MIM JOURNAL 2022 illuminate your work
Made in Millersville Journal | www.mimjournal.com

The Relationship Between the Number of Concussions and Cognitive Decline

Shannon O'Loughlin

Abstract

Concussions are a leading cause of neurological disorders and cognitive limitations. Athletes most commonly experience concussions and tend to present with the most decline; however, non-athletes are susceptible as well. Much of the literature focuses on cognitive function at the time of injury, or just following recovery. This study aims at assessing cognitive function in those with a history of concussions years after recovery; as well as latency between concussions, the age of first exposure and multiple impacts versus only one. This study hypothesizes (a) that the number of concussions acquired will negatively correlate with cognitive function, and (b) those with a history of one or more concussions prior to age twelve will perform more poorly on neuropsychological assessments than those with a history of one or more concussions after the age of twelve. Thirty participants were asked to complete six neuropsychological assessments and answer a demographic questionnaire. Each test was tested one time. The results showed no correlation between the number of concussions acquired and cognitive function. Given no participant reported a concussion prior to age twelve, there was not enough power to analyze the second hypothesis. The conclusions of this study suggest no correlation between the number of concussions and cognitive decline, however there are differences in the literature.

Concussions, a mild traumatic brain injury (mTBI), are one of the most common neurological disorders and are a leading cause of long-term disability in persons under the age of 45 (Clarke et al., 2012). Long-term issues in cognitive abilities and behavior are believed to be associated with multiple concussions. As cited in Iverson et al. (2004) Collins et al. found that American college football players with a history of two or more concussions performed more poorly on multiple measures for information processing compared to athletes with no previous concussions.

Pearce et al. (2018) presented data on former rugby players who showed slower reaction time in dexterity and visuomotor tests, as well as poorer cognitive performance. These assessments were done nearly twenty years post-concussion; therefore, the data provide evidence for long-term sequelae for individuals with a history of multiple concussions in contact sports.

As of 2019, approximately 65% of all pediatric concussions were reported as resulting from sport involvement (Moore et al., 2019) Long-term effects of pediatric concussions are inconclusive, and controversial. An argument is that the age of first exposure (AFE) may be a modifier of cognitive deficits in later-life (Alosco et al., 2017). Data from Stamm et al. (2015), suggested that NFL football players who sustained a concussion before the age of 12 scored worse on all measures of cognition relative to players who obtained a concussion at age 12 or older. Since brain and neuron development are at their peaks, children and adolescents are at a higher risk of damaging neurons and later presenting with cognitive dysfunctions (Stamm et al., 2015). These impairments may not be noticeable until early adulthood where environmental changes require cognitive skills associated in brain regions that failed to fully develop.

This study aims to address these gaps in individuals after recovering from a concussive event. The researcher hypothesizes that (a) the relationship between the number of concussions and cognitive performance on standard neuropsychological tests would depict a negative correlation, and (b) there is a significant difference in cognitive abilities between concussions acquired before the age of twelve and individuals who acquired a concussion after the age of twelve.

Method: Sample

Thirty participants were recruited via email signups forwarded by professors. Participants were undergraduate students at Millersville University between the ages of 18 and 30. Participants who indicated a history of concussions had to have their last concussion at least three months prior to this study. Any psychological conditions such as learning disorders, intellectual disorders, or any neurological conditions were also excluded from this study.

Materials

This study utilized six neuropsychological assessments found through the APA website and included: Numerical Memory, a comparison of short-term memory for digits presented in auditory versus visual formats. Associated Memory Test, a task associated with learning through reading or visual images. Self-Reference, depth of processing was measured in this task. Reaction Time Color, the measure of this task was reaction time reliability when making slightly different decisions. Lexical Decision, decision making skills were measured in this task. Line Motion, this task relates to visual processing and perception.

Procedure

Due to the COVID-19 pandemic, this study was completed online. A welcome email was sent from the researcher to each participant ten minutes prior to their test time. The email provided a brief overview and informed consent. Once the researcher received a signed informed consent, an instructional email was sent. A demographic questionnaire was attached and instructed to be completed after the neuropsychological assessments. To save the data securely, participants were given a class ID to input before beginning each neuropsychological assessment. Each participant completed the same six neuropsychological assessments, but in a different order decided by a Latin Square. Once all six assessments were completed, participants filled out the questionnaire and emailed it to the researcher, ending their participation in this study. A debriefing email was sent thereafter.

Results

Descriptive statistics and correlational analysis were used in this study. All three groups (control, one previous concussion and two or more previous concussions) were analyzed by their composite Z scores at 0.05 alpha. A weak to moderate correlation was found $r(28) = -3.5$, $p = .01$. Significant differences were found between the mean scores of cognition in those with a concussion history compared to those without. Due to a sample size of 8 participants with histories of concussions, and none reporting a concussion prior to age twelve, the second hypothesis could not be studied.

Conclusion

This study aimed at closing gaps in the literature regarding long term effects of concussions. Previous research focuses on the immediate effects of concussions such as symptoms experienced, length of recovery time, and what the brain looks like at the time of injury. This study was unique in that it focused on cognitive function long after a concussion has recovered. Future research should aim to continue filling in these gaps in concussion literature. A main focus should be obtaining larger and more evenly distributed sample sizes to yield more valid results.

Limitations

Online testing prompted several issues with testing delays, or a participant being unable to complete a test. Another limitation was the population. Many students denied participation to protect their medical history, especially student athletes. A third limitation was the sample size. Because of this, the data may show a significant difference or a stronger correlation than what truly exists.

References

Alosco, M. L., Kasimis, A. B., Stamm, J. M., Chua, A. S., Baugh, C. M., Daneshvar, D. H., Robbins, C. A., Mariani, M., Hayden, J., Conneely, S., Au, R., Torres, A., McClean, M. D., McKee, A. C., Cantu, R. C., Mez, J., Nowinski, C. J., Martin, B. M., Chaisson, C. E.,…Stern, R. A. (2017). Age of first exposure to American football and long-term neuropsychiatric and cognitive outcomes. *Translational Psychiatry*, *7,* (e1236).

Clarke, L. A., Genat, R. C., & Anderson, J. F. I. (2012). Long-term cognitive complaint and post-concussive symptoms following mild traumatic brain injury: The role of cognitive and affective factors. *Brain Injury*, *26*(3), 298-307. Doi: 10.3109/02699052.2012.654588

Iverson, G. L., Gaetz, M., Lovell, M. R., & Collins, M. W. (2004). Cumulative effects of concussion in amateur athletes. *Brain Injury*, *18*(5), 433-443. Doi: 10.1080/02699050310001617352

Moore, R. D., Sicard, V., Pindus, D., Raine, L. B., Drollette, E. S., Scudder, M. R., Decker, S., Ellemberg, D., & Hillman,C. H. (2019). A targeted neuropsychological examination of children with a history of sport related concussion. *Brain Injury*, *33*(3), 291-298. Doi: 10.1080/02699052.2018.1546408

Pearce, A. J., Rist, B., Fraser, C. L., Cohen, A., & Maller, J. J. (2018). Neurophysiological and cognitive impairment following repeated sports concussion injuries in retired professional rugby league players. *Brain Injury*, *32*(4), 498-505. Doi: 10.1080/02699052.2018.1430376

Stamm, J. M., Bourlas, A. P., Baugh, C. M., Fritts, N. G., Daneshvar, D. H., Martin, B. M., McClean, M. D., Tripodis, Y., & Stern, R. A. (2015). Age of first exposure to football and later-life cognition impairment in former NFL players. *American Academy of Neurology*, *84*, 1114-1120.