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# Academic adjustments and concussion recoveries in NCAA student-athletes: a LIMBIC MATARS investigation

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## ABSTRACT

**Objective:** The aim of this study was to investigate the association between academic adjustments and recovery from sport-related concussions (SRCs) in collegiate athletes.

**Materials and Methods:** A retrospective medical chart review was performed between the 2015–2016 and 2019–2020 sport seasons at 11 Long-term Impact of Military-relevant Brain Injury Consortium Military and Tactical Athlete Research Study (LIMBIC MATARS) sites. Days between injury and symptom resolution, and injury and return to sport (dependent variables) for collegiate athletes who did or did not receive academic adjustments (independent variable) were analyzed using Mann–Whitney *U* tests.

**Results:** The number of days between date of injury and symptom-resolution between those who did (median = 9 [interquartile range = 5,16]) and did not have (7[3,12]) academic adjustments were statistically different ( $z = -2.76, p < 0.01, r = -0.17$ ). However, no differences were observed between days to return to sport among those who did (14[10,22]) and did not (13[8,20]) receive assigned academic adjustments ( $z = -1.66, p = 0.10, r = -.10$ ).

**Conclusions:** Recovery trajectories were similar between athletes diagnosed with a SRC who did or did not receive academic adjustments. Our findings suggest academic adjustments supported recovery for those who needed academic adjustments. Clinicians and healthcare professionals should assist and support collegiate athletes after SRCs on an individual basis, including academic adjustments when appropriate based on patient presentation.

## ARTICLE HISTORY

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Mild traumatic brain injury (mTBI); return to learn; academic accommodations; return to classroom; return to school

## Introduction

Over the past decade, sport-related concussion (SRC) policies have evolved to include integrating athletes back into the classroom, in addition to their sport. The most recent Consensus Statement on Concussion in Sport provides a standardized return to learn (RTL) protocol and recommendations aimed at allowing students to return to academic work without exasperating symptoms or delaying recovery (1). The limited literature available on RTL protocols is largely based on academic and clinical expertise rather than empirical evidence. Additionally, despite the existence of governing healthcare bodies guidelines and recommendations, there is limited implementation of academic adjustments to facilitate the recovery of athletes with concussions (2). According to Carson et al. (3), almost half (44.7%) of athletes with SRCs returned to academic work prematurely based on an aggravation of symptoms following RTL. To prevent symptom exasperation, stakeholders, such as administrators, athletic trainers, coaches, educators, and physicians must collaborate to facilitate athletes' returns to both the classroom and sport (3). Premature RTL of athletes diagnosed with concussions may be ameliorated by the interdisciplinary collaboration of stakeholders (e.g.,

administrators, athletic trainers, coaches, educators, and physicians) associated with athlete RTL and return to sport (RTS).

Concussions can be associated with a myriad of symptoms including memory and information processing deficits, slowed reaction time, sensitivity to light and sound, and difficulty concentrating (4). Concussion-related signs and symptoms may impair athletes' ability to retain information and other challenges in daily academic activities (5). Due to the highly variable signs and symptoms associated with SRCs, the return to cognitive activities and responsibilities required for students' academic success must be individualized and closely monitored to identify circumstances that may provoke symptoms and potentially delay recovery (2). Educating healthcare providers, school administrators, guidance counselors, coaches, and other sports and education stakeholders about the importance of RTL adjustments is critical to assist in the recovery from concussion.

Understanding the importance of academic adjustments following concussions will aid in providing needed academic support for athletes' recovery. Potential barriers to the implementation of academic adjustments include a lack of

education prescribing adjustments, confusion as to who is responsible for RTL prescription and implementation, and the availability of resources to aid with the modification of assignments, the classroom environment, and other alterations (6). Specific to the university setting, athletes often have faculty from a wide variety of disciplines who may or may not have experience with concussion-related, academic adjustments that may cause communication and knowledge barriers between involved stakeholders (6). Moreover, in the collegiate setting, athletes believe it is the athletic trainers' responsibility to implement academic adjustments following a concussion (7); however, the ability to do so is likely outside of an athletic trainer's scope of practice. The reason for the lack of consistent implementation may be due in part to the breadth of responsibilities and patients under the care of athletic trainers that may present logistical difficulties in coordinating care for RTL considerations. Moreover, at the adolescent levels, while policies may be in place for navigating academic adjustments following SRC, there is a lack of consistent implementation of policies among stakeholders (8). The challenges collectively demonstrate disparities in RTL considerations among athletes at various levels of participation.

A range of adjustments provide the necessary scaffolding to allow athletes to RTL without exacerbating their symptoms while optimizing recovery time (9). To date, a paucity of research has addressed the clinical utility of academic adjustments on optimizing recovery time after a concussion. Understanding how academic adjustments can affect the recovery time of athletes diagnosed with SRC could help clinicians and other stakeholders appreciate how modifications to the academic experience may foster recovery of athletes and facilitate a successful RTL and RTS. Therefore, the purpose of our exploratory study was to compare the recovery of collegiate athletes with concussions who did or did not receive academic adjustments following their injury. More specifically, we compared the number of days between athletes' concussive injuries and when they reported symptom resolution and when they returned to play.

## Materials and methods

### Research design

A retrospective medical chart review was performed between the 2015–2016 and 2019–2020 sport seasons at 11 Long-term Impact of Military-relevant Brain Injury Consortium Military and Tactical Athlete Research Study (LIMBIC MATARS) study sites. Cases of concussions included in this study were from active collegiate athletes during the study period. For inclusion in the present study, concussion cases must have included data on whether or not the athlete received RTL adjustments post-injury (dichotomous; yes/no), which served as our independent variable. Additionally, cases also needed to include the pertinent recovery dates to calculate the dependent variables of time (in days) from injury occurrence to symptom resolution and return to sport.

### Procedures

The specific methodology associated with the LIMBIC MATARS consortium is described elsewhere (10). The University of Virginia Institutional Review Board granted

approval, and before data retrieval, researchers at all member institutions obtained Institutional Review Board approval and completed confidentiality disclosure and data use agreements to uphold ethical standards. Before collecting data, the LIMBIC MATARS investigators agreed on common data elements, as described in the methods paper (10). Institutional principal investigators from the LIMBIC MATARS consortium reviewed medical records of athletes with concussions that were recognized, diagnosed, and documented by their sports medicine healthcare teams. After exporting data from medical records, each investigator created a unique Microsoft Excel (Microsoft Corporation, version 2021) database for their institution. The consortium principal investigators combined and de-identified all site-specific concussion data to produce an aggregated database, which was shared with research contributors for analyses.

### Statistical analysis

Chi-squared tests ( $\chi^2$ ) were used to compare groups based on demographic and health history variables [i.e., biological sex, history of Attention Deficit/Hyperactivity Disorder (ADD/ADHD), depression, anxiety, prior concussions]. Primary outcome variables were deemed as being non-normally distributed via skewness and kurtosis ( $>1.0$ ) and Shapiro–Wilk's tests ( $p < 0.05$ ). Therefore, days between injury and symptom resolution, and injury and RTS (dependent variables) for collegiate athletes who did or did not receive academic adjustments (independent variable) were analyzed using Mann–Whitney  $U$  tests.  $Z$ -values from the Mann–Whitney  $U$  tests and the total sample size of the two groups being compared ( $n$ ) were used to calculate effect sizes as ( $r = z/\sqrt{N}$ ) (11). Effect sizes were interpreted as small ( $r = .1$ ), medium ( $r = .3$ ) and large ( $r = .5$ ) (12). All analyses were performed using via SPSS version 28 (IBM Inc, Armonk, NY).

## Results

### Participants

Our final sample consisted of 251 SRC cases (Figure 1) that were sustained by female (36.7%) and male (63.3%) collegiate athletes during sport participation (age = 20.00 + 1.41 years). Of the included sample, 62.9% ( $n = 158$ ) received academic adjustments and 37.1% ( $n = 93$ ) did not receive academic adjustments. No associations were identified between academic adjustment group and demographic variables (biological sex, history of ADD/ADHD, depression, anxiety, previous concussion; Table 1).

The number of days between date of injury and self-reported symptom-resolution between those who did (median = 9 [interquartile range = 5,16]) and did not have (7 [3,12]) academic adjustments were statically different ( $z = -2.76$ ,  $p < 0.01$ ,  $r = -0.17$  (Figure 2)). However, no differences were observed between days to return to sport among those who did (14 [10,22]) and did not (13[8,20]) receive assigned academic adjustments ( $z = -1.66$ ,  $p = 0.10$ ,  $r = -.10$ ; Figure 2).

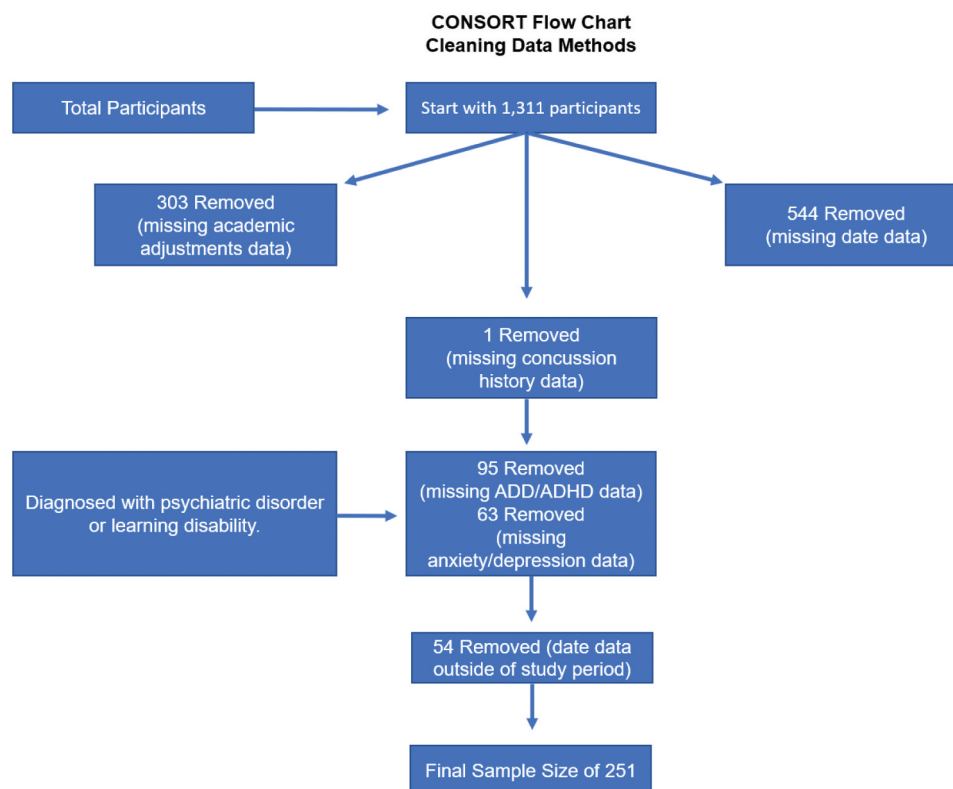


Figure 1. CONSORT flow chart of data cleaning.

Table 1. Demographic characteristics across levels of academic adjustments.

		Academic Adjustments	No Academic Adjustments	P-value	$\chi^2_1$	Phi Cramer	df
Depression	Yes	17	7	0.400	0.707	0.053	1
	No	141	86				
Anxiety	Yes	17	7	0.400	0.707	0.053	1
	No	141	86				
ADHD	Yes	16	5	0.189	1.723	0.083	1
	No	142	88				
Biological Sex	Female	58	34	0.981	0.001	0.002	1
	Male	100	59				
Previous Concussion	Yes	67	40	0.120	8.733	0.189	5
	No	88	50				

## Discussion

Return-to-learn protocols are evolving as knowledge continues to increase in this emerging area of concussion management. Multidisciplinary healthcare (13) and governing bodies (14) that make evidence-based recommendations for SRC suggest protocols should include individualized approaches to RTL and return to sport progressions. Our findings suggest that athletes who received academic adjustments took approximately two days longer to reach symptom resolution as compared to athletes who did not receive academic adjustments. Although statistically significant, the effect size was low which is suggestive of marginal clinical relevance. While those athletes who received academic adjustments had symptoms that persisted longer than those who did not receive academic adjustments (15), days until return to sport was similar between groups. The result may indicate that the academic adjustment group was able to

effectively return to sport in a typical timeframe despite experiencing symptoms for a longer period of time. More importantly, the recovery periods for each group were consistent with the typical time period for which the majority of collegiate athletes recover from SRC (16). Thus, it is likely that the prescribed academic adjustments allowed for collegiate athletes with a clinical trajectory for a prolonged recovery to achieve symptom resolution and return to sport in a similar period of time as collegiate athletes who were not prescribed similar adjustments. It is plausible that without academic adjustments, the subset of athletes may have experienced longer recovery times. Following concussion, collegiate athletes often experience cognitive impairments that impact their ability to learn and retain new information. Therefore, the cognitive demands of attending class, completing assignments, and taking assessments puts a heavy load on a system that is already strained due to injury.

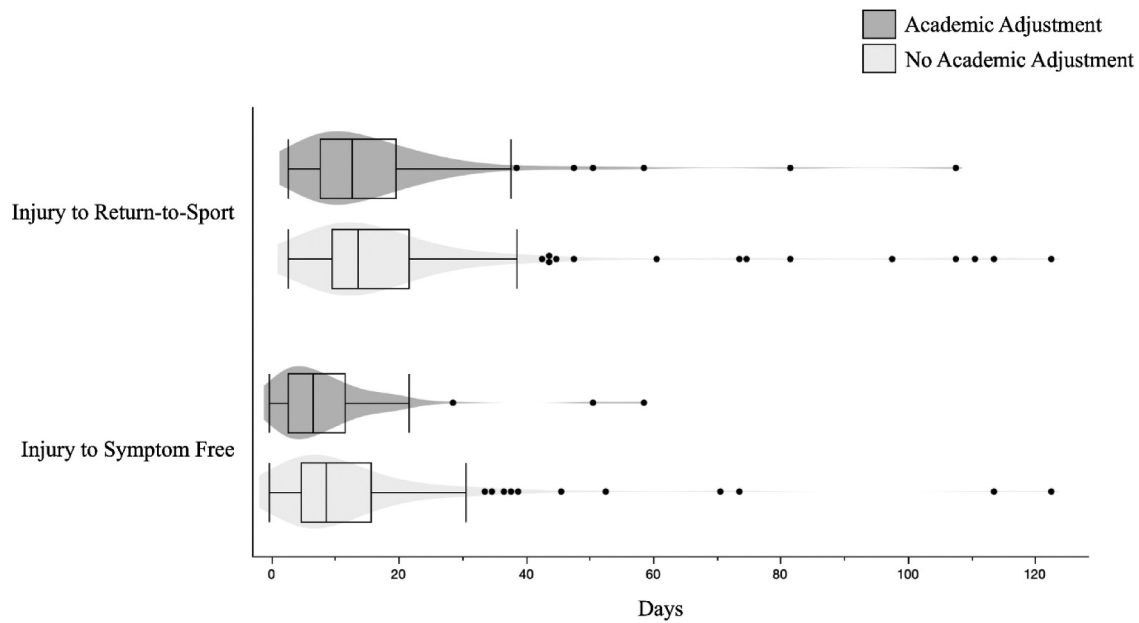


Figure 2. Violin charts of dependent variables across academic adjustments.

Although athletes with SRCs may recover without the need of academic adjustments, athletes who endorse a higher acute symptom burden (i.e., total symptom severity) are more likely to have a prolonged recovery. An increased symptom burden following an SRC may associate with difficulties in the classroom and may necessitate the need for academic adjustments (17). For example, a collegiate athlete who endorses photophobia may benefit from the adjustment from a PowerPoint presentation to printed notes. Said again, academic adjustments are symptom specific and should be prescribed on a patient-by-patient basis. Although we found statistically significant differences in days until symptom resolution between athletes who did or did not receive academic adjustments, days until return to sport was similar. A similar time period between groups for RTS is supportive of the purported clinical benefits of academic adjustments (17).

The majority of RTL literature that supports the clinical utility of academic adjustments following a SRC is based on high-school athletes (8). However, the structure of personnel at high school settings likely differs from higher education settings and, at times, is without athletic trainers. For example, 34% of surveyed secondary schools in the United States do not have an athletic trainer (18). School psychologists, who can determine student capabilities within classrooms, are often present in secondary schools and may offer an opportunity for determining academic adjustments. Offices of accessibility services at colleges and universities typically have staff who coordinate physician orders rather than execute learning assessments to determine appropriate adjustments. It is important to note that though a physician may prescribe academic adjustments, their prescription is not legally binding (19). As previously mentioned, only 66% of secondary schools in the United States have access to athletic trainers (20). In the absence of athletic trainers, schools may rely on nurses, if available, during school hours as well as physicians on an appointment basis. In contrast, collegiate athletes may have more resources, such as athletic trainers, on-campus health centers,

and physicians to refer patients to if they need additional support during recovery. Additionally, it is important to appreciate that differences in available resources may vary substantially between colleges and universities of varying sizes and levels of competition (e.g., D1 vs. D3). Despite the potential for additional resources, 37% of collegiate athletic trainers did not use mental health professionals to assist with RTL adjustments for athletes with SRC. Therefore, staffing differences between secondary and post-secondary institutions may have unique opportunities or disadvantages when implementing RTL considerations among athletes. Further research is needed to investigate recovery trajectories with collegiate athletes with variable access to RTL resources that may facilitate, or hinder, recovery from SRC.

As part of a standardized concussion management protocol, the NCAA mandates RTL considerations for athletes recovering from SRC (14). Clinicians should communicate the importance of RTL considerations, and the potential consequences of non-adherence to academic adjustments, to students and faculty alike (6). Consequences of nonadherence to academic adjustments may include decreased academic performance, reduced knowledge retention, lowered GPA, deterred graduation, and altered future academic or career trajectories. Additional resources, such as dedicated academic professionals, are necessary to implement RTL protocols and academic adjustments, as our data are suggestive that academic adjustments made during recovery from SRC may have resulted in a more typical recovery time period for collegiate athletes due to the mitigation of over-exertion and exacerbation of symptoms (21).

Academic adjustments are typically prescribed based on the unique symptom phenotype of each athlete. For example, reductions in phone and computer screen time, the use a blue-light filter option, the ability to wear sunglasses, and preferential seating may be adjustments that help athletes struggling with ocular symptoms (e.g., photophobia and blurred vision) following their SRC (22). Additional academic adjustments may include extending the time allotted



for assignments or the postponement of tests to address symptoms associated with memory and or information processes. An extension of homework or test deadlines may also reduce the anxiety associated with the accumulating coursework a collegiate student may face upon a complete recovery from their SRC (23). Scribes (i.e., notetakers) may also help injured collegiate athletes through their difficult, yet transient, periods of recovery (23). An evidence-based and multidisciplinary (i.e., athletic trainers, counselors, educators, neuropsychologists, nurses, physicians, and other stakeholders) approach should be taken for the development and implementation of RTL protocols to ensure an appropriate, individualized, RTL plan is incorporated into collegiate athletes' recovery plans.

### Limitations and further research

Our results were based on a retrospective chart review that limit drawing causal relationships. Due to our research design, variables included a dichotomization on whether or not each case of concussion received academic adjustments; however, the timing following the injury, length of implementation, type of adjustment(s) provided, and information on stakeholder oversight are unknown. Further, symptom burden was recorded at each of the 11 LIMBIC MATARS sites; however, the symptom inventory deployed among LIMBIC MATARS member institutions varied. As such, specific symptom data were heterogeneous making harmonization challenging. Site variations may also be a factor to consider when estimating date of symptom resolution among concussion cases included in this study.

Future research should aim to determine the benefits of RTL protocols. Symptom changes during RTL, alterations on collegiate athlete academic achievement, who administrates RTL protocols, and what adjustments are provided should be considered further in future research endeavors. RTL protocols have the potential to isolate athletes from teammates, classmates, staff, and/or faculty which could negatively alter recovery trajectories. Future research should investigate the possibility of isolation when athletes are removed from classrooms. In terms of recovery, the median time for reporting symptom-resolution and RTS for each group was within the typical recovery range (1). More varied and prolonged recoveries would be appropriate to determine the benefit of academic adjustments for collegiate athletes with SRC. Future research should aim to determine RTL dosage for athletes recovering from SRCs. Finally, athletic trainers self-reported the data within our study. Further research should be conducted prospectively, by investigating the impact of academic adjustments on collegiate athlete recoveries, potentially with similar premorbid and post-injury clinical presentations, to inform best practice recommendations.

### Conclusions

While days until symptom resolution were slightly longer for those who received academic adjustments, time to return to sport was similar between collegiate athletes who did or did not receive academic adjustments. Overall, our findings support academic adjustments as

a recovery facilitator for collegiate athletes for whom they were deemed necessary. Therefore, clinicians and health-care professionals should assist and support collegiate athletes after SRCs on an individual basis, including academic adjustments when deemed appropriate based on clinical presentation.

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