Potential factors influencing recovery from concussion in collegiate student-athletes

Kayla P Harvey¹, Eric E Hall², Kirtida Patel³, Kenneth P Barnes⁴ and Caroline J Ketcham²

Abstract

Background: Factors including sex, previous diagnosis of migraines, previous diagnosis of Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder, and a history of concussion may influence the length of recovery from concussion in collegiate student-athletes.

Purpose: To better understand factors that may influence recovery from concussion in collegiate-student athletes.

Methods: A total of 91 student-athletes from a Division I NCAA University who sustained concussions from the fall of 2011 to the spring of 2015 were evaluated. They were considered recovered from their concussion when neurocognitive and symptom scores returned to baseline and they were cleared by their physician. Analyses of variance were conducted to determine if potential factors influenced concussion recovery ($p < .0125$).

Results: No significant differences were found for sex (males $= 7.4 \pm 5.9$; females $= 8.3 \pm 4.8$ days; $p = 0.417$), previous diagnosis of migraines (diagnosis $= 8.0 \pm 5.7$; no diagnosis $= 7.8 \pm 5.4$ days; $p = 0.926$), or history of concussion (history $= 8.3 \pm 5.7$; no history $= 5.6 \pm 3.4$ days; $p = 0.088$). However, a significant difference in the length of recovery was found between those with a previous diagnosis of Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder and those without (diagnosis $= 13.3 \pm 7.3$; no diagnosis $= 7.3 \pm 4.9$ days; $p = 0.002$).

Conclusion: Student-athletes with Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder show significantly longer recovery from concussions than those without. Further investigation of this and other factors that influence recovery from concussion may help in concussion recovery and return-to-play guidelines that improve student-athlete well-being.

Keywords

Sex, migraine, Attention Deficit Disorder, Attention Deficit Hyperactivity Disorder, concussion history, mild traumatic brain injury

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Introduction

It is estimated that there are between 1.6 million and 3.8 million treated and untreated sports-related concussions each year in America.¹ As defined by the Zurich consensus statement, a concussion is "a complex pathophysiologic process affecting the brain, induced by traumatic biomechanical forces."² With so many sports-related concussions happening to collegiate student-athletes each year, it is important to understand how these athletes recover from concussions. Each concussion has the potential to impact the well-being and academic success of these student-athletes both immediately and long term.³ While the average length of recovery is between seven and 10 days,⁴⁵ missing classes, limiting daily activities, and being absent from practices and games for that period of time may influence the student-athlete’s well-being. By learning more about recovery from concussion and modifiers that may influence the length of recovery in collegiate

¹Department of Public Health Studies, Elon University, Elon, USA
²Department of Exercise Science, Elon University, Elon, USA
³Department of Athletics, Elon University, Elon, USA
⁴Greensboro Orthopedics, Greensboro, USA

Corresponding author:
Eric E Hall, Elon University, 2525 Campus Box, Elon, NC 27244, USA.
Email: ehall@elon.edu
student-athletes, we can better determine recovery and return-to-play guidelines that improve their well-being.

A study on high school and collegiate athletes, of both sexes and in seven different sports, found significant cognitive deficits still occurred 14 days after injury. This suggests that cognitive recovery may take longer than previously thought. Previous position statements on concussions suggest that factors such as sex, previous diagnosis of migraines, a history of concussion, as well as a diagnosis of Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder (ADD/ADHD) may influence incidence rate and recovery from concussion, but little research has examined these factors. Research on sex as a modifier of concussion recovery shows conflicting results. Some studies have shown longer recovery times in females compared to males, and other studies indicate that there is no difference in recovery time between males and females. It seems that a majority of studies examining sex and recovery from concussion focus on risk, symptoms, and cognitive scores, rather than length of recovery. Females have also been shown to be at a greater risk for Post-Concussion Syndrome than males and a meta-analysis on sex-based differences postconcussion revealed that females had a worse outcome in 17 of 20 variables.

A prior diagnosis of migraines may prolong recovery, as well as be a risk factor for concussion. The Canadian Community Health Survey found that having a prior migraine diagnosis was associated with a higher rate of sport-related concussions. In a study by Lau et al., eight out of 11 male high school football athletes who reported having a history of migraines had a classification of a complex concussion, defined as having a recovery of more than 10 days.

Similar to a previous diagnosis of migraines, a diagnosis of ADD/ADHD may influence recovery from concussion. Current research is limited, with some studies excluding athletes with ADD/ADHD from their population. Additionally, there is limited research on the effects of ADD/ADHD on concussion recovery length in collegiate athletes, as most focus on younger athletes. One study, which looked at high school athletes, found that although not significant, athletes with ADD/ADHD took an average of three days longer to recover from concussion.

Research regarding concussion history as a factor of concussion recovery has been conducted; however, these studies show conflicting results, leaving it unclear as to what effect prior concussions have on student-athletes. Numerous studies report that athletes with one to two prior concussions were not found to have a longer recovery time than those without a history of concussion. However, another study shows that recovery from concussion may be longer for athletes with a history of concussions. By having a better understanding of the factors that influence concussion recovery, return-to-play guidelines for collegiate student-athletes can hopefully be individualized, taking into account those possible factors that may prolong recovery. It is the hope that these athletes will have sufficient time to recover prior to returning to play so that the risk for additional complications such as Second Impact Syndrome and Post-Concussion Syndrome is reduced. The purpose of this study is to assess the relationship between sex, previous diagnosis of migraines, history of concussion, and previous diagnosis of ADD/ADHD and recovery length in student-athletes who have had a concussion.

Methods

Participants

The sample for this retrospective study was student-athletes who incurred a concussion during a four-year time period which ranged from the fall of 2011 to the spring of 2015 at a small, private Division I NCAA University. A total of 91 student-athletes were included in the study, with participants with a concussion lasting more than 30 days being removed from the population (n = 5). These five participants were not included because they averaged over 60 days of recovery, went past the season when concussion occurred, and because of the small overall sample size may have greatly influenced the final results. Of the 91 participants, 41 (45.1%) were female and 50 (54.9%) were male. The athletes were part of a variety of sports, including football (n = 24), volleyball (n = 8), softball (n = 8), women’s soccer (n = 7), baseball (n = 7), men’s soccer (n = 6), women’s basketball (n = 6), track and field (n = 5), lacrosse (n = 3), men’s basketball (n = 3), cheerleading (n = 2), women’s golf (n = 1), and women’s tennis (n = 1). The mean age of participants was 19.8 ± 1.3 years. The study received Institutional Review Board approval and all participants completed informed consent forms to be a part of this study.

Procedures

At the start of their collegiate athletic career, all student-athletes underwent a series of baseline assessments which included neurocognitive testing via the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT). This neurocognitive test includes six modules which results in four composite scores on verbal memory, visual memory, processing speed, and reaction time. In addition, ImPACT includes a symptom inventory with 22 items in which the participants self-reported their symptoms on this scale, determining
In regards to a previous diagnosis of migraines, five participants (5.5%) reported having a previous diagnosis of migraines. The mean length of recovery was not statistically different (see Table 1; \( F (1, 89) = 0.01, p = 0.926 \)).

Unlike sex and previous diagnosis of migraines, a previous diagnosis of ADD/ADHD did show a significant impact on recovery (\( F (1, 89) = 9.8, p = 0.002 \); see Table 1). Participants who reported having a previous diagnosis of ADD/ADHD had a mean recovery significantly greater than participants who did not report having a previous diagnosis of ADD/ADHD.

Of the 91 participants, 74 reported having had at least one previous concussion, 14 reported no history of concussion, and three participants did not provide any data on their concussion history. Although participants with a history of concussion did have a longer average recovery period, these data were not significantly different (\( F (1, 86) = 2.987, p = 0.088 \); see Table 1).

Discussion

When determining return to play from a concussion for collegiate student-athletes, it is important to be aware of individual factors, such as sex, previous diagnosis of migraines, previous diagnosis of ADD/ADHD, and history of concussion because they may influence recovery time. This study adds to the limited body of knowledge on concussion recovery in collegiate student-athletes and the data suggest that athletic trainers and physicians may need to include these factors in return-to-play decisions for individuals.

In regards to sex, the data from this study showed that although females did have a longer recovery than males, the difference was not significant. There is limited research on sex differences in length of recovery, but previous research has shown no significant difference between males and females on neurocognitive scores on ImPACT and symptoms postconcussion. Much of the research on concussion recovery has been conducted on football players, eliminating the possibility to examine sex as a factor of concussion recovery. However, other studies differ from the present study, showing that there is a significant difference between males and females in length of recovery. Though our data does not support a difference, there are many theories as to why there may be differences between males and females in days of recovery, both biological and social. Some researchers believe that females may be more likely to report symptoms or have different thresholds for reporting than males, as there is generally more stigma surrounding the need for males to be tough. Other research suggests that hormones may be a factor in concussion recovery in females, leading to more severe symptoms in females than males.
The current study did not find a significant difference in recovery from concussion in those who self-reported a previous diagnosis of migraine. A study on male high school football players found that a prior diagnosis of migraines was related to prolonged recovery from concussion. The sample size of participants with a previous diagnosis of migraine in our study was small (n = 5) which may influence the results.

The current study found that a previous diagnosis of ADD/ADHD influenced recovery from concussion. Participants with a previous diagnosis of ADD/ADHD had a significantly longer recovery, almost twice as long, as compared to participants without a previous diagnosis of ADD/ADHD. However, it should be noted that these results were based on a small sample size of concussions over a four-year time (n = 91) and only eight of these self-reported a previous diagnosis of ADD/ADHD. Although little research has been done on the effects of ADD/ADHD on concussion recovery length, a study on high school football players reported that in four athletes with a self-reported diagnosis of ADD/ADHD, three had a recovery lasting more than 10 days, as compared to only one athlete with a concussion recovery under 10 days.

There is little research on the influence of ADD/ADHD on concussion recovery, as participants with ADD/ADHD and learning disorders are often removed from studies. However, this results in very little knowledge of how concussion manifests in student-athletes with ADD/ADHD. Additionally, some of the previous studies that look at possible relationships between ADD/ADHD and concussion focus on younger populations, rather than collegiate athletes.

There may be other modifiers that are interacting with the diagnosis of ADD/ADHD, such as a history of concussion. A retrospective analysis of our data found that all of the participants in this study with a previous diagnosis of ADD/ADHD also reported a history of concussion. A study on Division-I collegiate student-athletes determined that concussions were more prevalent among student-athletes with ADHD, suggesting that further research should be done on whether ADHD serves as a risk factor for concussion.

Although there does not appear to be a clear explanation on why the rate of concussion may be higher for student-athletes with ADD/ADHD, perhaps there is a connection to the tendency for people with ADD/ADHD to take risks. One of the symptoms of ADD/ADHD is described as unnecessary risk taking. Related to concussion in athletics, this may influence how an athlete with ADD/ADHD plays. For example, a soccer player with ADD/ADHD may be more likely to head the ball without thinking through the risk component of that action than someone without ADD/ADHD. These risky decisions may be leading the student-athlete to experience more hits to the head, resulting in a higher incidence of concussion, as it is known that ADHD is common in adults with a history of concussion. Additionally, student-athletes with ADD/ADHD may be confusing their symptoms from ADD/ADHD, such as attention deficits and hyperactivity, with concussion symptoms, as it has been shown that concussion symptoms are similar to those of ADHD. This may lead these participants to take a longer time to report being asymptomatic compared to their peers without ADD/ADHD. Another explanation is that student-athletes with ADD/ADHD may have more difficulty with adhering to cognitive and physical rest, resulting in a lengthened recovery from concussion as the brain is not able to heal as quickly. Given the data on recovery from concussion being significantly longer in participants with ADD/ADHD, additional research on the subject of ADD/ADHD in collegiate student-athletes is warranted, as very little is known about this population. These data are important, as trainers and physicians need to be aware of how a diagnosis of ADD/ADHD could extend recovery time.

Although it was not statistically significant, data from the current study show that participants with a history of concussion had a longer recovery period than participants with no history of concussion. Some studies are consistent with our findings, indicating that there is no significant difference for recovery length in student-athletes with a history of concussion compared to those without. However, other studies have shown that a history of concussion led to a longer recovery after concussion.

It should be noted that there are a few limitations to our study. First, our total population was small (n = 91) and that when examining certain factors the sample size was even smaller. For example, when looking at previous diagnosis of migraine, only five participants reported having a previous diagnosis. For future research, it would be helpful to have larger sample sizes in the overall population as well as for the factor examined. Additionally, since the information we gathered on demographics is self-reported, it is possible there are student-athletes who have been previously diagnosed with migraines or ADD/ADHD or who have a history of concussion prior to the start of their collegiate career who did not choose to disclose that information in their survey. Future research should try to confirm these self-report diagnoses with physician report and examine medication history for treatment of ADD/ADHD. Finally, it was noticed that there was some crossover between variables, which may have influenced results, such as all participants who reported having a previous diagnosis of ADD/ADHD also reported a history of concussion. Due to
the small sample size in our overall population and lack of power; these interactions were not examined. However, when making return-to-play decisions it is important to consider how different factors may interact and influence the length of recovery and future research needs to continue examining potential factors which may influence concussion recovery.

Conclusion

Concussion recovery is a different and individualized experience for each student-athlete. Though not all data were found to be statistically significant, factors including sex, previous diagnosis of migraines, and ADD/ADHD, as well as a history of concussion may lead to differences in the length of recovery from concussion. These data, along with continued research, are critical to make informed and individual return-to-play guidelines for each student-athlete based on their own demographics.

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