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**Development and Preliminary Testing of the Concussion Assessment  
Web App Tool**

**by**

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## Abstract

**Introduction:** Identifying and monitoring the resolution of cognitive impairment following sport-related concussion and providing objective information for clinical return-to-play decisions is crucial, particularly for contact sports. Many concussion symptoms do not appear immediately, and the sports person would need to be monitored and re-tested over time, however most sport teams do not have the luxury of readily available medical staff. Therefore, this study presents the process of developing a novel web-based neuropsychological test battery App for concussion, and the subsequent determination of sensitivity, reliability, and repeatability as a first step in validity and reliability testing.

**Subjects and design:** Neuropsychological baseline data was collected on 11 healthy male volunteers (mean age =  $22 \pm 2.5$  years). Repeat data was collected pre- and post-fatiguing exercise for sensitivity, and further tests for diurnal variation included three daily repeat assessments (morning:  $0700 \pm 2$  h; afternoon;  $1400 \pm 2$  h; evening:  $1900 \pm 2$  h) over a five-day period.

**Measurements:** The administration of the Concussion Assessment Web-App tool (CAWA) included six tests as a part of a test battery. These included concussion red flag questions, a self-report inventory of neuropsychological symptoms; The Concussion Symptom Inventory (CSI), as well as a series of four cognitive sub-tests: Simple Reaction Time, Complex Reaction Time, Digit Span Backwards, and Auditory Reaction Time.

**Results:** The results indicate that the CAWA battery is sensitive to the effects of treadmill-based maximal exercise, with no diurnal variation in asymptomatic participants.

**Conclusions:** Prior to any field trials, the CAWA preliminary findings indicate that the individual elements are sensitive and are repeatable in an asymptomatic population. The CAWA is an easy, time-efficient, and cost-effective method for individuals to test and re-test multiple times to identify latent signs / symptoms and neurocognitive trauma following sports-related concussion.

**INDEX WORDS:** Concussion, Sports Related Concussion, Self-Reported Symptoms, Concussion Assessment Tool

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## **Preface**

The basis of this research was discussed in length with supervisors Dr. Sally Lark and Associate Professor Wyatt Page, who had the idea for a concussion web-App. The discussion comprised of what should be included in the web-App in the assessment for concussion injury. The student's contribution to the study entailed independent research for web-app inclusion and background, discussion and contribution to technological problems (see Chapter 4.), participant recruitment, and independent data collection and initial analysis from which the results and implications were discussed.

## **Acknowledgements**

Firstly, I would like to thank each of the participants for the time and effort they contributed to the study. Their willingness to accommodate the requirements of the study into their already busy schedules was much appreciated. Furthermore, it was refreshing to experience the positive attitude towards the Web-App and the patience provided by all involved throughout the development process. I would like to express my sincere gratitude to each participant and trust that participation was both enjoyable and interesting.

I would also so like to acknowledge the guidance and expertise of my supervisors Dr. Sally Lark and Associate Professor Wyatt Page. Their combined professional standards and attention to detail was vital to maintaining a consistent effort in striving for excellence in all areas of the study.

The Massey University Human Ethics Committee: (Southern A, Application 16/32) approved the testing procedure and written consent was obtained from all participants prior to commencing the study.

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## List of Abbreviations

|               |   |
|---------------|---|
| <b>ART</b>    | Auditory Reaction Time                                  |
| <b>CAWA</b>   | Concussion Assessment Web-App                           |
| <b>CISG</b>   | Concussion in Sport Group                               |
| <b>CNT</b>    | Computerised Neuropsychological Test                    |
| <b>CRI</b>    | Concussion Resolution Index                             |
| <b>CRT</b>    | Complex Reaction Time                                   |
| <b>CSI</b>    | Concussion Symptom Inventory                            |
| <b>GXT</b>    | Graded Exercise Test                                    |
| <b>ImPACT</b> | Immediate Post-Concussion Assessment and Cognitive Test |
| <b>mTBI</b>   | Mild Traumatic Brain Injury                             |
| <b>NP</b>     | Neuropsychological Assessment                           |
| <b>PCS</b>    | Post-Concussion Syndrome                                |
| <b>SCAT</b>   | Sport Concussion Assessment Tool                        |
| <b>SIS</b>    | Second Impact Syndrome                                  |
| <b>SRC</b>    | Sports-related Concussion                               |
| <b>SRT</b>    | Simple Reaction Time                                    |
| <b>TBI</b>    | Traumatic Brain Injury                                  |
| <b>WM</b>     | Working Memory  |