

Introduction

Concussions are a problem many athletes will confront at least once in their athletic career. This can have an impact on the education they need for when their career is over and they find a new field in which to work. While there is an ever-growing body of research on individuals with concussions, most of the literature focuses on immediate (days to weeks) or long-term (10+ years) consequences. A relatively small portion of this literature has looked at the effects between these time periods. Given that many high school athletes suffer concussions, it is important to see if college academic performance is influenced. By investigating potential deficits in academic performance among those who have suffered at least one concussion, we can determine if special interventions are needed and provide student athletes with better information about concussion risks.

Methods

Participants

- Students at Austin College who were enrolled in a psychology course and/or were varsity athletes were invited to participate in an experiment of academic performance.
- For the survey portion of the study, there were 211 students (77.7% female) enrolled in a psychology course at Austin College who chose to respond (response rate = 52.6%).
- The mean age of the participants was 19.56 ($SD = 1.83$). Of the participants, 55 (26.1%) reported suffering at least one concussion. The average time since their last concussion was 4.00 ($SD = 4$) years.
- The average cumulative GPA of the sample was 3.29 ($SD = 0.50$).
- For the lab portion of the study, 37 of the 211 students volunteered to participate (17.5%).
- All participants were given extra credit in their psych classes for volunteering their time to take the survey. More credit time was given to those who participated in the lab portion

Procedure

- The survey collected information regarding cumulative GPA, concussion history, and attitudes toward head injuries. The lab testing assessed four components of academics: verbal memory, processing speed, verbal reasoning, and delayed recall
- For the lab portion of the study:
 - Verbal memory and delayed recall were assessed using the Verbal Selective Reminding Test (VSRT; Levin, Benton, & Grossman, 1982). Processing speed was assessed using a timed series of math equations. Verbal reasoning was assessed using practice GRE questions.
 - Participants were divided into two comparison groups: *Negative for Concussions* or the *Positive for Concussions* based on their response to the survey question regarding number of previous diagnosed concussions.
 - First, participants were given an informed consent sheet describing the testing procedure. Then, the VSRT was administered, followed by the math equations and practice GRE questions. Finally, participants were asked to recall the words from the VSRT one last time.

Results

Symptoms

- Participants who reported they had suffered a concussion were asked to select any Post-Concussion Symptoms (PCSs) they experienced in relation to the head injury.
- Headaches were the most commonly reported PCS with 96.3% of the 55 who suffered at least one concussion.
- Another common symptoms was dizziness which was reported by 89% of the participants.
- Participants reported the following symptoms: drowsiness (49%), sensitivity to light and/or sound (65.4%), difficulty concentrating (61.8%), irritability (41.8%), blurred vision (45.4%), nausea (36.3%), and loss of consciousness (23.6%).

Attitudes

- Participants who reported they had suffered a concussion were asked whether or not they agreed with the following statements:
 - "I have a harder time concentrating since suffering a concussion" – 35.1% agreed.
 - "I have to study harder since suffering a concussion" – 33.3% agreed.
 - "I am more cautious about head injuries when competing since suffering a concussion" – 72.2% agreed.
 - "I am fully educated about concussions" – 77.8% agreed.

Inferential Statistical Analyses

- An independent samples t -test showed there was a significant effect of suffering a concussion on cumulative GPA [$t(187) = -2.29, p = .02$], such that those without a history of concussion ($M = 3.34, SD = 0.49$) had higher GPAs than those with a history of concussion ($M = 3.15, SD = 0.53$).
- Independent samples t -tests showed no significant differences on any of the lab test scores between those who had suffered at least one concussion and those who had not (see Table 1). In delayed recall, however, the effect size was $d = 0.47$ [$t(24) = 1.17, p = .25$].

Table 1.
Independent Samples t-test between Positive or Negative for Concussion History on Lab Test Variables (n = 26).

Test	Positive		Negative		t	p
	M	SD	M	SD		
Verbal Memory	97.72	28.82	110.87	20.97	1.35	.19
Processing Speed	41.55	14.83	36.86	15.10	-0.79	.44
Verbal Reasoning	13.18	5.04	15.20	7.09	0.81	.43
Delayed Recall	8.55	3.39	9.66	1.23	1.17	.25

Results (cont.)

- To further analyze why the results turned out this way, we ran a linear regression analysis (see Table 2) to determine whether the number of diagnosed concussions (rather than any history of concussions) was a predictor of cumulative GPA when controlling for age and gender. The results showed concussions to be a significant predictor for cumulative GPA [$b = -0.08, t = -2.65, p = .008$], though the model did not account for much of the variance in cumulative GPA ($R^2 = .04$).

Table 2.
Regression Analysis Predicting Cumulative GPA from Number of Concussions Suffered, Age, and Gender (n = 190).

Variable	b	SE	β	t	p
Constant	3.48	0.51		6.84	< .001
Number of Concussions	-0.08	0.03	-0.19	-2.65	.008
Age	-0.01	0.03	-0.03	-0.39	.70
Female	0.06	0.09	0.05	0.65	.52

Note. $R^2 = .04$.

Conclusions

Findings

- We found that even at a competitive liberal arts college, a history of suffering concussions is related to academic performance. According to our research, each concussion suffered is associated with a 0.08 decrease in GPA. While a single concussion may not make a large impact, those with multiple concussions would be predicted to have bigger effects.

Limitations

- One limitation of the research is the self-report nature of concussion history. This is problematic because participants may over or under estimate the number of concussions they have actually suffered.
- There was no measurement tool to report the severity of each individual's concussion(s). The effects of one very severe concussion may have similar effects to multiple less severe concussions.
- Another major limitation of this study is the sample size being limited to the Austin College campus. The recruiting process was difficult because not many students volunteered to participate in the lab testing portion of the study.

Recommendations

- In future research, it would be best to use measurements that have been used previously and have been examined for reliability.
- It would be interesting to include a biological aspect of psychology and be able to physically examine how the brain changes and recovers after injury.
- Also it would be interesting to look at how multiple concussions have an effect on the brain versus one and no concussions.

References

Levin, H. S., Benton, A. L., & Grossman, R. G. (1982). *Neurobehavioral consequences of closed head injury*. New York: Oxford University Press.