strategies and supports its integration as a core component of comprehensive rehabilitation programmes for adolescent athletes [4].

For athletes with clinically significant PTSD symptoms, more intensive and structured psychological interventions are required. In vivo exposure therapy — the systematic, graduated exposure to feared stimuli (including specific movements, training environments, or competitive situations) under controlled and therapeutically supported conditions — has been proposed as an evidence-based approach to reducing avoidance behaviours and hyperarousal in post-injury athletes [2]. Cognitive-behavioural therapy (CBT) addresses the maladaptive thought patterns and behavioural avoidance that maintain anxiety and depression, and has strong evidence in general adolescent mental health populations, though controlled trials specifically in injured athlete populations are lacking [28]. Dzieciatkowska et al. recommended mindfulness practices, interpersonal therapy, and visualisation techniques as additional evidence-informed components of a comprehensive rehabilitation approach, emphasising that early integration of psychological intervention — from the beginning of rehabilitation rather than as a late addition — consistently improves recovery outcomes [28].

For athletes with kinesiophobia specifically, Nedder et al. identified imagery training, knee bracing, and kinesiotaping as interventions capable of reducing fear of movement and improving functional performance testing outcomes [9]. Psychologically informed practice — a rehabilitation philosophy in which physiotherapists and rehabilitation specialists receive training to systematically identify and address psychological barriers — represents a structural approach to embedding psychological care within physical rehabilitation settings without requiring specialist referral for every athlete [10]. Mental health literacy programmes, designed to promote awareness, reduce stigma, and encourage help-seeking, have also shown promise as preventive strategies in high-risk populations such as early-specialised athletes [17].

#### **14. Barriers to Psychological Support for Injured Adolescent Athletes**

Despite the availability of effective psychological interventions, a substantial proportion of adolescent athletes who develop post-injury mental health difficulties do not access appropriate support. The barriers to care in this population are multiple and operate at the individual, social, institutional, and systemic levels — a multilevel structure that requires correspondingly multilevel solutions.

At the individual level, stigma represents the most consistently documented barrier. Within sport culture — particularly in contact and traditionally masculine sports — help-seeking for psychological difficulties is frequently perceived as incompatible with the identity of a competitive athlete [2,28]. Male athletes face cultural norms that equate strength with emotional suppression, creating a structural disincentive to acknowledging distress that is particularly powerful in the adolescent peer context, where social comparison and impression management are developmentally salient concerns [2]. This normative pressure is compounded in adolescent populations by heightened sensitivity to peer judgment: Valovich McLeod et al. documented that adolescent athletes actively minimised and masked post-concussion symptoms to avoid being perceived differently by peers — a behaviour pattern that directly suppresses accurate clinical assessment and delays appropriate care [14].

Coach attitudes represent a second significant barrier. Coaches occupy positions of substantial authority and social influence in the lives of adolescent athletes, and their beliefs about the legitimacy of psychological difficulties powerfully shape the environments in which athletes function [2]. Coaches who dismiss psychological complaints, prioritise competitive return over psychological readiness, or model stigmatising attitudes toward mental health help-seeking effectively suppress athletes' willingness to report distress [2,21]. Conversely, coaches who model help-seeking behaviour, maintain athletes' sense of team belonging during recovery, and openly acknowledge the psychological dimensions of rehabilitation can function as powerful facilitators of appropriate care — underscoring that coach education is an essential component of any systemic approach to improving mental health support in youth sport [21].

Access barriers — including the cost of psychological services, geographic availability of sport psychology expertise, and the limited integration of psychological assessment within standard sports medicine and rehabilitation pathways — prevent many adolescent athletes from accessing timely support even when their distress has been recognised [2]. In many clinical settings, psychological assessment is not a routine component of sports injury management, and referral to a sport psychologist occurs — if at all — only after physical recovery has been achieved and psychological barriers to RTS become unmistakable [9]. This structural delay in psychological intervention is counterproductive given the evidence that the acute post-injury period is the window of greatest psychological vulnerability and optimal intervention timing [3].

At the systemic level, the absence of standardised psychological screening protocols within youth sports medicine represents a structural gap with significant practical consequences. Park et al. identified 19 different psychological screening tools in use across studies in their systematic review — a proliferation reflecting the immaturity of the field and the absence of clinical consensus on which instruments should be applied routinely to which patient populations and at which timepoints [3]. The same review found no published interventional studies in the paediatric post-injury population, confirming that clinical practice in this area is not yet guided by a robust evidence base specific to adolescent athletes [3]. Walker et al. captured the multifaceted nature of rehabilitation barriers across psychological, physiological, service delivery, rehabilitation characteristic, and interpersonal domains — confirming that no single systemic fix is sufficient, and that comprehensive reform of rehabilitation delivery models is required [21].

## **15. Discussion**

The body of evidence reviewed in this paper confirms that sports injuries in adolescents generate a broad, clinically significant, and frequently underaddressed spectrum of psychological consequences, extending from transient emotional distress to persistent PTSD, depression, and enduring impairment of quality of life well into adulthood. Several converging findings deserve particular emphasis in the context of clinical practice and future research design.

The bidirectionality of the mental health–sports injury relationship, established by Chow et al. through a meta-analysis of 84 studies encompassing over 221,000 adolescents, fundamentally reframes the role of psychology in sports injury management [1]. If poor mental health

constitutes an independent injury risk factor — with an odds ratio of 1.54 — then psychological assessment and support cannot be deferred until after injury occurs; they must be integrated into the broader preventive healthcare of adolescent athletes as a standard, not exceptional, practice [1]. Concurrently, the evidence that sustaining a sports injury produces measurable deterioration in mental health ( $Z_r = 0.34$ ) confirms that psychological consequences are primary outcomes warranting systematic attention rather than secondary concerns to be addressed only when they become obstructive to physical rehabilitation [1].

The ACL injury model provides the most detailed evidence base within this domain and offers a template for understanding injury-related psychological sequelae more broadly. The progression of ACL-RSI scores from a mean of 55 at 6 months to 71 at 12 months post-ACLR, documented by Webster and Feller, demonstrates that psychological recovery follows a materially different and slower timeline than physical recovery [6]. Clinical clearance based on physical criteria alone will therefore consistently misrepresent an adolescent athlete's true readiness to return to competition. The finding that only 33% of adolescents had returned to competitive sport at 12 months despite evidently improving ACL-RSI scores highlights the complexity of the RTS decision and the multiple barriers — physical, psychological, social, and institutional — that combine to produce the return-to-sport gap documented by Piątek et al. [6,26].

The evidence on kinesiophobia and fear of reinjury is particularly actionable from a clinical standpoint. A TSK-11 score exceeding 19 at the time of RTS clearance predicts a 13-fold increase in the risk of sustaining a second ACL tear within 24 months [5]. This association implies that kinesiophobia screening must be a mandatory rather than optional component of RTS decision-making protocols in adolescent athletes — not as a mechanism to delay return, but as a clinical indicator that triggers targeted psychological intervention before physical return to full competitive activity [5,9]. The targeted interventions identified by Nedder et al. — imagery training, knee bracing, and kinesiotaping — are relatively accessible and can be delivered within standard physiotherapy settings without requiring specialist referral [9].

Comparing the psychological burden of concussion and musculoskeletal injury reveals an important clinical distinction. The effect size for the concussion–mental health association ( $Z_r = 0.19$ ) is smaller than for general sports injuries ( $Z_r = 0.34$ ) [1], suggesting that while concussion unequivocally carries psychological consequences — including depression, sleep disruption, and emotional dysregulation — the magnitude of the mental health burden associated with major musculoskeletal injuries is greater in aggregate terms. However, this comparison masks important differences in the character of the sequelae: concussion-related psychological difficulties are neurologically mediated and may persist despite apparent physical recovery due to ongoing axonal disruption, whereas musculoskeletal injury-related difficulties are more strongly driven by identity disruption, fear of reinjury, and prolonged rehabilitation. These mechanistic differences suggest that the optimal psychological interventions for each injury type are likely to differ in emphasis and content.

Across multiple outcome domains, female sex and mid-to-late adolescence consistently emerge as risk factors for greater psychological burden. The nearly threefold higher prevalence of depression in female compared with male athletes, the consistently lower ACL-RSI scores in female adolescents, and the significantly greater PTSD symptom severity in athletes aged 15–

21 relative to those under 14 all identify these subgroups as priority targets for early and intensive psychological assessment and intervention [4,6,8]. The gender differences in locus of control orientation identified by Lisee et al. further suggest that the content and delivery of psychological interventions may need to be tailored to the systematically different coping profiles of male and female athletes [20].

Athletic identity disruption — and the linked phenomenon of identity foreclosure — represents a mechanism with consequences extending beyond individual athlete well-being. The synergistic operation of kinesiophobia and identity foreclosure in producing the return-to-sport gap noted by Piątek et al. indicates that failure to address psychological barriers carries not only health costs but competitive, economic, and institutional costs for the sport organisations that have invested in these athletes [26]. The dual nature of athletic identity documented by Brewer and Chatterton — as simultaneously a source of vulnerability and a reservoir of motivation — suggests that clinicians should leverage rather than suppress athletic identity in designing rehabilitation-focused psychological interventions [16].

Several limitations in the current evidence base require acknowledgement. The absence of published interventional studies specifically targeting psychological outcomes in paediatric post-injury populations — identified by Park et al. — means that clinical recommendations in this area are largely extrapolated from adult athlete literature or general adolescent mental health research, with uncertain generalisability [3]. The majority of quantitative studies reviewed here draw on North American populations, limiting the generalisability of findings to populations with different cultural norms around sport, help-seeking, and athletic identity. The marked heterogeneity of psychological screening instruments across studies complicates direct comparisons of outcome data and reinforces the need for consensus-based standardisation of assessment protocols. Finally, the causal direction of the bidirectional relationship cannot be fully established from the meta-analytic data alone, and longitudinal prospective studies with repeated psychological measurement are needed to elucidate the temporal dynamics of this relationship in adolescent athlete populations.

## **16. Conclusions**

Sports injuries generate a complex, multifaceted, and frequently underaddressed psychological burden in adolescent athletes that cannot be adequately managed by physical rehabilitation alone. On the basis of the evidence reviewed, the following principal conclusions are offered:

First, the relationship between mental health and sports injury is bidirectional: injuries worsen mental health outcomes, and pre-existing poor mental health elevates injury risk. This cycle requires integrated physical and psychological assessment from the earliest stages of athlete care — including preventive mental health screening before injuries occur.

Second, depression, anxiety, PTSD, athletic identity disruption, fear of reinjury, and kinesiophobia are each clinically meaningful outcomes in injured adolescent athletes with measurable associations with rehabilitation adherence, return-to-sport rates, and long-term quality of life. They coexist and mutually reinforce each other and should be assessed concurrently rather than sequentially.

Third, female sex, mid-to-late adolescence (15–21 years), high athletic identity, injury severity, and early sport specialisation consistently amplify psychological vulnerability following injury.

These characteristics identify priority subgroups for early, intensive, and tailored psychological support.

Fourth, the acute post-injury period is the window of greatest psychological vulnerability and the optimal moment for baseline psychological screening. Validated instruments — including the ACL-RSI and TSK-11 — provide clinically actionable data and should be incorporated into routine return-to-sport protocols, not applied only when psychological barriers become clinically obvious.

Fifth, evidence-based psychological interventions — including imagery training, goal setting, cognitive reframing, CBT, psychologically informed rehabilitation practice, and targeted fear reduction techniques — are available and applicable, but their systematic implementation in paediatric athlete populations is inadequate. Closing this gap requires investment in practitioner training, multidisciplinary rehabilitation team development, and the design of intervention protocols validated specifically in adolescent athlete samples.

Sixth, systemic barriers — including stigma, inadequate coach education, limited integration of psychological assessment in clinical pathways, and absence of standardised screening protocols — prevent a substantial proportion of affected adolescent athletes from accessing timely and appropriate support. Addressing these barriers requires coordinated action at the individual, institutional, and sport governance levels, as well as the prioritisation of paediatric athlete populations in future clinical research agendas.

As Piepiora et al. emphasise, sport psychology addresses theoretical and practical mechanisms governing the psyche and behaviour of athletes throughout their involvement in sport — including, and especially, during injury and rehabilitation [29]. It is within this rehabilitation context that the application of sport psychology is most urgently needed and most demonstrably beneficial, and it is here that the gap between research evidence and clinical practice remains widest.

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