The Effect of Concussions on Academic Performance, Balance, and Reaction Time

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Research Question

For patients who have experienced a concussion or traumatic head injury, are there greater deficits in academic performance, reaction time, and balance compared to those patients who have suffered a bodily injury or not suffered a concussion or traumatic head injury?

Purpose

This project is a review of the literature of the impairments associated with concussions. The purpose is to determine the impact of concussions relative to academic performance, balance, and reaction time. Additionally, this project compares the symptoms of those with a traumatic head injury to the symptoms of those who have not experienced a traumatic head injury.

What is a Concussion?

A concussion is defined as a mild traumatic brain injury that occurs when there are forces to the head which cause the brain to move rapidly back and forth. Some common symptoms of a concussion include cognitive, somatic, affective, and sleep impairments. Onset of these symptoms can be immediate or delayed, and the effects can be temporary or long lasting. Nearly 4 million concussions occur each year in the US due to sports, with about 300,000 occurring between the ages of 14-19. Concussion in an athlete can often go unnoticed, and an early return to sport may put them at a higher risk for greater long term damage.

Materials and Methods

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<th>Authors</th>
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<td>Williams RM, Puetz TW, Giza CC, Broglio SP</td>
<td>Concussion recovery time among high school and collegiate athletes: a systematic review and meta-analysis.</td>
<td>The purpose of this review was to compare the recovery time of high school and collegiate athletes following a concussion.</td>
<td>Subjects of this study were high school and collegiate athletes that were concussed during a sporting event. The number of recovery days was variable, and recovery was described as a return to a asymptomatic state by either self-report or neurological tests that were taken at baseline.</td>
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<td>Wasserman E, Bazarian J, Mapstone M, Block R, van Wijngaarden E</td>
<td>Academic dysfunction after a concussion among US high school and college students.</td>
<td>The purpose of this study was to determine if concussed collegiate and high school students experienced greater academic dysfunction than either collegiate and high school athletes who experienced extremity and non-head related injuries.</td>
<td>Students in both college and high school who reported to one of three emergency departments in the Rochester, NY area (70 students with a concussion, 108 students with extremity injuries).</td>
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<td>Basford JR, Choi L-S, Kaufman KR, Brey RH, Walker A, Malen JL, Moore AM, Brown AW</td>
<td>An assessment of gait and balance deficits after traumatic brain injury.</td>
<td>This study aimed to determine the presence of balance deficits and sensation of instability following a diagnosed mild traumatic brain injury (TBI)/concussion.</td>
<td>Twenty subjects were obtained including 10 participants with TBI/concussion, 10 participants without reports of a concussion. Ages ranged from 18 to 65 years old.</td>
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<td>Eckner J.T., Kitcher J.S., Broglio S.P., &amp; Richardson, K</td>
<td>Effect of sport related concussion on clinically measured simple reaction time.</td>
<td>The purpose of this study was to determine the effect of concussion on a simple clinical test of reaction time, and to determine the sensitivity and specificity of that test for concussion.</td>
<td>Subjects included multiple sport athletes at two universities and one high school. 26 sustained one concussion, 2 sustained two concussions, and 28 sustained no concussions during the season.</td>
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Results

1. In the meta-analysis by Williams et al, it was found that collegiate athletes noted self-reported symptom recovery after 6 days, while high school athletes noted self-reported symptom recovery after 15 days post concussion. In addition, the review indicated a cognitive recovery delay in each group after 5 and 7 days respectively. Regardless of age, a decrease in cognitive function was shown directly following a concussion.
2. Wasserman et al reported a greater amount of academic dysfunction in the population that experienced a concussion compared to the population that experienced an extremity injury at 1-week post-injury. Additionally, neither group reflected a statistically significant difference in academic dysfunction at 1-month post-injury. The authors concluded that those most susceptible to academic dysfunction are females who have experienced multiple concussions.
3. Basford et al reported that their evidence suggests that deficits in balance and gait stability may be due to neurologic and sensory deficits of the vestibular system following a concussion. Additionally, through gait assessment, data indicated that subjects with a concussion exhibited a decrease in sagittal plane motion to maintain balance. Furthermore, they demonstrated impaired balance control in the frontal plane, similar to that of previously reported balance-impaired elderly adults.
4. Eckner et al found that all study participants had similar baseline scores for reaction time at the start of the season. At the end of the season, the control group demonstrated a trend toward shorter reaction times than during the preseason test. However, the athletes who sustained a concussion during the season had significantly greater reaction times 48 hours after the injury occurred.

Graphical Data

This graph provides a comparison between anterior to posterior and medial to lateral translation during ambulation in both the control subjects and subjects with concussion. The dark bars portray individuals with concussions and the light bars depict the control subjects. The most notable result is that individuals with concussions ambulate with a greater medial to lateral translation than those without concussion.

Conclusions

Based on a review of the literature, concussions have a negative effect on academic performance, balance, and reaction time. Limitations to concussion studies exist due to variability in symptoms onset presentation, and severity. Additionally, a majority of studies concerning concussion are performed retrospectively due to variability of diagnosis and availability of concussed subjects. Most studies available also focus on concussion symptoms in the short-term rather than long term impact.

Future Research

Future research should examine the effects of concussions in the long-term. Additionally, research should continue to focus on effective treatment of concussion symptoms and post-concussive symptoms, as well as accurate diagnosis and return-to-play guidelines.

References