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Childhood Mental Health Outcomes Following Mild Traumatic Brain Injury: An Evidence-to-Practice Review

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ABSTRACT

Concussions can have lasting symptoms in children such as depression, anxiety, hyperactivity, or failure to control anger. If diminished mental health outcomes are not monitored and do not improve after concussion, children may need additional treatment as a result of sequela. The purpose of the guiding systematic review was to determine if there are increased mental health symptoms in pediatric patients who sustained a concussion as compared to pediatric patients who have not sustained a concussion. The guiding systematic review and meta-analysis authors used seven different databases for articles published from 1980 to 2020. Selected articles had mental health outcomes classified as internalizing, externalizing, or total mental health difficulties. Mental health was assessed by new psychiatric findings post-injury, as well as total problem subscales. Twenty-nine articles identified mental health complications following a pediatric concussion. Children with pre-injury mental health (50% to 60%) were more likely than children without pre-injury mental health symptoms to have decreased mental health outcomes following concussion. In acute (less than 3 months post-injury), persistent (between 3- and 12-months post-injury), and chronic (over 12 months post-injury) timelines, the concussion group demonstrated significant, moderate effects in mental health for internalizing and externalizing. This topic is clinically relevant for athletic trainers as they may work with adolescent populations with a previous medical history of concussion or who may experience a concussion in the future. Mental health training sessions, such as online continuing education courses, for athletic trainers will build the skills to treat patients who may be experiencing diminished mental health outcomes following concussion.

Content Focus: Health Care Competency

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SUMMARY

CLINICAL PROBLEM AND QUESTION

Sports related concussions are estimated to affect between 1.1-1.9 million children under the age of 18 per year.¹ Concussion is a form of mild traumatic brain injury (mTBI) as defined by the International Concussion in Sports Group (CISG) as “a traumatic brain injury induced by direct or indirect biomechanical forces to the head, neck or body”.² Concussions can have lasting difficulties such as cognitive, behavioral, physical, somatic, and emotional symptoms and often coincide with mental health symptoms.² Specifically, in children aged 0-18 years, symptoms may present as internalizing which are focused inward or externalizing features which are focused outward. Internalizing features may be anxiety or depressive symptoms, and externalizing features may be aggression, hyperactivity, or disruptive conduct. This topic is clinically relevant because athletic trainers often work with adolescent populations who have or will experience a concussion, as well as

work with patients who have been diagnosed with a mental health condition by a psychiatrist. The lasting impact of concussions can be hard to determine which makes assessments and interventions critical. Poor increased mental health symptoms typically decrease after concussion, but occasionally children have lasting mental health symptoms that require additional treatment. Utilizing mental health outcomes and mental health questionnaires could help concussion management regarding mental health difficulties faced post-concussion.³ The purpose of the guiding systematic review was to determine if there are increased mental health symptoms in pediatric patients with concussions as compared to pediatric patients without concussion.

Summary of Literature

The guiding systematic review used Medline, Embase, PsycINFO, CINAHL, SportDiscus, Scopus and PubMed in their search for articles published from 1980 to June 2020. Article inclusion criteria was 1) peer-reviewed articles reporting prospective mental health outcomes following concussion in pediatric populations (ages 0-18 years at time of injury), 2) quantitative studies included observational designs, prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies, 3) qualitative studies included phenomenology, grounded theory, ethnography and action research, 4) mixed-methods studies were considered if data from the quantitative or qualitative components could be extracted, 5) the concussion definition was consistent with the Berlin CISGCriteria, regardless of whether or not these criteria were explicitly cited, 6) presence of a control group, and 7) completion of mental health measures (SCAT5, VOMS, symptom evaluation, etc.). The classifications of mental health symptoms were internalizing (symptoms focused inwardly), externalizing (symptoms focused outwardly) and overall mental health difficulties measured by novel psychiatric diagnoses post-injury.⁴ Internalizing classifications were disorders such as anxiety, depressive, and somatic symptoms.⁴ Externalizing classifications were disorders such as prominent impulsive, disruptive conduct, aggression, and substance use symptoms.⁵ Mental health was assessed by new psychiatric findings post-injury as well as total problem subscales of confirmed behavioral and emotional inventories. The study included a broader range of time since injury to capture the context of recovery, the time points were defined as: 1) acute, 2) persisting, and 3) chronic. The Downs and Black Quality Appraisal Criteria (DBC) and the Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence was used to assess the quality and strength of the eligible studies.^{6,7} The studies that were included were rated as excellent or good quality on the DBC. Forty-three studies recruited participants using consecutive admissions or inception cohort design, indicating low risk of selection bias. Risk of selection bias was suggested in 22 studies in the meta-analysis because they recruited controls from the same setting as the concussion sample. The search of databases discovered 69 articles that met the eligibility criteria and 60 were included in the systematic review. Out of the 69 articles, 29 were excluded from the meta-analysis because of the absence of a control group, or because the meta-analysis did not complete the mental health measures, resulting in 40 articles.

SUMMARY OF OUTCOMES

The data was collected from the characteristics of 89,114 children (60.9% males) with concussions. The three main mechanisms of injury were from falls (42.3%), sporting injuries (29.5%), and motor vehicle accidents (15.5%).⁸ The mental health outcomes were defined by validated questionnaire measures (n=60), interviews of the children (n=2), a formal psychiatric diagnosis (n=3), or engagement with mental health services (n=3). The most commonly used outcome measures to detect mental health outcomes were the Child Behavior Checklist, The Behavior Assessment System for Children, and The Personality Inventory for Children. The Child Behavior Checklist (n=19, 27.5%) is a self-administered test given to a parent, teacher, and the child. This

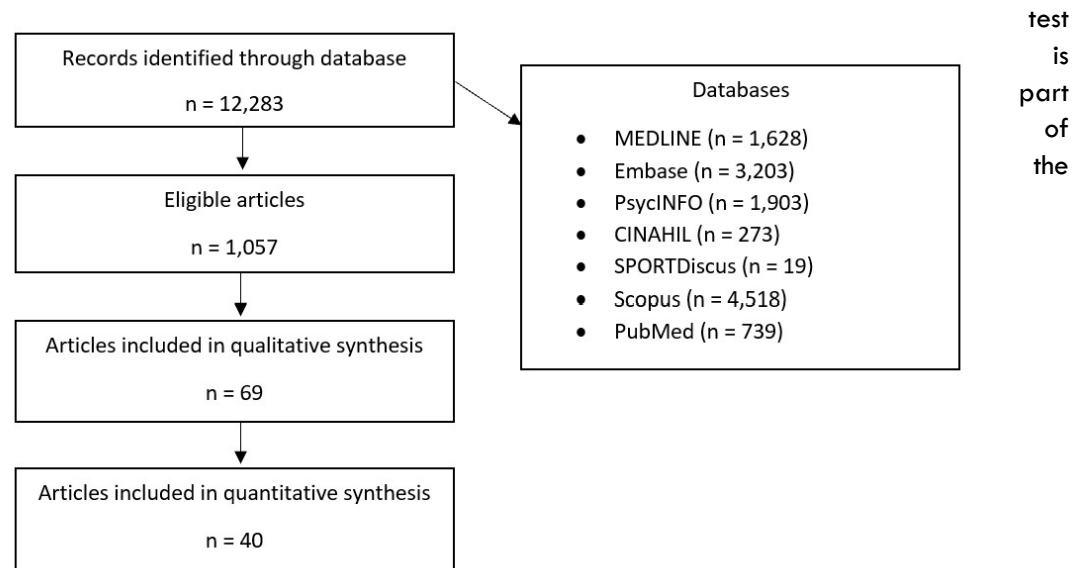


Figure 1. Systematic Review Flow Chart

Achenbach System of Empirically Based Assessment to test for behavioral and emotional problems in children.⁹ The Behavior Assessment System for Children (n=7, 10.1%) was used to assess the behavioral and emotional functions from taking the results of a questionnaire given to the child, parent, and a teacher.^{9,10} The Personality Inventory for Children (n=7, 10.1%) was also used to measure mental health outcomes. Internalizing features (n=43), overall mental health (n=32), and externalizing features (n=29) were assessed (Table 1). Twenty-eight of the studies assessed the premorbid mental health status. This included the pre-injury behavior (n=19) or psychiatric diagnoses (n=9) using the International Classification of Disease Criteria-10 (ICD-10).

FINDINGS AND CLINICAL IMPLICATIONS

The present systematic review showed significant, moderate effect sizes of internalizing features with comparing the acute, persisting and chronic outcomes (Table 1). The acute outcome was measured over less than three months, the persisting difficulties was from 3 to 12 months and the chronic difficulties were any case over 12 months. There were significant, moderate effect sizes observed in the externalizing features comparing the acute persisting, and chronic outcomes. For total features, the results showed that mental health in children generally improves over a span of 12 months with the acute cases experiencing the most effects. Several of the articles addressed the frequency of decreased mental health after a pediatric concussion. These studies suggest a minority of the children experienced clinically significant levels of internalizing, externalizing, and total mental health difficulties following their concussions.¹¹ The factors that predicted mental health challenges following pediatric concussion included pre-injury mental health, age from 2.5 to 18 years old (the younger kids from age 2.5 to 11 showed more externalizing features), and sex (females have a greater risk of developing new mental health symptoms).^{8,12,13} Males with psychiatric history were at a greater risk for further complications. Overall, age and sex were inconsistent predictors of mental health difficulties but some studies showed females to be more vulnerable to internalizing mental health features post-concussion.¹¹ Familial factors such as the family functioning, anxiety, characteristics (e.g.,

parent education, family socioeconomic status, living arrangements of the child), as well as parent mental health, and distress played a role in the mental health of the children studied.¹⁴ Mental health and post-concussion syndrome was examined in 11 studies. Internalizing symptoms significantly predicted the acute and post-acute post-concussion syndrome recovery.¹⁵ Mental health remains consistent over time post-injury with the mental health issues developing within the first-year post-concussion.¹¹ It took 3 to 6 months to see significant improvements post-concussion with infants and toddlers experiencing social and emotional behavior issues (oppositional defiance, attention-deficit/hyperactivity, substance use and mood disorder symptoms seen around ages 14 to 16).¹⁶ Additional studies are needed on the impact of age and sex due to the lack of age-specific and sex-specific data acquired.

Table 1. Mental health difficulties following pediatric concussions as compared to controls

	Acute Timeline		Persistent Timeline		Chronic Timeline	
	<i>Internalizing</i>	<i>Externalizing</i>	<i>Internalizing</i>	<i>Externalizing</i>	<i>Internalizing</i>	<i>Externalizing</i>
Mean size difference	5.12	5.77	4.26	4.94	2.88	3.46
Likelihood ratio	0.45	0.37	0.42	0.46	0.41	0.25
95% CI	0.17-0.74	0.09-0.65	0.20-0.63	0.25-0.66	0.10-0.72	0.09-0.41
p	0.01	0.03	0.001	<0.001	0.01	0.005

t=mean size difference between two groups; g=likelihood ratio that the test would be positive in the target population; 95% CI=confidence interval means that there is a 95% chance the real value is in the interval; p=means that there is the p-value chance that the observed differences occurred by chance

CLINICAL BOTTOM LINE

Clinicians who work with patients who participate in sports are likely to have experiences with mild traumatic brain injuries (mTBI) and mental health conditions. It is especially important for pediatric patients that the sports medicine team remains aware of the patient's mental health as a factor in their concussion recovery. Athletic trainers can greatly improve the concussion recovery by including a mental health screen with the baseline concussion test before the onset of the sport/activity. For mental health concerns to be detected early, a psychiatric screening should be conducted in accordance with a yearly concussion baseline test as part of PPE. These additions can be implemented into the established policies and procedures manuals. As the National Athletic Trainers' Association position statement on concussion management does not adequately address mental health screenings, The Translating Research into Injury Prevention Practice (TRIPP) framework would be necessary to start those changes. The previous recommendation would be a part of stages 5 and 6 of the TRIPP frameworks which would help explore how to implement changes and then if those changes would be effective.

After typical concussion symptoms have decreased, it is recommended that the same psychiatric screening used prior to the injury is utilized again. This will allow providers to assess if there is a change in the patients baseline mental health and the mental health concerns they may still be facing. After sustaining a concussion, the patient's "symptoms check" should include physical and cognitive symptoms, as well as mental health-related items such as nervousness, anxiety, sadness, depression, and/or increased irritability.³ In children, externalizing features are prominent such as hyperactivity, failure to control anger, or disordered conduct.⁸

It is key to remember that children that have been diagnosed with a concussion will experience overall mental health problems that will express internally and externally. As athletic trainers, we must be able to recognize and refer based off these symptoms. Internalizing symptoms would include anxious/overwhelmed (e.g., restlessness, uneasiness, panic), somatic concerns (e.g., excessive thoughts or feelings related to body symptoms such as pain or aches), and withdrawal (e.g., social isolation, introverted personality). A patient presenting with aggressive behaviors, intrusive thoughts, and risky behaviors are experiencing more externalizing symptoms. Athletic trainers should consider using screening instruments, like the Brief Symptom Inventory 18 (BSI-18) in conjunction with a psychological care team, to measure psychological distress prior to and following a pediatric concussion.

Individuals with an existing history of mental health challenges appear to be at a greater risk for persistent symptoms prior to their concussion diagnosis.¹⁷ Athletic trainers should be mindful of assessing persistent post-concussion symptoms and recognize the possible overlap of mental health symptoms. Athletic trainers should work with other health care providers when there are persistent mental health concerns. An interprofessional team consisting of an athletic trainer, physician, counselor, or psychologist is recommended with prolonged mental health concerns.¹⁸ If the site does not have an athletic trainer, the physician who is responsible for clearing the athlete for participation after their concussion should screen the athlete for any mental health concerns and if found, there should be a follow-up appointment with that physician, or a referral made to a counselor or psychologist to.

Previous management recommendations included prolonged rest, but studies have identified this to be associated with poor mental health outcomes.¹⁹ Participation in early physical activity is associated with shorter symptom recovery times and fewer overall symptoms such as dizziness, nausea, headache, or visual problems.²⁰ Athletic trainers have an important duty to educate and increase awareness for the pediatric patients and their families regarding the effects of mental health-related symptoms associated with concussions. An educational pamphlet can be incorporated with the initial PPE form including information on post-concussion management as well as potential mental health consequences for the parents or guardians since they play a vital role in the patient's care. The physical, cognitive, and mental health-related symptoms of concussion occur at different rates and last for various periods of time. This represents an important diagnostic criterion of post-concussion syndrome for both ICD-10 and Diagnostic and Statistical Manual of Mental Disorders (DSM-5).³

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