Researching Effects of Repetitive Subconcussive Impacts in Sports

Sahib Lohcham

INTRODUCTION

In recent years, many questions and studies have come to surface regarding brain damage in sports. As more concerns were being raised, more studies began to take place. As a result, many studies have proven that years of subconcussive impacts can accumulate into something detrimental that may cause issues for an athlete in the future. The world has seen many examples regarding this with sports like football, boxing, MMA and etc. In soccer, the use of heading is a popular technique to strike the ball. When one cannot reach the ball with any other body part, the use of heading is the most favoured technique. Similar to the concerns about constant subconcussive impacts in boxing, football and other major contact sports, more people are starting to question whether heading in soccer can lead to future neurological problems. The first step is to determine whether repetitive subconcussive impacts involving heading can have an effect on the brain's cognitive functions. The goal here is to study and analyze the effects of repetitive heading on the brain's cognitive functions.

HYPOTHESIS

When looking at many studies with sports like football and boxing, we can clearly observe the structural changes in the brain. Studies reported changes in white matter microstructure, decreased cortical volume, and cortical thinning. Furthermore, in interviews, many former athletes have shared their problems and ordeals that are consequences of repetitive blows to the head. Even though this study is observing effects on the brain's cognitive function on a short term basis and most evidence is about the long term effects, I believe the repetitive heading will have an effect on the brain's cognitive functions.

MATERIALS

1. Soccer ball
    a. Size five
    b. Inflated to 8.5 - 15.6 psi
2. Computer
3. Stopwatch

PROCEDURE

The study is using a pre-post design. This means that measurements will be taken before and after the stimulus has been applied. The stimulus is the heading of a soccer ball. The reaction time, memory and concentration tests will have links and information about them down below in the references. The step involving the ball being kicked to the subject was designed to emulate a corner kick in a game scenario. Corner kicks that did not receive head impact were not counted. Both participants had experience with the game of soccer. Proper heading techniques were utilized.

1. Measure time on the concentration test involving numbers and letters and average the times. Read through as fast as you can
2. Measure reaction time in three trials and average the times.
3. Measure number, verbal, and visual memory and average the scores.
4. Measure time on the concentration test involving words and colours three times and average the times. Read through as fast as you can
5. Head the ball 30 times at game speed (have it kicked to the subject)
6. Rest for 3 minutes.
7. Repeat steps 1-4
8. Compare the pre-stimulus and post-stimulus scores to draw conclusions.

DATA

Test	Pre-stimulus	Post-stimulus
Concentration (numbers and letters)	Trial 1 - 24.52 Trial 2 - 19.86 Trial 3 - 22.44 Average - 22.27	Trial 1 - 27.91 Trial 2 - 24.95 Trial 3 - 24.78 Average - 25.71
Reaction Time	Trial 1 - 249 ms Trial 2 - 260 ms Trial 3 - 253 ms Average - 254 ms	Trial 1 - 261 ms Trial 2 - 283 ms Trial 3 - 274 ms Average - 273 ms
Memory	Number memory - Level 12 Visual memory - Level 11 Verbal Memory - 129 points Average - 50.66	Number memory - Level 11 Visual memory - Level 9 Verbal Memory - 50 points Average - 23.33
Concentration (words and colours)	Trial 1 - 20.75 Trial 2 - 19.55 Trial 3 - 19.61 Average - 19.97	Trial 1 - 22.52 Trial 2 - 20.76 Trial 3 - 22.60 Average - 21.96

RESULTS AND ANALYSIS

When comparing the pre-stimulus and post-stimulus results, there is a perceivable difference in some fields. The first test involving concentration with numbers and letters was three seconds slower as seen above. There is a slight difference in reaction time too along with memory and concentration involving words and colours. The only major difference is perceived in verbal memory. These slight changes may be explained by the fact that with proper heading technique practiced, the ball strikes the frontal lobe of the brain. The frontal lobe acts as a control panel for our bodies. It is responsible for things like motor function, problem solving, spontaneity, memory, language, initiation,

judgement, impulse control, and social and sexual behaviour. In the frontal lobe is something called the prefrontal cortex. The prefrontal cortex is located at the very front of the brain. Two main functions of this area are complex cognitive behaviour and short term memory. Now when looking at the experiment, we can see that when heading the ball, it strikes the frontal lobe (specifically prefrontal cortex). Realizing the functions of the frontal lobe and prefrontal cortex, it makes sense that there are slight differences in the brain's cognitive functions when comparing post-stimulus and pre-stimulus results, Despite there being changes, the changes are only slight except for verbal memory. Saying this, I'm not quite sure why there was a greater effect on verbal memory rather than visual or numerical. Further consultation with an expert is needed. Adding on, many other studies have also reported a drop in verbal memory results after heading. Future research and experimentation should study these effects with a larger group of participants, with greater ball speed, try to emulate game-like scenarios, and also study changes in brain structure rather than just changes in cognitive functions. A greater number of participants would also allow for comparisons between males and females.

CONCLUSION

In conclusion, slight differences between the pre-stimulus and post-stimulus results were observed. The only major difference was observed in verbal memory. These results may be explained by the fact that the ball was striking the frontal lobe which is responsible for cognitive behaviour and decision making. Further studies should experiment with a greater number of participants to allow for comparisons between male and female participants. Also, experimentation with ball speed and game-like scenarios would further enhance the research project. Lastly, changes in brain structure should be explored too with an MRI.

Errors

- Lack of participants
    - Covid-19 restriction
- Lack of equipment
    - Can't see structural changes in the brain
- Lack of time
    - To really see changes, this must be explored over a long term. Such as a full soccer season with check-ins throughout. Other studies have highlighted that these short term changes disappear within twenty-four hours. When looking at research with sports like football, it studies the long term effects and how conditions like CTE develop. In this study's case, a study that takes place over the course of multiple years would reveal a lot of new information.

REFERENCES

Tools for Testing

https://www.readersdigest.ca/health/healthy-living/test-your-concentration/ - colours and words

https://docs.google.com/document/d/1xbV4O9-woE6bStL67GhFas7ra2eNQCLJoYrNuxquyr4/edit?usp=sharing - concentration test -> letters and numbers

https://humanbenchmark.com/ - memory and reaction time

Works Cited

https://docs.google.com/document/d/1PbHjMRD97Qsizum0xGyEPgx79Tokykg3EG0hmisZbnw/edit?usp=sharing