


Current State of the Literature on Psychological and Social Sequelae of Sports-Related Concussion in School-Aged Children and Adolescents

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Kristin Wilmoth¹ , Alexander Tan², Cole Hague³, Tahnae Tarkenton³, Cheryl H Silver³, Nyaz Didehbani³, Heidi C Rossetti³, Hunt Batjer⁴, Kathleen R Bell⁵ and C Munro Cullum^{3,4,6}

¹Department of Neurology, Medical College of Wisconsin, Milwaukee, WI, USA. ²Department of Neuropsychology, Children's Healthcare of Atlanta, Atlanta, GA, USA. ³Department of Psychiatry, The University of Texas Southwestern Medical Center, Dallas, TX, USA. ⁴Department of Neurological Surgery, The University of Texas Southwestern Medical Center, Dallas, TX, USA. ⁵Department of Physical Medicine and Rehabilitation, The University of Texas Southwestern Medical Center, Dallas, TX, USA. ⁶Department of Neurology and Neurotherapeutics, The University of Texas Southwestern Medical Center, Dallas, TX, USA

ABSTRACT: Considerably less attention has been paid to psychological and social sequelae of concussion in youth athletes compared with neurocognitive outcomes. This narrative review consolidates the literature on postconcussive emotional and psychosocial functioning in school-aged children and adolescents, highlighting athlete-specific findings. MEDLINE and PsycINFO databases were queried for pediatric concussion studies examining psychological and/or social outcomes, and 604 studies met search criteria (11 of those specific to sport). Results were organized into domains: emotional and social dysfunction, behavioral problems, academic difficulties, sleep disturbance, headache, and quality of life. The small body of literature regarding psychological and social issues following pediatric concussion suggests behavioral disturbances at least temporarily disrupt daily life. Extrapolation from samples of athletes and nonathletes indicates postconcussive anxiety and depressive symptoms appear, although levels may be subclinical. Social and academic findings were less clear. Future well-controlled and adequately powered research will be essential to anticipate concussed athletes' psychosocial needs.

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CORRESPONDING AUTHOR: C Munro Cullum, Department of Psychiatry, The University of Texas Southwestern Medical Center, 5323 Harry Hines Blvd, Dallas, TX 75390-9044, USA. Email: Munro.Cullum@UTSouthwestern.edu

Annually, 173 285 cases of pediatric sports-related concussion (SRC) are seen in US emergency departments,¹ although the actual incidence is unknown and likely to be higher than recorded numbers. Sports-related concussion can produce a variety of neurobehavioral symptoms with physical, emotional, and cognitive sequelae²⁻⁴ that can overlap with typical psychological responses to injury.^{5(p519)} After accounting for baseline symptoms, headache, fatigue, irritability, and being "more emotional" were the most common symptoms in children with mild traumatic brain injury (mTBI).⁶

Whereas concussion symptoms generally resolve within a few days to weeks, they tend to last longer in younger individuals, and an estimated 14% to 20% of children experience symptoms that persist beyond 3 months.⁶⁻⁸ Furthermore, postconcussive symptoms, including mood and behavior problems, remained clinically elevated in 12% of one mTBI sample ($n = 176$, age 8-15) 12 months after injury.⁹ Such symptoms can directly affect multiple aspects of daily life, including emotional functioning, school attendance, and social engagement.¹⁰

Despite growing research on cognitive outcomes after mTBI in children, other psychological and social outcomes are not well described. For young athletes in particular, routine

physical activity, social contact with peers, and daily routines at home/school are often restricted as part of postconcussion symptom management. A recent systematic review of 30 case-controlled studies on the psychiatric component of mTBI recovery from sport and nonsport injuries indicated initially elevated psychological symptoms in children following mTBI compared with controls, which generally resolved over time.¹¹ Another review of predominantly high school and collegiate athletes provided evidence for mood disturbances following SRC associated with anxiety and reduced social support as symptoms persisted.¹² Less is known about emotional sequelae in younger children in the context of the developing brain, as school-aged children with mTBI may be at elevated risk of negative outcomes.⁶ A summary of postinjury behavioral, emotional, and social functioning has not been published specific to pediatric SRC.

Our aim was to consolidate and present the body of research pertaining to psychological/social sequelae of SRC in school-aged children and adolescents in a narrative review. We note differing characteristics of the studies (eg, sample size, setting) to provide context to the findings. We elected not to address cognitive symptoms following injury, as this has been summarized elsewhere.¹³ Academic outcomes were included because



Table 1. Database queries conducted.

MEDLINE
1. Brain concussion (MeSH Term) OR concuss* OR mild traumatic brain injur*
2. Psychiatry OR emotional adjustment OR behavioral medicine OR mental disorders OR mental health services (MeSH Terms)
3. Adolescent OR child OR minors (MeSH Terms)
4. Student* OR adolescen* OR pediatric OR children* OR youth*
5. 3 OR 4
1 AND 2 AND 5
509 articles returned
PsycINFO
1. Brain concussion (Index Term)
2. Concuss* OR mild traumatic brain injur* OR mild head injur*
1 OR 2
95 articles returned

Asterisks indicate broad word endings were included. Searches included articles published between November 14, 2006 and May 17, 2018.

school is a prominent social environment for children and adolescents. Sleep problems are nonspecific and can indicate emotional disturbance or postconcussive symptoms. Headache is one of the most common symptoms of pediatric SRC.^{14,15} Given the significant psychosocial relevance of sleep and pain, we included these in our review. Finally, we included investigations of quality of life (QOL) following SRC because it dovetails with psychosocial well-being and is relevant for children and adolescents.

MEDLINE and PsycINFO databases were queried using relevant search terms and controlled vocabulary, and 604 articles were returned (see outline/summary in Table 1). To be included, studies had to contain (1) participants with mild TBI/concussion; (2) subjects 4 to 19 years old, or analyses for age; and (3) an outcome variable of postinjury psychological or social issues. Outcomes were organized into the following domains: emotional/social dysfunction, behavioral problems, academic difficulties, sleep disturbance, headache, and QOL. Reference lists of selected articles were also examined. Studies were excluded if they combined samples (eg, collegiate and high school athletes) to focus on pediatric populations. Only 11 articles (highlighted in Table 2) met inclusion criteria. Sport-specific concussion literature was emphasized first, with expansion into mTBI of other etiologies as applicable. There were no studies specifically comparing sport and nonsport samples on outcomes and an absence of studies focusing specifically on SRC in youth within some domains.

Emotional and Social Dysfunction

Changes in mood after SRC have been well documented, including the suggestion that the biochemical cascade of SRC may, at least temporarily, directly disrupt mood.²⁵ In addition, symptoms of SRC, such as reduced concentration, headaches, and sleep disturbance, may negatively impact activities in daily

life and produce stress, compounding and/or producing emotional disturbances. Restrictions from sport, a significant source of socialization and physical activity in youth, may cause further frustration due to reduced contact with teammates, worry about the future, and limited participation in the sport that is important to personal identity formation.²⁶ Mood disturbances have been reported following mTBI,^{25,27,28} potentially implicating a neurobiological disruption.²⁹

Several concussion workgroups have identified concerns about emotional well-being after mTBI in children and adolescents.^{30,31} For example, maladaptive coping is more pronounced in student-athletes with SRC than orthopedic injuries.¹² In one of the few pediatric SRC studies of emotional difficulties, which has been included in Table 2, half of children seen in an outpatient concussion clinic (N = 174) experienced emotional symptoms, and poorer psychiatric outcomes were associated with initial symptom burden and postconcussive syndrome.¹⁸ A new onset or worsening of a psychiatric disorder occurred in 10% of their sample, of which 25% went untreated.¹⁸

Depression

We found no SRC studies focusing on middle and high school athletes alone, specifically examining depression. Inferences about depression in concussed athletes may be informed by the broader pediatric mTBI literature. Children (ages 6-15) hospitalized for mTBIs of mixed etiologies were reported to be over 9 times more likely to have a new-onset mood diagnosis at 6 months after injury compared with orthopedic controls with skeletal fractures.²⁷ Greater mood swings and withdrawal, but not depression per se, were described in school-aged children approximately 2 years after concussion compared with age- and sex-matched controls.³² In a separate study comparing depressive symptoms at 2 years after mTBI and arm injury,²⁸ no

Table 2. Overview of pediatric studies examining psychological and/or social sequelae of sports-related concussion.

STUDY	MTBI SAMPLE SIZE	AGES, Y	SAMPLE CHARACTERISTICS
Baker et al ¹⁶	91	13-19	Students evaluated by a physician following a sports-related concussion (SRC) observed by a team athletic trainer (AT)
Collins et al ¹⁷	109	15.8 ± 1.2	High school athletes with SRC diagnosed on field by a physician
Ellis et al ¹⁸	174	14.2 ± 2.3	Chart review for patients aged ≤19 who were diagnosed within 30d of SRC by physicians using consensus statement guidelines
Frommer et al ¹⁴	Year 1: 391 Year 2: 421	$M_{Year 1}$: 15.9 $M_{Year 2}$: 15.9	Concussions sustained during practice or competition requiring AT/physician attention, resulting in restricted sport participation
Houston et al ¹⁹	122	15.8 ± 1.1	High school athletes sustaining an SRC
Iadevaia et al ²⁰	7	12-16	Adolescent student-athletes sustaining a first SRC who were examined by an AT and diagnosed by a physician
Kostyun et al ²¹	545	11-18	Patients treated for SRC, identified via chart review
Lau et al ²²	108	M_{Short} : 16.12 M_{Long} : 15.90	Male high school football athletes divided into early (≤14d, n = 58) and late (>14d, n = 50) symptom clearance groups
Makki et al ²³	42	14-19	Adolescent student-athletes with SRC
Meehan et al ¹⁵	544	13-18	High school athletes sustaining a concussion.
Russell et al ²⁴	63	13-18	Children presenting for evaluation within 30d of SRC, diagnosed using consensus statement guidelines.

(Continued)

Table 2. (Continued)

	SETTING	RELEVANT MEASURES	PSYCHOLOGICAL/SOCIAL RESULTS
Baker et al ¹⁶	Outpatient concussion clinic in New York between 2010 and 2012	Sport Concussion Assessment Tool-2 (SCAT2), computerized neurocognitive testing, and follow-up phone interview	School problems associated with postconcussive symptoms (including irritability and trouble falling asleep) and neurocognitive performance <9th percentile
Collins et al ¹⁷	20 high schools in University of Pittsburgh Medical Center's Sports Concussion Program	Immediate Post-concussion Assessment and Cognitive Test (ImPACT) within 5-7 d	Postinjury headache was associated with postconcussive symptoms and lower neurocognitive performance
Ellis et al ¹⁸	Outpatient concussion clinic in Winnipeg	Postconcussive symptom log and psychiatric history, from clinic visit	Emotional symptoms in 50%. Psychiatric disorder (new or worse) in 10%, of which 25% went untreated
Frommer et al ¹⁴	US High School Reporting Information Online (HS RIO) sport injury surveillance tool	Initial postconcussive symptoms, documented by the AT	Headache was the most common symptom and most frequently reported as primary. Drowsiness reported by more females than males
Houston et al ¹⁹	15 high schools in Arizona	Pediatric Quality of Life Inventory (PedsQL), Multidimensional Fatigue Scale, and SCAT2 at 3 and 10 d	Postconcussive symptoms negatively associated with quality of life (QOL). Lower physical QOL, fatigue, and school dysfunction predicted longer return to play
Iadevaia et al ¹⁰	Interscholastic athletes in 2011-2012 from upper Midwest schools	Semi-structured interview ≥ 1 year (15.3 \pm 2.8 months) after injury	Postconcussive symptoms significantly affected daily lives, evoked feelings of frustration, and impeded school attendance, activities, and social interactions
Kostyun et al ²¹	Sports medicine concussion clinic affiliated with a Connecticut children's hospital	ImPACT within 90 d	Sleeping <7 h the night prior associated with greater postconcussive symptoms. Sleeping >9 hours associated with lower neurocognitive performance
Lau et al ²²	Pennsylvania interscholastic athletic association football programs in 2002-2006	ImPACT within 2-3 d and postconcussive symptom clusters	Migraine and sleep symptoms more frequent within the long recovery group. Migraine (but not sleep) symptoms were a risk factor for protracted recovery
Makki et al ²³	Outpatient concussion clinic in New York	SCAT2 symptom log and hours in school for 14 d after clinic visit	Postconcussive symptoms associated with number of hours spent in school, controlling for time since injury
Meehan et al ¹⁵	HS RIO	Initial postconcussive symptoms, documented by the AT	Headache was the most common symptom (93%). Drowsiness in 27% and irritability in 9% of injuries
Russell et al ²⁴	Outpatient concussion clinic in Winnipeg	Post-concussion Symptom Scale, PedsQL, and medical history, at initial and follow-up clinic visits	Lower physical and cognitive QOL associated with postconcussive symptoms and longer recovery

Studies were excluded if samples combined concussed pediatric athletes with other populations (eg, collegiate athletes).

differences were found across time points (3, 12, and 24 months), although criteria for major depressive disorder were met by a larger proportion of patients with uncomplicated mTBI (4%–6% across time points vs 0%–3% in controls).

Postconcussive depressive symptoms are predictive of other symptoms (ie, pain and sleep) and outcomes (ie, academic and QOL) following pediatric mTBI, which suggests that disruptions in other areas of the child's life may produce or exacerbate low mood.³³ Depressive symptoms appear, most often at sub-clinical levels, in children and adolescents after SRC and other mTBI. Further research is needed to determine under what conditions depression may be more likely to manifest.

Anxiety

Anxiety-related symptoms have not been specifically explored in pediatric SRC, and current literature involving mTBI due to other causes may provide guidance. Approximately 10% of 63 children aged 5 to 14 with mTBI developed a new-onset anxiety disorder within 1 year, with younger age and premorbid anxiety being risk factors.³⁴ Another investigation found concussed children ($n = 42$) were over 4 times more likely to have a new-onset anxiety diagnosis within 6 months of injury compared with orthopedic controls²⁷; however, anxiety symptom levels were comparable in the mTBI and orthopedic injury groups 1 and 2 years later.^{32,35}

Social functioning

Empirical evidence for the effects of SRC upon children's social relationships or development of social competence is lacking. It could be that prolonged disruption in a concussed athlete's reintegration with classmates and teammates might temporarily interfere with social relationships at a critical time in personal development. Social support after mTBI assists in improving QOL and physical health.³⁰ In the absence of specific research on social functioning following SRC, we may extrapolate evidence from studies of children with mTBI of other etiologies. When measuring caregiver report of social competence in children who experienced TBIs of varying severity and etiology, the mTBI group ($n = 60$) displayed the poorest social competence compared with both uninjured controls ($n = 43$) and the moderate/severe TBI group ($n = 33$).³⁶ Although social adjustment problems were not present at 6 months after mTBI,³⁶ difficulties emerged by 2 years when compared with uninjured controls.³⁷ Children with mTBI may receive less support than those sustaining more severe injuries, which fits with the concept of mTBI as an "invisible injury" wherein neurobehavioral changes go unnoticed by others yet pose challenges to the individuals experiencing the problems.³⁸ These findings attest to the need for further investigation of the effects of SRC upon social functioning of school-age athletes to understand their needs and provide appropriate support and intervention.

Behavioral Problems

There is a dearth of studies investigating behavioral disorders following pediatric mTBI in general, and to our knowledge, none have directly addressed youth SRC. In an examination of a New Zealand birth cohort followed until age 16, children with a history of mTBI during preschool years were at greater risk of attention-deficit/hyperactivity, conduct, or oppositional defiant disorder during adolescence.³⁹ Negative outcomes may be attributable to a disruption in behavioral skill acquisition (whether neurobiologically or psychosocially) during a critical period during development.^{39,40} When comparing behavior problems including delinquency and aggression following mTBI with orthopedic injuries, subtle findings emerged. Youth (mean age = 10) had substantially worse behavior following mTBI than orthopedic injury according to parent, but not teacher report; however, postinjury behavior in adolescents (up to age 15) was similar between mTBI and control groups according to both parents and teachers.⁹

Thus far, a clear understanding of the relationship between SRC and postconcussive behavioral symptoms remains elusive. Conclusions from more general pediatric mTBI studies have also been hampered by a variety of methodological differences and limitations. These include small sample size, reliance on parent report, issues with premorbid psychiatric or behavioral concerns, little differentiation between TBI etiologies in analyses, and combining samples of heterogeneous TBI severity. Future studies will need to be conducted with larger samples with attention to aspects of premorbid functioning to clarify these relationships, as has been done in adult, and to a lesser extent pediatric samples, in the moderate/severe TBI literature.⁴¹

Academic Difficulties

Common symptoms of SRC such as headache, dizziness, sensory sensitivities, concentration difficulties, and sleep disturbance may have negative implications in the school environment, including problems with sustaining concentration, using academic resources, navigating school environments, and learning new material.⁴² The SRC guidelines encourage initial rest and a graduated, step-by-step return to normal academic activities,³¹ based on the idea that resuming activities too soon may exacerbate symptoms and potentially delay recovery. Although greater mental activity in the initial weeks following concussion was associated with reported symptom exacerbation, children who had symptom exacerbations did not experience poorer outcomes.⁴³ There is also concern that prolonged withdrawal from the school environment may socially isolate a student; thus, maintaining an appropriate level of academic activity is important.

The optimal period of rest for each individual is unknown, however, as both too little and too much restriction from school participation may negatively impact recovery.^{44–46} One study found that of 45% of 170 concussed students examined, the athlete returned to school "too soon" after concussion, as

determined by physician chart review, resulting in a recurrence or worsening of symptoms.⁴⁷ In addition, a recent prospective study (briefly outlined in Table 2) indicated that too many hours of school after concussion exacerbated symptoms.²³ While limiting cognitive activity within academic environments acutely after injury may reduce the risk of persistent postconcussive symptoms,⁴⁸ moderate levels of mental and physical activity have been associated with better neurocognitive performance for student-athletes in the initial days to weeks following injury.⁴⁹

Factors that have been most associated with return-to-learn (RTL) issues after SRC include concussion severity and prolonged recovery. A study of middle and high school athletes with observed concussions (described in Table 2) linked postconcussive symptoms and impaired neurocognitive performance with school problems.¹⁶ Symptom monitoring in the academic setting is critical, as school concerns have been reported by actively symptomatic students and their parents following pediatric mTBI, with greater symptom severity associated with more school-related problems and worse academic effects.⁵⁰ While this relationship held for both parent and adolescent symptom ratings, younger students aged 10 to 12 denied problems by self-report.

Sleep Disturbance

Sleep disturbance is a significant consequence of SRC, as normal sleeping patterns are often altered initially following concussion and disruptions may remain throughout the child's recovery.⁵¹ Neurocognitive function during recovery from SRC may be particularly affected by disrupted sleep, although present examinations of this question have been limited. In a high school athlete surveillance study ($n=544$; see Table 2 for more detail), nearly a third of adolescents self-reported excessive sleep or trouble falling asleep following SRC.¹⁵ In a similar pediatric sport concussion sample ($n=545$; also described in Table 2), excessive sleep (longer than 9 hours) the night prior to postconcussion testing was associated with reduced visual memory, visual motor speed, and reaction time.²¹

Although few sleep studies in SRC have been conducted, sleep difficulties have been associated with poorer functional, social, and emotional outcomes in the general pediatric mTBI literature.^{52,53} Changes in a child's normal sleeping patterns following SRC may hinder recovery and worsen other symptoms and outcome.^{15,54} In contrast to subjective report, findings regarding sleep disturbance from studies using actigraphy and polysomnography have been inconsistent within the pediatric mTBI literature. Polysomnographic sleep activity did not differ in a study of 10 athletes following SRC and 11 healthy athletes from noncontract sports.²⁰ However, greater objectively measured sleep problems have been documented in adolescents with mTBI compared with controls.^{55,56}

Sleep allows the brain to restore its normal neurometabolic homeostasis, and fatigue has been posited as a protective mechanism from overexertion of cognitive activities^{21,57}; however,

excessive sleep or fatigue may be detrimental. While some rest after injury appears to be beneficial, mounting evidence suggests that too much rest can be associated with prolonged symptoms.⁴⁵ Thus, further investigation of sleep disturbance following pediatric SRC may aid in determining optimal levels of prescriptive rest.

Headache

Pain can have a negative impact on daily activities, mental health, sleep, and personal relationships.⁵⁸ Complaints of acute and chronic headache are frequently reported after SRC, occurring in more than 90% of high school concussions,¹⁵ and may co-occur with other physical, emotional, and cognitive complaints. High school athletes with postconcussive headache at 1 week after injury ($n=36$) were more likely to endorse other symptoms than those without headache ($n=73$; study outlined in Table 2).¹⁷ Headache is not only a key symptom that in combination with other on-field indications leads to a suspected or diagnosed concussion but also serves as an important determining factor in players' RTP. In a sample of Pennsylvania high school football programs, athletes with concussion symptoms lasting >14 days ($n=50$) were more likely to have migraines than those recovering within 2 weeks ($n=58$; see Table 2 for more detail).²²

Presentation of headache symptoms appears to differ by age, gender, and informant, likely due to differences in communication of symptoms. Postinjury headache is more common in children with mTBI (43% of 402) than arm fractures (26% of 122), with a larger discrepancy for adolescent females (55% vs 23%).⁵⁹ At 3 months after injury, headache remained more common for children with mTBI than extracranial trauma.⁶ In a representative US sample ($n=6483$), caregivers were less likely to identify headache symptoms reported by their adolescent children.⁶⁰

In the pediatric mTBI literature, rates of chronic headache vary. In a sample of 406 children and adolescents with mTBI, headache was present in 31% at 3 months.⁶¹ A larger sample of children reporting to an emergency department following mTBI ($n=670$), however, found that only 11% experienced posttraumatic headaches initially, with reduction to 8% at 3 months.⁶² The transition of acute post-mTBI headache pain to chronic pain following pediatric SRC is poorly understood, and extrapolated evidence from more severe head injury would indicate this transition involves complex interactions between neurobiological and psychosocial factors.⁶³

Quality of Life

QOL is a multidimensional construct that involves evaluation of life satisfaction. Health-related QOL specifically addresses the impact of health on physical, mental, and social well-being. In a study of 15 Arizona high schools, athletes with greater postconcussive symptoms had reduced QOL, and lower physical QOL was linked to longer recovery.¹⁹ Lower physical and cognitive QOL acutely following SRC was associated with

postconcussive symptoms and longer recovery in a sample recruited from outpatient concussion clinics.²⁴ These studies are described in more detail in Table 2.^{19,24} After pediatric mTBI, QOL ratings remained significantly below normative levels, even after symptom resolution.⁶⁴ Using clinical cutoffs, poor health-related QOL was reported in 11% of mTBI children at 3 months and 13% at 12 months following concussion.⁶⁵

A recent systematic review of pediatric mTBI and health-related QOL had mixed findings, with several studies documenting marginal or nonsignificant postinjury changes in QOL.⁶⁶ Prospective studies indicate postinjury QOL ratings across time points appeared no different than baseline estimates, with similar ratings from children and caregivers.^{67,68} It is notable that postinjury QOL ratings have not been significantly different between mTBI and orthopedic injury groups,^{69,70} even considering baseline QOL.⁷¹ Overall, QOL impairments observed after pediatric concussion appear generally minimal, with symptom burden likely driving the disruption.⁷⁰

Discussion

Empirical investigation of the consequences of SRC has increased dramatically in the past decade, with much attention on professional and collegiate athletes. Less research emphasis has been placed on younger athletes, particularly with regard to psychological and social adjustment issues. This review explored these and related domains (ie, emotional/social functioning, behavioral problems, academic difficulties, sleep disturbances, headache, and QOL) following SRC in school-aged and adolescent student-athletes (summarized in Table 2). General pediatric mTBI studies were included, as they provide a basis for understanding possible outcomes of SRC where few specific SRC studies are available.

Our overall conclusion is that a solid understanding of both the short-term and long-term emotional and behavioral sequelae of SRC in pediatric populations has yet to be achieved. As research about the psychosocial outcomes of SRC expands, clinicians will be able to more accurately anticipate the psychosocial needs of concussed student-athletes. Identification of issues early in the course of recovery may allow for attenuation of prolonged affective and behavioral disturbances. To this end, more complete knowledge of the risk factors and psychosocial outcomes related to SRC and clinical attention to these areas in children and adolescents is needed. Some postconcussion mood symptoms may be subsyndromic and not reach the clinical threshold of diagnosis, although behavioral problems occur at a higher rate in children and adolescents following mTBI. In addition, there is a paucity of information about factors related to the development of more prolonged or severe psychological distress and who may be at risk.

Relevant to psychosocial outcomes, the optimal amount of cognitive and physical rest following concussion is currently under debate. While some initial rest is usually indicated, this

should not come at the expense of delaying successful reintegration. First, it is important to consider when and how concussion symptoms might affect academic performance. Children and adolescents spend a good part of their day in school, and school adjustment and performance have important implications for identity/social development and future academic and even occupational potential. Up to 73% of concussed athletes may need academic accommodations, and accommodations are more often provided to students within schools that have a concussion policy in place.⁷² However, only 53% of school nurses (n = 1027)⁷³ and 44% of athletic trainers (n = 995)⁷⁴ reported awareness of existing RTL guidelines. Emotional distress and social withdrawal, whether or not accompanied by academic failure, have the potential to affect interpersonal connections, which are at the heart of identity development, particularly for adolescents.

Future research should address study design limitations common in mTBI recovery.⁷⁵ In particular, notable heterogeneity in research designs makes conclusions about emotional and behavioral symptoms following SRC difficult. For example, parent, teacher, and self-report of social-emotional and behavioral symptoms are often discrepant,^{76,77} and children with mTBI report more somatic symptoms of concussion than do their parents.⁷⁸ Therefore, the sources for symptom reporting should be specified. Parent reports may differ due to misattribution of pre-morbid psychiatric symptoms.⁷⁹ Family functioning including perceived family relationships and distress is poorly understood in the context of concussion outcomes.

Research should also be translated into clinical practice by directing efforts toward identifying appropriate interventions and accommodations for both acute and prolonged concussion symptoms. Emotional symptoms may go unrecognized because of lack of knowledge about concussion. Early intervention is expected to mitigate the distress experienced by concussed athletes in the short term and help to avert the development of prolonged psychosocial consequences. Education, particularly directed to school staff, is crucial. Informed management of psychological sequelae of SRC such as depression can range from informal support to referrals for therapies.¹⁸

Conclusions

Although symptoms of concussion typically resolve within days or weeks, for some children and adolescents sequelae can persist for months; this variability in recovery is not fully understood. The consequences of SRC are well documented for cognitive and physical domains. However, emotional, behavioral, and social implications are less robust, particularly for young athletes. Current studies suggest psychological sequelae of concussion such as heightened emotional reactivity and irritability at least temporarily disrupt daily life, and symptoms of depression and anxiety may be present. Conclusions about potential disruption in social and academic functioning are less specific. Student-athletes experience a unique set of psychological issues following SRC, given the importance of

athletics and related social activities in their lives. The available body of literature about these issues following SRC is small, and future well-controlled research is needed with larger samples.

Author Contributions

KW and CH conducted database queries and identified relevant literature. KW, AT, CH, TT, and CHS reviewed selected articles and reference lists. All authors contributed, reviewed, and approved of the final manuscript.

ORCID iD

Kristin Wilmoth  <https://orcid.org/0000-0003-4192-8756>

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