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.

Results

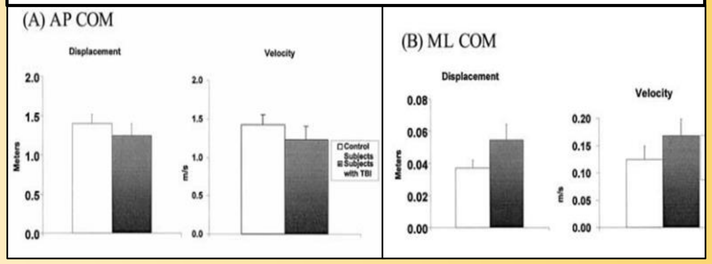
1. In the meta-analysis by Williams et al, it was found that collegiate athletes noted self-reported symptom recovery after 6 days, while high school athletes noted self-reported symptom recovery after 15 days post concussion. In addition, the review indicated a cognitive recovery delay in each group 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 researched 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.

Materials and Methods

Authors	Purpose	Subjects	Methods
Williams RM, Puetz TW, Giza CC, Broglio SP Concussion recovery time among high school and collegiate athletes: a systematic review and meta-analysis.	The purpose of this review was to compare the recovery time of high school and collegiate athletes following a concussion.	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 an asymptomatic state by either self-report or neurological tests that were taken at baseline.	The review was conducted with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A meta-analysis of six studies comprised of 702 high school and collegiate athletes. The primary moderator analysis included three variables of age, concussion measure and age x measure interaction.
Wasserman E, Bazarian J, Mapstone M, Block R, van Wijngaarden E Academic dysfunction after a concussion among US high school and college students.	The purpose of this study was to determine if concussed collegiate and high school students experienced greater academic dysfunction than other collegiate and high school athletes who experienced extremity and non-head related injuries.	Students athletes in both college and high school who reported to one of three emergency departments in the Rochester, NY area. (70 students with a concussion and 108 students with extremity injuries).	Researchers performed a prospective cohort study and asked patients to self report their level of academic dysfunction using a 29 statement, 174 point questionnaire. Statements were based on symptoms relative to general performance, attention, and symptom exacerbation. Students completed this questionnaire at 1-week and 1-month post-injury. Patients were also asked to provide information about presence of concussion sequelae, demographics, and other premorbid characteristics.
Basford JR, Chou L-S, Kaufman KR, Brey RH, Walker A, Malec JF, Moessner AM, Brown AW An assessment of gait and balance deficits after traumatic brain injury.	This study aimed to determine the presence of balance deficits and sensation of instability following a diagnosed mild traumatic brain injury (TBI)/concussion.	Twenty subjects were obtained through physician referral: 10 participants 3 months post-concussion, and 10 participants without reports of a concussion. Ages ranged from 18 to 65 years old.	Subjects were administered a variety of neuropsychometric tests to determine learning and retention, cognitive flexibility, and processing speed. Researchers administered several clinical tests including but not limited to: Tinetti Balance Assessment, Dizziness Handicap Inventory, Dix-Hallpike Test, Caloric Irrigation, Optokinetic Testing, Pure-tone hearing test, and computerized dynamic posturography. Gait was assessed using motion analysis to observe deviations due to balance deficits.
Eckner, J. T., Kutcher, J. S., Broglio, S. P., & Richardson, J. K Effect of sport related concussion on clinically measured simple reaction time.	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 concussions.	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.	Researchers performed a clinical test of reaction time by dropping an 80 cm measuring stick with a weighted rubber disk through the hand of the athletes. The distance the stick fell before being caught was recorded and reaction time was calculated. This test was performed during a preseason exam and 48 hours after injury or at the end of the season.

Graphical Data

Figure 1. Graph depicting results from Basford et al[3]



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 recovery 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

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