

# Prevalence of Posttraumatic Stress Disorder Symptoms Among Young Athletes After Anterior Cruciate Ligament Rupture

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*Investigation performed at Columbia University, New York, New York, USA*

**Background:** The risk of depression and the fear of reinjury were documented in recent investigations of patients after anterior cruciate ligament (ACL) ruptures. The extent of psychological trauma accompanying these injuries among young athletes, however, has never been assessed.

**Hypothesis:** Posttraumatic stress disorder (PTSD) symptoms after ACL injury are present among young athletes with high athletic identities.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** Patients  $\leq 21$  years of age who had suffered an acute ACL rupture were consecutively recruited at a tertiary care center. Patients completed the Horowitz Impact of Event Scale - Revised (IES-R) to analyze for PTSD symptomatology, the Athletic Identity Measurement Scale, and an athlete specialization instrument created at the authors' institution.

**Results:** A total of 24 patients were consecutively recruited. The mean patient age was  $14.5 \pm 2.7$  years, and 50% of patients were male. More than 87.5% of patients experienced avoidance symptoms, 83.3% acknowledged symptoms of intrusion, and 75% had symptoms of hyperarousal. Patients aged 15 to 21 years incurred a higher severity of PTSD symptoms than younger patients ( $P = .033$ ). Female patients experienced greater emotional trauma than male patients ( $P = .017$ ). Finally, patients with high athletic identities experienced greater emotional trauma than those with lesser athletic identities, but this finding was not statistically significant ( $P = .14$ ).

**Conclusion:** Following ACL rupture, young athletes experience significant emotional trauma, including symptoms of avoidance, intrusion, and hyperarousal. High school and college athletes, female athletes, and patients with high athletic identities may be most susceptible.

**Keywords:** ACL rupture; pediatric sports medicine; psychological trauma

Anterior cruciate ligament (ACL) ruptures represent one of the most common American sports injuries, with  $>300,000$  reported per year.<sup>11,20,30</sup> While the optimal surgical technique for reconstruction has been a focus of sports medicine

research for decades, identifying the psychological impact of ACL ruptures has gained attention only in recent years.<sup>10,13</sup> These investigations revealed that the incidence of depression after diagnosis and of fear of reinjury can be as high as 40% and 50%, respectively.<sup>13,22</sup>

Patients have reported lower quality-of-life scores immediately after receiving the diagnosis of a serious knee injury.<sup>23,24</sup> The psychosocial impact of an ACL injury was found to be even greater than that of a concussion.<sup>19</sup> While decreased knee function likely contributes to this emotional disturbance,<sup>12</sup> McCullough et al<sup>22</sup> showed that psychological factors, including fear of injury, are present in approximately half of patients. Subsequent studies have corroborated that a fear of reinjury persists among athletes after ACL rupture and that this fear may contribute to as many as 60% of these athletes not returning to their pre-injury level of play.<sup>2-4,31,34</sup> These findings have led to increased attention regarding the importance of counseling in the recovery of these athletes.<sup>10,29,34</sup>

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Ethical approval for this study was provided by the Columbia University Institutional Review Board.

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Boykin et al<sup>6</sup> demonstrated a strong correlation between knee function and psychological health among pediatric patients with ACL tears. Importantly, young athletes with a strong athletic identity were shown to correlate their self-worth and image with their sports involvement.<sup>7,21</sup> While depressive symptoms can be found in approximately 4% of the pediatric population at baseline,<sup>26</sup> the constellation of symptoms experienced after an ACL rupture may extend beyond dysthymia and depression.

Given the high impact of serious injuries on susceptible pediatric athletes, posttraumatic symptomatology may exist among young athletes after ACL rupture. Posttraumatic stress disorder (PTSD) has a lifetime incidence of approximately 2% to 3%<sup>1</sup> and presents with symptoms of avoidance (keeping away from harmful triggers), hyperarousal (heightened baseline alertness with problems sleeping and concentrating), and intrusion (troubling flashbacks and memories regarding the event) after experiencing or witnessing a traumatic event.<sup>5,14,15</sup> The diagnosis consists of exposure to a severe event causing the aforementioned symptoms, lasting for at least 1 month and causing a change in the patient's quality of life.<sup>5</sup> While depressive symptoms after ACL rupture have been demonstrated,<sup>7,10,13</sup> the full extent of symptomatology remains unclear.

The goal of this study was to examine the psychological trauma, including potential PTSD symptomatology, following ACL rupture among young athletes. We hypothesized that feelings of avoidance, hyperarousal, and intrusion would be present among young athletes after suffering an ACL rupture. We also hypothesized that higher levels of athletic identity would correlate with increased severity of symptoms.

## METHODS

Institutional review board approval was obtained at the tertiary care center in which this prospective study was conducted. Written consent for all patients and parental consent for patients <18 years old were obtained. Patients aged ≤21 years who had acutely suffered an ACL rupture met the inclusion criteria. Patients were excluded from the study if they sustained significant concomitant injuries (eg, spinal cord injury, knee dislocation) and if they had previously injured the ipsilateral knee (recurrent ACL rupture, meniscal injury, etc). All patients who met inclusion criteria were consecutively recruited from the senior author's (C.A.P.) office. Patients were asked to participate on the visit following the initial diagnosis, given the often emotional reactions they experienced immediately upon diagnosis.<sup>24</sup> All responses remained entirely anonymous. Patients who eventually underwent ACL reconstructions completed the instruments prior to operative intervention.

All patients who agreed to participate completed identical survey instruments, including a demographics section and 3 surveys assessing athletic identity, level of sports specialization, and PTSD symptoms. Demographics included age, sex, concurrent knee injuries, history of prior knee injuries, and surgical history. All survey instruments selected were previously utilized in pediatrics/sports medicine research.<sup>16,17,28</sup>

Athletic identity—or the extent to which a patient correlates self-identity with sports participation and success—was measured with the Athletic Identity Measurement Scale (AIMS).<sup>17</sup> This scale was selected because it represents the athletic identity assessment tool previously used in ACL investigations<sup>7,8</sup> and pediatric sports medicine as a whole.<sup>17,25</sup>

Youth athlete specialization, as defined by the American Orthopaedic Society for Sports Medicine, consists of 3 items: playing a single sport ≥8 months per year, playing that sport to the exclusion of other sports, and beginning this specialization process by age 12 years.<sup>18</sup> The specialization score utilized in this study was developed at our institution by an interdisciplinary team of orthopaedic surgeons, physical therapists, athletic trainers, and academy instructors. The tool includes a self-assigned level of specialization and 15 items analyzing intrinsic enjoyment, extrinsic pressures, burnout, and overall time investment.<sup>27,28</sup> Neither the athletic identity tool nor the athlete specialization instrument has yet been validated.

A senior psychiatrist (M.K.P.) was consulted to provide insight into choosing an optimal validated PTSD screening tool in the target population. The Horowitz Impact of Event Scale - Revised (IES-R) was selected, and it consists of 22 items assessing hyperarousal, avoidance, and intrusion—3 major symptoms seen in patients with PTSD. The IES measures self-reported levels of intrusion and avoidance symptoms after a traumatic event. The instrument was extensively validated for the adult population<sup>16,32</sup> and has been used in >60 PTSD studies.<sup>33</sup>

## Statistical Analysis

Responses were collected with independent survey software (Qualtrics). We used *t* tests to analyze IES-R and AIMS scores between distinct cohorts of players (stratified by age, sex, level of specialization). A 1-way analysis of variance determined the correlation between level of specialization and athletic identity. Findings were deemed statistically significant at  $P < .05$ .

## RESULTS

Twenty-seven consecutive patients from the senior author's office who met all inclusion criteria were asked to participate. One patient did not finish the assessment tools and was excluded from final data analysis. Two patients refused to partake in the study, resulting in a 92.3% participation rate. The mean ± SD age was 14.5 ± 2.7 years; 50% of patients were male; and 41.7% of patients reported concomitant meniscal injuries. Table 1 displays relevant demographic characteristics.

All patients self-assigned specialization levels and completed athlete identity questionnaires. Approximately 29.2% of patients played 1 sport only; 58.3% of patients played multiple sports with a favorite; and 12.5% balanced their sports equally. Single-sport athletes scored significantly higher on the AIMS (mean: single sport, 57.7; multi-sport, 52.8;  $P = .043$ ). Additionally, 70.8% of athletes stated

TABLE 1  
Patient Demographics (N = 24)<sup>a</sup>

Age, y, mean ± SD	14.5 ± 2.7
Male	50
Concomitant meniscal tear	41.7
Single-sport athletes	29.2
Play 1 sport ≥8 mo/y	50.0
Collegiate/professional ambition	70.8

<sup>a</sup>Values are presented as percentages unless noted otherwise.

that they had collegiate or professional aspirations, and 50% of athletes played a single sport ≥8 months per year.

Regarding the prevalence of PTSD symptoms, 87.5% of patients experienced avoidance symptoms, 83.3% incurred symptoms of intrusion, and 75% had symptoms of hyperarousal (Figure 1). These findings are in contrast to normative values that Briere and Elliott<sup>9</sup> established by surveying 505 patients from the general population with the original IES and subsequently conducting a robust psychometric analysis. Their study demonstrated that approximately 40% of the population scored 0 to 2 on the total score of the original 15-item IES.

Analysis of the avoidance questions revealed that 61.5% of patients attempted to not think about the injury, 37.5% had feelings of numbness after the injury, and 37.5% avoided talking about the injury. Concerning intrusion symptoms, 61.5% of patients had repeated strong waves of emotions regarding the injury, 50% had trouble staying asleep, and 41.7% had trouble concentrating. Regarding hyperarousal, 50% of patients felt on guard, 29.2% felt jumpy and/or easily startled, and 25% had physical reactions (eg, sweating) when thinking about the injury.

### Responses Stratified by Age

Patients aged 15 to 21 years had significantly more psychological trauma after an ACL rupture than those aged ≤14 years (mean IES-R: older patients, 55.8; younger patients, 40.2;  $P = .033$ ). No age-dependent relationship was found regarding athlete identity score (AIMS: older patients, 54.1; younger patients, 54.5;  $P = .71$ ). Figure 2 displays these findings.

### Responses Stratified by Sex

When stratified by sex, female patients incurred significantly more psychological trauma than male patients (mean IES-R: female, 58.1; male, 40.3;  $P = .017$ ). While female athletes had a higher athletic identity, this finding was not statistically significant (mean AIMS: female, 56.6; male, 53.4;  $P = .092$ ). Figure 3 displays these findings.

### Responses Stratified by Specialization and Athletic Identity

Single-sport athletes suffered lower psychological trauma, but this finding was not statistically significant (mean IES-R: single sport, 44.7; multisport, 51.1;  $P = .34$ ). Patients

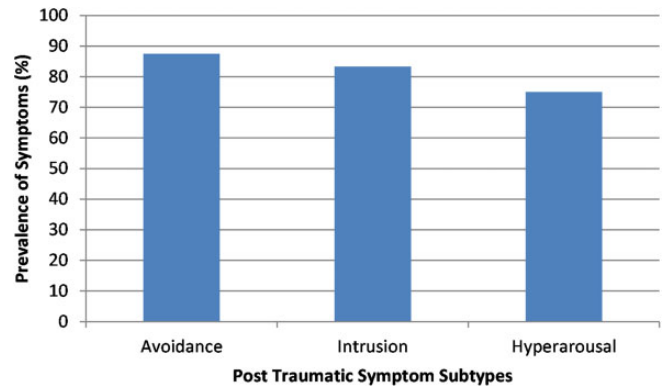


Figure 1. Prevalence of posttraumatic stress disorder symptom subtypes experienced by patients after an anterior cruciate ligament rupture.

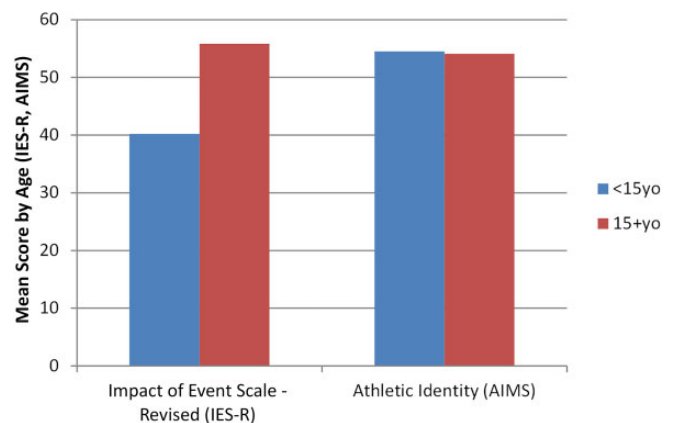


Figure 2. Mean Impact of Event Scale - Revised (IES-R) and Athletic Identity Measurement Scale (AIMS) scores stratified by age. Patients aged 15 to 21 years experienced greater emotional trauma ( $P = .033$ ).

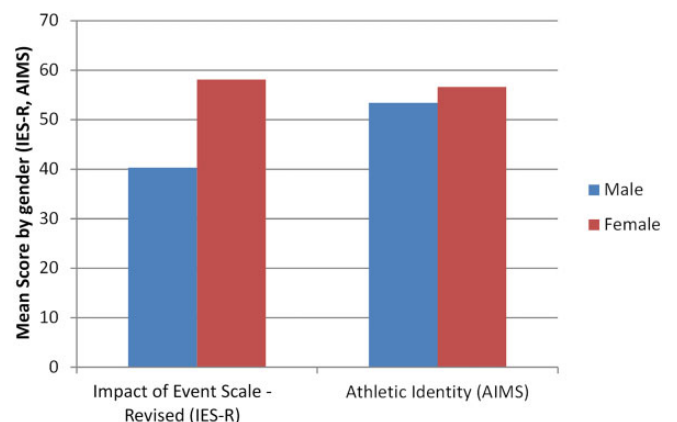


Figure 3. Mean Impact of Event Scale - Revised (IES-R) and Athletic Identity Measurement Scale (AIMS) scores stratified by sex. Female patients were more likely to suffer greater emotional trauma ( $P = .017$ ).

with athletic identity scores  $>50$  incurred more psychological trauma, but this finding was also not statistically significant (mean IES-R: high athletic identity, 52.4; low athletic identity, 41.3;  $P = .14$ ).

## DISCUSSION

The majority of young athletes experienced symptoms consistent with PTSD following ACL rupture. Patients endorsed 3 major symptoms seen with PTSD: avoidance, intrusion, and hyperarousal. Female patients and high school and college athletes experienced more severe psychological trauma than male patients and younger patients. While athletes with high athletic identity scores experienced more emotional trauma, this finding was not significant, likely because of the small sample size.

This study indicates that the level of psychological trauma experienced by young athletes after ACL injury may be dramatically greater than previously thought. Previous investigations demonstrated that fear of reinjury persists among approximately half of patients<sup>3,4,22</sup> and that depression may affect as many as 40%.<sup>13</sup> However, for young athletes who more directly correlate their identities with their athleticism,<sup>7</sup> the emotional impact of suffering a severe injury likely extends into the spectrum of PTSD.

A pediatric patient may have difficulty reconciling his or her preinjury health with the concepts of surgery and missing an extended period of sports participation. These factors could explain the high rates of difficulty sleeping, poor concentration, numbness, and difficulty speaking about the injury demonstrated in this study. The severity of these symptoms was greatest among female patients, patients aged  $\geq 15$  years, and patients with high athletic identities. While the etiology behind sex-specific trauma is unclear, older patients may be able to comprehend the reality of surgery and missing a full season of play better than younger patients. Additionally, patients with greater athletic identities could be affected more severely because of the tight association between their self-worth and athletic performance.

These findings indicate that the severity of psychological trauma among young athletes after ACL injury is likely underappreciated in the clinical setting. While the diagnosis delivered in the office setting is routine for the physician, the athletes may be experiencing significant psychosocial trauma. As the role of counseling is further established in caring for patients after ACL rupture,<sup>3,10,34</sup> this study emphasizes the importance of emotional assessment and treatment in the pediatric population. Furthermore, psychiatric consultation may be warranted to help treat these patients, although further studies must be conducted to assess this role. The full extent of the young athlete's emotional health must be investigated to best care for patients after ACL rupture.

This study has several limitations. First, it had a small sample size, given the age-specific inclusion criteria. While a larger study size may make certain conclusions more generalizable, the extremely high prevalence of PTSD symptoms in this patient population was robustly demonstrated.

Second, the instrument used to assess psychological trauma has not been established in the orthopaedic literature. While this instrument has been extensively validated in the field of psychiatry, further orthopaedic investigations are needed to validate this underdiagnosed symptomatology in the pediatric orthopaedic population. Finally, this study did not differentiate the level of athletic competition among the enrolled patients. While specialization and athletic identity were assessed, athletes of all competitive levels were enrolled. This component was intentional to best represent the pediatric orthopaedic population, although future studies may differentiate competitive and recreational athletes. Additionally, future studies should analyze the symptomatology that these young patients experience over time after they undergo ACL reconstruction and return to higher levels of function.

## CONCLUSION

Young athletes experience a high prevalence of PTSD symptoms following the diagnosis of an ACL rupture. Athletes experience symptoms beyond fear of reinjury, including trouble sleeping, poor concentration, numbness, and avoidance of speaking about the injury. High school and college athletes, female athletes, and patients with high athletic identities may be more susceptible to experiencing severe emotional trauma, although further research is necessary.

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