Protracted Recovery From a Concussion: A Focus on Gender and Treatment Interventions in an Adolescent Population

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**Background:** Several studies have demonstrated that age and sex may influence concussion recovery time frames, with female athletes and adolescents being potentially more susceptible to a protracted recovery course. Currently, limited work has examined the influence sex may have on concussion management strategies and treatment interventions, especially for younger individuals suffering persistent concussion symptoms and cognitive dysfunctions.

**Hypothesis:** Female athletes are prescribed more treatment interventions than male athletes during a protracted recovery from a concussion.

**Study Design:** Descriptive epidemiology study.

**Level of Evidence:** Level 4.

**Methods:** Data were retrospectively collected for adolescent athletes presenting to a sports medicine concussion clinic between September 2010 and September 2011.

**Results:** A total of 266 adolescent athletes were evaluated and treated for concussion. Female athletes had a longer recovery course ($P = 0.002$) and required more treatment interventions ($P < 0.001$) for their symptoms and dysfunction. Female athletes were more likely to require academic accommodations ($P < 0.001$), vestibular therapy ($P < 0.001$), or medication ($P < 0.001$).

**Conclusion:** Medical providers should be aware that during the recovery course, adolescent female athletes may require a management plan that will most likely include additional treatment interventions beyond the standard cognitive and physical rest.

**Clinical Relevance:** Treatment interventions are more commonly prescribed for adolescent female athletes than for adolescent male athletes during a protracted recovery from a concussion. This highlights the need for identifying evidence-based clinical management guidelines that focus on sex, especially when dealing with persistent concussion symptoms and cognitive dysfunctions.

**Keywords:** concussion; sex; adolescent; treatment intervention
athletes may also be more likely to seek medical treatment for concussive symptoms and to honestly report symptoms when they suffer a concussion. Ultimately, sex differences in injury susceptibility and recovery time frames are most likely multifactorial in etiology and reinforce the need for an individualized management approach. In the majority of individuals, postconcussion symptoms and cognitive dysfunctions before guidelines advocate for individualized care by recommending this recovery takes only a few days and requires few individualized management approach.6,8 Multifactorial in etiology and reinforce the need for an injury susceptibility and recovery time frames are most likely. Recent management strategies. Are seeing an increase in concussion patients. Current clinical appropriate and prompt care for this injury acutely, clinicians United States, paired with a heightened public recognition of concussion for adolescent athletes. Treatment interventions included rest, academic accommodations, and medications as well as referrals to physical therapy, vestibular therapy, neuropsychology, neurology, speech pathology, and psychology. During the rest period, patients were asked to avoid the classroom environment and to refrain from participation in academic activities at home. The interventions of rest and academic accommodations were identified by school notes. Statistical analyses were conducted using SAS (version 9.3; SAS Institute). Descriptive analysis was conducted for age, sport, and treatment interventions. A single-factor analysis of variance was used to determine the differences between sex and recovery along with sex and number of prescribed treatment interventions. A univariate logistic regression with an alpha level set at 0.05 was used to determine sex and specific treatment intervention.

RESULTS

A total of 266 adolescent athletes, including 102 female athletes, who were treated for concussion during the 2010-2011 sports season met the inclusion criteria for this study (Figure 1). The average ages for female and male athletes were 14.9 ± 3.4 years and 14.3 ± 2.3 years, respectively. On average, female athletes took longer to recover from their concussions than male athletes: 75.6 ± 73.0 and 49.7 ± 62.0 days, respectively (P = 0.002). More than half the female (67.6%) and male (53%) athletes had a recovery time greater than 1 month (Figure 2).

The most commonly prescribed treatment inventions for female and male athletes were rest (95.1% and 73.2%) and academic accommodations (72.5% and 42.1%), respectively. The average number of treatment interventions prescribed during the management of a concussion was 2.2 ± 1.5 for female and 1.3 ± 1.0 for male athletes (P = 0.001). The differences in treatment interventions between sexes were significant for rest (P < 0.001), academic accommodations (P < 0.001), vestibular therapy (P < 0.001), and medications (P < 0.001). Female athletes were 7 times more likely to be prescribed rest, 3 times more likely to be prescribed academic accommodations, 8 times more likely to be prescribed vestibular therapy, and 4 times more likely to be prescribed medication over male athletes (Table 1).

DISCUSSION

To enhance the understanding of the complex interaction between sex and age on concussion recovery, this study aimed to investigate the frequency of treatment interventions.
prescribed for each sex during the management of adolescent athletes with a protracted recovery from a concussion.

The results of this study extend the understanding of persistent concussion symptoms and current management strategies in several ways. First, these results support current evidence that adolescent athletes require a greater amount of time to recover from a concussion than the traditionally quoted time frame of 7 to 10 days. The results also showed that adolescent female athletes were more likely to require additional treatment interventions beyond the standard cognitive and physical rest. This emphasizes the need for an individualized management plan for an athlete recovering from a concussion.

Physical and cognitive rest is the cornerstone of concussion management. Those suffering from a concussion are recommended to rest from activities that exacerbate concussive symptoms. In our cohort, nearly all female athletes and the majority of male athletes were prescribed a period of rest after their concussions. Although rest was the most commonly prescribed treatment for each sex, a difference was found in the number of female athletes prescribed a period of absolute rest.
from academic and physical activities compared with male athletes. Female athletes often report a greater number of symptoms after a concussion and have greater declines in cognitive function than male athletes.\(^5\) Given the potential impact of these concussive symptoms and cognitive impairments on academic activities, it is possible that medical providers are more likely to initiate a period of absolute rest for female athletes as compared with male athletes.

Unfortunately, there is currently no standard length of rest an individual will require after a concussion. However, in most patients, there is a point where the clinical benefits of rest are outweighed by the side effects caused by the lack of activity and social interactions. At this stage, the treating provider should alter a patient's treatment to address the current concussive symptoms while avoiding the negative side effects that may further delay recovery.

When a student is absent for an extended period of time, there may be a certain level of stress and anxiety about integrating back into the classroom environment.\(^3\) Students may become overwhelmed with trying to balance the normal workload of their classes with the additional task of completing the missed assignments during their absence. Approximately 6.3% of healthy adolescents have positive generalized anxiety disorder screens\(^11\) and may experience subclinical anxiety concerns over academics, social acceptance, and emotional difficulties,\(^16,17,34\) with many of these symptoms beginning as early as age 11 years.\(^21\) A disproportionate number of healthy adolescent female athletes, as compared with healthy adolescent male athletes, commonly express concerns about trouble sleeping, feeling tired, and being stressed out\(^15\) among other anxiety symptoms.\(^16\)

This study showed that female athletes with concussions were 3 times more likely than male athletes to be prescribed academic accommodations for their transition back into the classroom after a period of absolute rest. Therefore, it appears that female athletes may be more likely to need the security of academic accommodations to help ease potential anxiety or stress over missed assignments and incomplete grades. Although the exact accommodations prescribed were not collected as part of this study, they commonly range from simple adaptations such as assignment deadline extensions to aggressive modifications of the academic environment such as accommodations for light and noise sensitivity. In certain situations, the use of a tutor or implementation of a temporary action strategy that addresses the student's current cognitive disabilities\(^18\) (504 plan) may be required in the event of a prolonged absence from the classroom.\(^35\)

Vestibular and visual dysfunctions have been identified in concussed individuals\(^1,2\) with persistent symptoms of dizziness, imbalance, headaches, and nausea commonly provoked by repetitive eye movements during reading activities, note taking, or riding in a car. Although dizziness is a commonly reported symptom in the acute phase of a concussion,\(^15,28\) dizziness during the on-field assessment of a concussion is an identifier of a protracted recovery course.\(^25\)

Vestibular therapy has been implemented in patients with chronic symptoms during activities of daily living after head injuries.\(^1,2,20\) In this study,\(^1\) female athletes were 8 times more likely to be prescribed vestibular therapy. Therefore, female athletes may be more susceptible than male athletes to vestibular or visual dysfunctions during their concussive episodes. These results may be limited by the lack of consideration of severity of postconcussion symptoms, which may have influenced the medical provider's decision to prescribe such treatments. Unfortunately, little is known about the relationship of vestibular and visual dysfunctions to concussions as well as the appropriate time during the recovery course to implement therapeutic exercises. Cervical strains and whiplash injuries can present with similar symptoms of headache, dizziness, nausea, and visual dysfunction.\(^12,38\)

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**Table 1. Number of patients who were prescribed each treatment intervention during the management of their concussion**

| Intervention/Referral | Male Patients (N = 164) | Female Patients (N = 102) | Odds | CI | P |
|-----------------------|------------------------|---------------------------|------|---|---|
| Rest                  | 120                    | 97                        | 7.11 | 2.71-18.6 | <0.001 |
| Academic accommodations | 69                     | 74                        | 3.63 | 2.13-6.21 | <0.001 |
| Vestibular therapy    | 9                      | 33                        | 8.23 | 3.7-18.1 | <0.001 |
| Medications           | 10                     | 22                        | 4.23 | 1.91-9.37 | <0.001 |
| Physical therapy      | 5                      | 8                         | 2.70 | 0.86-8.51 | 0.080 |
| Neuropsychology       | 3                      | 10                        | 5.83 | 1.56-21.7 | 0.009 |
| Neurology             | 0                      | 6                         | —    | —    | 0.984 |
| Speech pathology      | 2                      | 2                         | 1.62 | 0.23-11.68 | 0.632 |
| Psychology            | 0                      | 1                         | —    | —    | 0.986 |
To date, there has been little evidence to support medication usage to help correct the pathophysiologic processes that occur from trauma-induced biomechanical forces and thus shorten recovery times for a concussion. Since there is a limited role of over-the-counter medications for management of cognitive or somatic symptoms, medications are typically used to control significant or persistent symptoms. Melatonin may be a useful over-the-counter medication for sleep initiation in conjunction with sleep hygiene counseling. The off-label benefits of some prescription medications are options for managing somatic and cognitive symptoms as well as sleep alternations. These medications should only be considered for those with prolonged recovery and functional deficits due to specific symptoms, as medications may preclude a return to physical activity. The concussed individual should be symptom free prior to progressing through a graded return to physical activity.

This study has several limitations, including the interpretation of clinical notes, missing charts, unrecorded information, and incomplete documentation. In addition, clinical outcomes were not used during the management of this injury to determine the effectiveness of each prescribed treatment intervention. It is possible that individually prescribed interventions did not improve the individual’s symptoms or dysfunctions and therefore additional interventions were applied to the management plan. Last, although statistically significant differences were found between sex and recovery as well as sex and treatment intervention, this study did not evaluate injury severity. It is possible that female athletes had more severe concussions than male athletes, which could explain the additional treatment interventions prescribed during the management of their injury.

CONCLUSION

Adolescent athletes may be susceptible to a protracted recovery course from a concussion. Persistent symptoms and chronic cognitive dysfunctions can impact an adolescent athlete recovering from a concussion. Young female athletes may require an individualized treatment plan that will most likely contain additional treatment interventions outside of the standard cognitive and physical rest.

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