

# Lived Experiences of Adolescents Undergoing Rehabilitation After Sports-Related Concussions: A Phenomenological Approach

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## Article Info

### Article type:

Original Research

### How to cite this article:

Saadati, S. M., & Khadem Fini, A. (2025). Lived Experiences of Adolescents Undergoing Rehabilitation After Sports-Related Concussions: A Phenomenological Approach. *Journal of Adolescent and Youth Psychological Studies*, 6(6), 1-10.  
<http://dx.doi.org/10.61838/kman.jayps.6.6.18>



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## ABSTRACT

**Objective:** This study aimed to explore the lived experiences of adolescents undergoing rehabilitation after sports-related concussions (SRCs).

**Methods and Materials:** A qualitative research design grounded in a phenomenological approach was employed to capture the essence of participants' subjective experiences. Twenty adolescents aged 13–18 years, all from Minnesota and with a medically diagnosed SRC within the past 12 months, were recruited through purposive sampling from rehabilitation clinics, sports medicine centers, and school athletic departments. Data were collected through semi-structured, in-depth interviews conducted in private, comfortable settings and lasting between 45 and 75 minutes. Interviews explored participants' symptoms, coping strategies, academic reintegration, and social support networks. Recruitment continued until theoretical saturation was reached. All interviews were audio-recorded, transcribed verbatim, and analyzed using NVivo 14 software.

**Findings:** Four major themes emerged: (1) Physical and Cognitive Recovery Challenges, encompassing persistent symptoms, fluctuating recovery patterns, and adaptation to modified routines; (2) Emotional and Psychological Adjustment, including emotional distress, identity disruption, coping mechanisms, and social withdrawal; (3) Academic and School Reintegration, highlighting classroom challenges, the role of accommodations, and teacher and peer support; and (4) Social and Familial Support Systems, involving family engagement, team and coach encouragement, community resources, and experiences of misunderstanding.

**Conclusion:** Recovery from SRCs in adolescence is a multifaceted process shaped by interrelated physical, cognitive, psychological, academic, and social factors. Effective rehabilitation requires multidisciplinary, individualized approaches that address both clinical recovery and the lived realities of young athletes, incorporating medical, educational, and psychosocial support to optimize outcomes.

**Keywords:** sports-related concussion, adolescents, rehabilitation, phenomenology

## 1. Introduction

Sports-related concussions (SRCs) are a prevalent form of mild traumatic brain injury (mTBI) among youth athletes, representing a significant concern for public health,

sports medicine, and educational systems worldwide. Characterized by a complex pathophysiological process affecting the brain, SRCs result from biomechanical forces applied directly or indirectly to the head, leading to transient neurological dysfunction without structural brain

abnormalities detectable on standard imaging (Schneider et al., 2019). Adolescents, due to their ongoing neurodevelopment and involvement in high-intensity competitive sports, are particularly vulnerable to both the acute and long-term consequences of concussions (Murdaugh et al., 2018; Pate et al., 2022). In the United States alone, it is estimated that hundreds of thousands of youth sustain concussions annually, with contact and collision sports such as football, soccer, and hockey among the leading causes (Biese et al., 2021; Master et al., 2020).

The adolescent brain's unique physiology renders it more susceptible to prolonged recovery times and heightened symptom severity compared to adults (McLeod et al., 2017; Pate et al., 2022). Disruption of neural connectivity, alterations in cerebral blood flow, and metabolic disturbances can result in a constellation of somatic, cognitive, emotional, and sleep-related symptoms (Russell et al., 2017; Sargeant et al., 2018). While many athletes recover within a few weeks, a considerable subset experiences persistent post-concussion symptoms (PPCS) that can extend recovery to several months (Neidecker et al., 2021; Podolak et al., 2021). Prolonged recovery not only impacts physical well-being but also has significant implications for academic performance, social functioning, and mental health (Lucas et al., 2023; Valovich et al., 2022).

A growing body of evidence has highlighted the multifactorial nature of concussion recovery, influenced by injury characteristics, pre-injury health status, and post-injury management strategies (Long et al., 2024; Mathew et al., 2025). Early, individualized rehabilitation has been associated with improved outcomes, with delayed initiation of therapy linked to extended symptom duration (Ferry et al., 2023; Mathew et al., 2025). Rehabilitation approaches often include graded physical activity, vestibular therapy, cognitive rest, and psychological support, tailored to the athlete's evolving symptom profile (Ferry et al., 2023; Schneider et al., 2019). However, despite advances in evidence-based management, inconsistencies remain in clinical recovery criteria and return-to-play (RTP) decision-making (Moser et al., 2024; Moser et al., 2023).

Return-to-play protocols are designed to ensure athletes progress safely from rest to full participation, yet adherence to these protocols varies across settings (Daly & Ryan, 2024; Wortley & Schellenberg, 2024). Psychological readiness—encompassing factors such as fear of re-injury, motivation, and self-compassion—can influence both the pace and sustainability of recovery (Valovich et al., 2022; Wortley & Schellenberg, 2024). Furthermore, cultural and sport-

specific norms may shape attitudes toward concussion reporting, symptom disclosure, and rehabilitation engagement (D'Alonzo et al., 2025; Jaffee et al., 2023). These psychosocial dimensions are especially relevant in adolescence, a developmental stage characterized by identity formation, peer influence, and academic pressures (McLeod et al., 2017; Valovich et al., 2022).

Adolescents' lived experiences of concussion rehabilitation are shaped not only by their physical recovery but also by the social ecosystems surrounding them—family, peers, coaches, teachers, and healthcare providers. Social support can facilitate adherence to treatment, mitigate emotional distress, and foster resilience (Biese et al., 2021; Lucas et al., 2023). Conversely, perceived stigma, misunderstanding, or minimization of symptoms by others can exacerbate isolation and hinder recovery (Lucas et al., 2023; Valovich et al., 2022). The role of parents and guardians is particularly salient, as they often navigate complex decisions about rest, school reintegration, and medical follow-up (Lucas et al., 2023; Podolak et al., 2021).

In addition to psychosocial influences, biological and contextual factors also play critical roles. Studies suggest that sex differences may influence concussion incidence, symptom presentation, and recovery trajectories, with female athletes in certain sports experiencing higher rates and more severe symptom burdens (Bramley et al., 2018; Master et al., 2020). Body mass index, sport type, and pre-existing conditions such as migraines or mood disorders can further complicate recovery (Bramley et al., 2018; Long et al., 2024). Sport-specific contexts—team versus individual sports, competitive versus recreational settings—may also shape the recovery experience (Hainline et al., 2019; Long et al., 2024).

Despite increased awareness and research, significant gaps remain in understanding the subjective, day-to-day realities of adolescents undergoing concussion rehabilitation. Much of the existing literature has focused on clinical and neurocognitive outcomes, RTP timelines, and biomechanical risk factors (Miller et al., 2022; Sargeant et al., 2018). While these data are essential, they provide an incomplete picture of recovery, omitting the nuanced ways in which adolescents perceive and navigate their rehabilitation journey (D'Alonzo et al., 2025; Valovich et al., 2022). Qualitative approaches are uniquely positioned to capture these perspectives, offering insights into the emotional, social, and experiential dimensions of recovery that may inform more holistic care models (Daly & Ryan, 2024; Finnegan et al., 2024).

Moreover, the intersection between concussion and other health outcomes warrants attention. Previous research has suggested a potential association between concussion history and increased risk of subsequent musculoskeletal injuries (Biese et al., 2021) and motor skill deficits (Dalecki et al., 2019; Lowe et al., 2021). These findings underscore the importance of addressing both physical and neuromotor recovery in rehabilitation planning. Vestibular dysfunction, balance impairments, and coordination deficits can persist even after symptom resolution, highlighting the need for comprehensive post-concussion assessments (Ferry et al., 2023; Lowe et al., 2021).

Concussion recovery also interacts with educational demands. Adolescents often face challenges in returning to academic settings, experiencing difficulties with concentration, memory, and information processing (Podolak et al., 2021; Russell et al., 2017). Academic accommodations, such as reduced workload and extended deadlines, can facilitate reintegration but require coordinated efforts between medical and educational teams (Neidecker et al., 2021; Valovich et al., 2022). The success of these measures depends not only on policy but also on the attitudes of educators, peers, and families (Jaffee et al., 2023; Lucas et al., 2023).

Given these complexities, there is a pressing need to explore adolescents' rehabilitation experiences through a phenomenological lens, capturing the essence of their lived realities. This approach allows for the examination of how adolescents make sense of their injury, adapt to new limitations, and negotiate the interplay of physical, cognitive, and social changes over time (D'Alonzo et al., 2025; Mathew et al., 2025). By foregrounding the voices of adolescents themselves, such research can illuminate barriers and facilitators to recovery that may be overlooked in quantitative studies (Daly & Ryan, 2024; Finnegan et al., 2024).

The present study addresses this gap by investigating the lived experiences of adolescents undergoing rehabilitation after sports-related concussions in Minnesota.

## 2. Methods and Materials

### 2.1. Study Design and Participants

This study adopted a qualitative research design grounded in a phenomenological approach, aiming to capture the lived experiences of adolescents undergoing rehabilitation following sports-related concussions. The phenomenological framework was selected to facilitate a

deep exploration of participants' subjective perceptions, emotions, and meanings attached to their recovery process. The target population consisted of adolescents aged 13–18 years who had sustained a diagnosed sports-related concussion and were currently in, or had recently completed, a formal rehabilitation program.

Participants were recruited using purposive sampling to ensure that those included had rich and relevant experiences aligned with the study's objectives. Recruitment was conducted through local rehabilitation clinics, sports medicine centers, and school athletic departments in Minnesota. Inclusion criteria were: (a) age between 13 and 18 years, (b) a medical diagnosis of sports-related concussion within the past 12 months, (c) completion of at least two weeks in a structured rehabilitation program, and (d) ability to communicate in English. Exclusion criteria included the presence of severe cognitive impairments, co-occurring neurological conditions unrelated to the concussion, or unwillingness to participate in audio-recorded interviews. A total of 20 participants meeting these criteria were enrolled, with recruitment continuing until theoretical saturation was achieved, meaning that no new themes or significant insights emerged from additional data collection.

### 2.2. Measures

Data collection was carried out using semi-structured, in-depth interviews to allow participants to express their experiences freely while ensuring consistency in the topics explored. An interview guide was developed based on a review of the literature and consultation with concussion rehabilitation specialists, covering topics such as physical symptoms, emotional challenges, school reintegration, social interactions, and perceived support during recovery. Interviews were conducted face-to-face in a quiet and private setting, either at participants' rehabilitation facilities or a location of their choice, ensuring confidentiality and comfort. Each interview lasted between 45 and 75 minutes, and all sessions were audio-recorded with participants' informed consent. Brief demographic data, including age, gender, type of sport, and time since injury, were also collected.

### 2.3. Data Analysis

Data analysis followed the thematic analysis principles of phenomenological research, focusing on identifying the

essence of participants' lived experiences. Audio recordings were transcribed verbatim, and transcripts were reviewed against the recordings for accuracy. The coding and analysis were conducted using NVivo software version 14 to manage, organize, and retrieve data systematically. Initial open coding was performed to identify significant statements and concepts, followed by axial coding to group related codes into broader themes. Finally, selective coding was used to refine and integrate themes into an overarching phenomenological description. The analysis process was iterative, involving multiple readings of the transcripts and regular peer debriefings to enhance interpretive depth and validity.

### 3. Findings and Results

The study sample consisted of 20 adolescents aged between 13 and 18 years ( $M = 15.6$  years), all of whom had

sustained a medically diagnosed sports-related concussion within the previous 12 months and were currently engaged in, or had recently completed, a structured rehabilitation program. Eleven participants (55%) identified as male and nine (45%) as female. The most common sports in which the concussions occurred were football ( $n = 6$ , 30%), soccer ( $n = 5$ , 25%), hockey ( $n = 4$ , 20%), basketball ( $n = 3$ , 15%), and gymnastics ( $n = 2$ , 10%). Time since injury at the point of interview ranged from 3 weeks to 11 months, with the majority ( $n = 12$ , 60%) in the 1–6 month post-injury period. Fourteen participants (70%) reported having sustained their concussion during competitive play, while six (30%) were injured during training or practice sessions. Most participants ( $n = 16$ , 80%) were enrolled in high school at the time of the study, with the remaining four (20%) attending middle school.

**Table 1**

*Categories, Subcategories, and Concepts*

Category (Main Theme)	Subcategory	Concepts (Open Codes)
1. Physical and Cognitive Recovery Challenges	Post-Concussion Symptoms	Persistent headaches; Sensitivity to light; Sensitivity to noise; Fatigue; Sleep disturbances
	Cognitive Difficulties	Short-term memory issues; Difficulty concentrating; Slowed processing speed; Mental fog
	Physical Limitations in Activity	Reduced endurance; Dizziness during movement; Difficulty returning to sport drills
	Fluctuating Recovery Progress	Good and bad days; Symptom flare-ups after activity; Unpredictable healing timeline
	Adaptation to New Physical Routines	Modified exercise plans; Incremental activity increase; Balancing rest and activity
2. Emotional and Psychological Adjustment	Emotional Reactions to Injury	Frustration; Anxiety; Sadness; Irritability; Fear of re-injury
	Self-Identity Disruption	Feeling different from peers; Loss of athletic role; Doubting self-worth
	Motivation and Resilience	Setting small goals; Persistence despite setbacks; Celebrating minor progress
	Coping Mechanisms	Talking to friends; Journaling feelings; Distraction through hobbies
	Mental Health Support Seeking	Counseling sessions; Trust in school psychologist; Peer support groups
3. Academic and School Reintegration	Social Withdrawal	Avoiding large gatherings; Feeling misunderstood; Isolation during recovery
	Challenges in Classroom Learning	Struggling to focus in lectures; Difficulty with reading comprehension; Overwhelmed by assignments
	School Accommodations	Extended test times; Reduced homework; Flexible deadlines
	Teacher and Staff Support	Understanding from teachers; Regular check-ins; Modified PE requirements
	Peer Relationships at School	Friends offering help; Avoidance from classmates; Explaining injury repeatedly
4. Social and Familial Support Systems	Family Involvement in Recovery	Parents adjusting schedules; Sibling encouragement; Family monitoring symptoms
	Support from Sports Teams	Teammates visiting; Coaches checking progress; Encouragement to return gradually
	Community Resources	Concussion education workshops; Local rehab programs; Support from sports clubs
	Perceived Lack of Understanding	Minimization of injury; Misinterpretation of symptoms; Pressure to recover faster
	Online and Peer Support Networks	Sharing experiences on forums; Learning tips from other athletes; Social media encouragement

### Physical and Cognitive Recovery Challenges

*Post-Concussion Symptoms* – Participants consistently described lingering physical symptoms as one of the most significant hurdles during their rehabilitation. Commonly reported issues included persistent headaches, heightened sensitivity to light and noise, ongoing fatigue, and disruptions to sleep patterns. One adolescent explained, “Even weeks after the injury, I still couldn’t go outside without sunglasses because the light felt like it was stabbing my eyes.” Another noted, “The headaches would come out of nowhere and shut me down for the rest of the day.” These symptoms were not only physically exhausting but also directly influenced the pace of recovery.

*Cognitive Difficulties* – Mental challenges were equally prominent, with participants recounting short-term memory lapses, difficulty concentrating, slowed processing speed, and a pervasive sense of mental fog. One participant shared, “It’s like my brain was walking through mud—everything felt slower.” Another reflected, “I would read the same paragraph over and over and still not remember what it said.” Such cognitive limitations impacted school performance and daily functioning, amplifying frustration.

*Physical Limitations in Activity* – Many adolescents expressed frustration at being unable to participate fully in sports or physical routines. Reduced endurance, dizziness upon movement, and difficulty performing even basic sport drills were common. “I used to run five miles without thinking,” one participant recounted, “but after the concussion, walking a block made me dizzy.” These restrictions often required a complete rethinking of physical activity schedules.

*Fluctuating Recovery Progress* – Recovery trajectories were rarely linear, with adolescents describing alternating “good and bad days,” symptom flare-ups following exertion, and an unpredictable timeline for healing. As one participant put it, “I’d feel okay for two days, then suddenly the headache and dizziness would come back for no reason.” This inconsistency created uncertainty and sometimes reduced motivation.

*Adaptation to New Physical Routines* – Rehabilitation required adjusting to modified exercise plans, gradual increases in activity, and careful balancing between rest and exertion. A participant shared, “My therapist gave me this plan—ten minutes of exercise, then rest. At first it felt silly, but it helped.” These adaptations were often viewed as essential for preventing setbacks and regaining baseline functioning.

### Emotional and Psychological Adjustment

*Emotional Reactions to Injury* – Adolescents described a wide spectrum of emotions, including frustration, anxiety, sadness, irritability, and fear of re-injury. One athlete explained, “I was angry because it wasn’t fair—I did everything right, and still got hurt.” Another admitted, “Every time I thought about going back to the field, I got scared it might happen again.” These emotions often fluctuated alongside physical progress.

*Self-Identity Disruption* – For many, the concussion disrupted their sense of self, particularly for those whose identity was closely tied to sports. Feelings of being “different” from peers, losing their athletic role, and doubting self-worth were common. One participant confessed, “I wasn’t the team’s star anymore. I was just the injured kid.” This shift in self-perception often influenced social interactions and motivation during recovery.

*Motivation and Resilience* – Despite the challenges, some adolescents reported strategies for staying motivated, such as setting small goals, persisting despite setbacks, and celebrating minor milestones. “I made it through an entire class without feeling dizzy—that was a win for me,” one participant said. Resilience was often bolstered by visible progress, no matter how incremental.

*Coping Mechanisms* – Participants relied on various coping strategies to manage emotional distress, including talking to friends, journaling, and engaging in hobbies that did not exacerbate symptoms. A participant noted, “When I couldn’t play soccer, I started painting. It kept me from going crazy.” These methods served as psychological anchors during recovery.

*Mental Health Support Seeking* – Several adolescents accessed mental health services, such as counseling sessions, school psychologist visits, or peer support groups. “Therapy helped me understand that it was okay to feel anxious about going back,” one interviewee explained. Professional and peer-based interventions were seen as valuable in addressing the psychological toll of the injury.

*Social Withdrawal* – Some participants described withdrawing from friends and social activities, often due to feeling misunderstood or struggling with sensory overload in large gatherings. “I just stayed in my room because being around people made my head spin,” one adolescent recounted. This isolation sometimes deepened feelings of loneliness.

### Academic and School Reintegration

*Challenges in Classroom Learning* – Returning to school posed significant difficulties, particularly in maintaining concentration, processing written material, and managing



academic workload. “I would sit in class and hear the teacher’s voice, but none of the words made sense,” one participant recalled. Overwhelm from assignments was a recurring theme, especially during the early phases of reintegration.

*School Accommodations* – Many adolescents benefited from accommodations such as extended test times, reduced homework loads, and flexible deadlines. One student reported, “My teachers let me take breaks during tests, which made a huge difference.” These adjustments often played a critical role in reducing stress and enabling gradual academic recovery.

*Teacher and Staff Support* – Positive experiences with supportive educators and school staff were common. Teachers who offered regular check-ins, understanding, and modified physical education requirements were especially valued. “My PE teacher told me I could sit out without having to explain myself every time,” one adolescent shared.

*Peer Relationships at School* – Social dynamics at school were mixed. Some participants found peers supportive, offering help with notes or walking them to class, while others experienced avoidance or repeated questions about the injury. “It felt like I was a broken record explaining my concussion over and over,” one participant said.

#### **Social and Familial Support Systems**

*Family Involvement in Recovery* – Parents often played a central role by adjusting their schedules, offering encouragement, and monitoring symptoms. “My mom would check in on me every hour after school to make sure I wasn’t overdoing it,” one participant noted. Siblings also provided companionship and emotional support.

*Support from Sports Teams* – Teammates and coaches who maintained contact and encouraged gradual return to sport were a source of motivation. “My coach texted me every week, reminding me that my health came first,” one adolescent explained. Such gestures reinforced a sense of belonging.

*Community Resources* – Some participants engaged with concussion education workshops, local rehabilitation programs, or sports club initiatives. “The workshop at the community center taught me how to pace myself and not rush back too soon,” one participant recalled. These resources complemented clinical care.

*Perceived Lack of Understanding* – Not all interactions were positive; some adolescents felt that others minimized their injury, misunderstood their symptoms, or pressured them to recover faster. “People kept saying, ‘It’s just a bump

on the head, you’ll be fine,’ which made me feel invisible,” one participant shared.

*Online and Peer Support Networks* – Social media groups and online forums allowed participants to share experiences and receive encouragement from others who had gone through similar recoveries. “Talking to someone online who had the same injury made me feel less alone,” one adolescent said. These platforms provided both practical advice and emotional reassurance.

#### **4. Discussion and Conclusion**

The present study explored the lived experiences of adolescents undergoing rehabilitation after sports-related concussions (SRCs), revealing a multifaceted recovery process shaped by persistent physical and cognitive symptoms, emotional and psychological adjustment, academic reintegration challenges, and the role of social and familial support. These findings reinforce and extend prior research highlighting that recovery from concussion in adolescence is not solely a matter of symptom resolution but a dynamic, individualized process influenced by biological, psychological, and contextual factors (Schneider et al., 2019; Valovich et al., 2022).

One of the most prominent themes emerging from our data was the persistence of physical and cognitive symptoms, such as headaches, fatigue, dizziness, concentration difficulties, and memory lapses, which participants reported as barriers to both physical activity and academic performance. These findings align with studies indicating that adolescents often experience a more protracted recovery trajectory compared to adults due to ongoing neurodevelopmental vulnerability (McLeod et al., 2017; Pate et al., 2022). Previous research has shown that metabolic and neurophysiological changes following concussion can lead to prolonged symptomatology, particularly when activity levels are not carefully managed (Lowe et al., 2021; Sargeant et al., 2018). Our participants’ experiences of fluctuating recovery progress—with “good and bad days” and symptom flare-ups—mirror longitudinal findings showing that concussion recovery is nonlinear, with setbacks occurring even after initial improvements (Neidecker et al., 2021; Podolak et al., 2021).

Participants also described adapting to modified physical routines and engaging in gradual return-to-activity protocols. This resonates with evidence supporting early, tailored rehabilitation to optimize recovery outcomes (Ferry et al., 2023; Mathew et al., 2025). Delayed initiation of

therapy has been associated with extended symptom duration, and our findings underscore the importance of timely interventions incorporating both physical and vestibular rehabilitation (Mathew et al., 2025; Schneider et al., 2019). In this regard, vestibular therapy—cited by some of our participants as beneficial—has been shown to expedite recovery, particularly for athletes experiencing balance and dizziness issues (Ferry et al., 2023; Lowe et al., 2021).

The second major theme concerned emotional and psychological adjustment. Adolescents in this study reported frustration, anxiety, sadness, and fear of re-injury, highlighting the psychological burden of concussion beyond physical symptoms. Such emotional responses are consistent with earlier studies that have documented heightened emotional distress during recovery, particularly in cases of prolonged symptom persistence (Daly & Ryan, 2024; Wortley & Schellenberg, 2024). Our participants' narratives of identity disruption—feeling “different” from peers or losing their athletic role—echo findings that concussions can threaten adolescents' developing self-concept, especially when sport participation is a core component of identity (McLeod et al., 2017; Valovich et al., 2022).

Motivation and resilience emerged as important factors in facilitating recovery, with participants describing the use of small, achievable goals and the importance of celebrating incremental progress. This is in line with findings that psychological readiness, including self-efficacy and self-compassion, influences return-to-play adherence and recovery outcomes (Valovich et al., 2022; Wortley & Schellenberg, 2024). Conversely, social withdrawal and isolation were reported by several participants, often stemming from sensory overload or feeling misunderstood by peers. Similar patterns have been documented in qualitative studies where adolescents described withdrawing from social contexts to manage symptoms, sometimes at the cost of emotional well-being (D'Alonzo et al., 2025; Lucas et al., 2023).

The theme of academic and school reintegration revealed the significant impact of concussion on educational participation. Participants described difficulties focusing in class, challenges with reading comprehension, and feelings of being overwhelmed by assignments—symptoms widely documented in the literature on concussion-related cognitive deficits (Murdaugh et al., 2018; Russell et al., 2017). Our findings reinforce that school accommodations, such as reduced workloads and flexible deadlines, are essential in facilitating reintegration (Neidecker et al., 2021; Podolak et

al., 2021). Moreover, participants valued understanding teachers and staff, which mirrors earlier findings that educator awareness and flexibility are critical to successful academic recovery (Lucas et al., 2023; Valovich et al., 2022). However, our data also suggest variability in the availability and quality of such accommodations, pointing to a need for standardized, evidence-based return-to-learn protocols (Biese et al., 2021; Miller et al., 2022).

The final theme centered on social and familial support systems. Family involvement was often cited as a key facilitator of recovery, whether through practical adjustments, emotional encouragement, or monitoring symptoms. This is consistent with previous studies emphasizing parental and guardian roles in coordinating care, managing rest periods, and liaising with schools (Lucas et al., 2023; Podolak et al., 2021). Support from teammates and coaches also emerged as significant, underscoring the importance of maintaining social connectedness to athletic communities even during physical absence (Biese et al., 2021; Valovich et al., 2022). However, some participants described experiences of perceived misunderstanding or minimization of their injury by peers and adults, which can contribute to feelings of invalidation and hinder emotional recovery (Jaffee et al., 2023; Lucas et al., 2023). This aligns with findings that sociocultural attitudes toward concussion can shape recovery behaviors and influence symptom disclosure (Hainline et al., 2019; Jaffee et al., 2023).

Our results also intersect with existing evidence on broader health implications of concussion. For example, the persistence of motor and coordination deficits described by some participants resonates with findings linking concussion to impairments in complex motor skills (Dalecki et al., 2019; Lowe et al., 2021). Additionally, previous concussion history has been associated with elevated risk for subsequent musculoskeletal injuries (Biese et al., 2021), suggesting that recovery should extend beyond symptom resolution to include targeted neuromotor retraining. The nutritional dimension of recovery, while not a primary focus of our participants' narratives, is another area of emerging interest, as dietary strategies may influence neuroinflammatory processes and healing trajectories (Finnegan et al., 2024).

From a phenomenological perspective, our findings highlight the interplay between personal meaning-making and systemic structures in shaping the recovery journey. Adolescents navigated not only physiological healing but also shifts in identity, relationships, and daily routines. This layered complexity supports calls for concussion management models that integrate physical, cognitive, and

psychosocial domains (Podolak et al., 2021; Schneider et al., 2019). It also emphasizes the necessity of clinician awareness regarding the subjective experiences of adolescent athletes, which may reveal barriers to recovery invisible in clinical metrics alone (D'Alonzo et al., 2025; Daly & Ryan, 2024).

## 5. Limitations & Suggestions

This study is subject to several limitations. First, the sample was limited to 20 adolescents from Minnesota, which may restrict the generalizability of the findings to other geographic regions or cultural contexts. Second, data collection relied on self-reported accounts, which are inherently subject to recall bias and the influence of social desirability. Third, although phenomenological methods allowed for in-depth exploration of participants' lived experiences, they do not provide quantitative measures of symptom severity or functional recovery, which could have added complementary insights. Additionally, our study did not include triangulation with other stakeholders such as parents, coaches, or healthcare providers, which could have enriched understanding of the recovery context. Finally, as interviews were conducted within a defined time frame post-injury, the study may not fully capture long-term trajectories or late-emerging consequences of SRCs.

Future research should aim to include larger, more diverse samples to enhance the transferability of findings. Comparative studies across different sports, competition levels, and cultural contexts could illuminate how environmental and social factors influence recovery experiences. Longitudinal qualitative designs would be particularly valuable for tracing the evolving meanings and challenges of concussion rehabilitation over time. Additionally, incorporating perspectives from parents, educators, and healthcare providers could provide a more holistic picture of adolescent recovery ecosystems. Interdisciplinary approaches that integrate qualitative insights with neuroimaging, biomarker analysis, and functional assessments could also deepen understanding of the complex biopsychosocial mechanisms underlying SRC recovery.

Practitioners working with adolescents recovering from SRCs should adopt a multidisciplinary, athlete-centered approach that addresses not only physical rehabilitation but also psychological support, academic accommodations, and social reintegration. Rehabilitation plans should be flexible and responsive to fluctuating symptoms, with gradual

progression informed by both clinical assessments and the athlete's subjective readiness. Educators should receive targeted training on concussion awareness to ensure consistent and supportive return-to-learn strategies. Families and coaches should be actively engaged in the rehabilitation process to reinforce adherence, provide emotional support, and facilitate social connectedness. Finally, integrating psychosocial screening and counseling into concussion care pathways may help address the emotional and identity-related challenges that often accompany recovery.

## Acknowledgments

We would like to express our appreciation and gratitude to all those who cooperated in carrying out this study.

## Declaration of Interest

The authors of this article declared no conflict of interest.

## Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

## Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

## Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

## Authors' Contributions

All authors equally contributed to this article.

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