

## Final Report

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**Title of Project:** *Sports related concussion and its correlates among current and former professional contact sports athletes.*

### Summary:

Update: we have completed MRI scanning and neuropsychological assessments on 70+ participants. Data analysis is on-going. We have identified group differences in **retired** rugby league players in DTI and MRS metrics as well as neuropsychological measures compared with age, gender and education matched controls.

All of the following publications/presentations acknowledged funding from the Brain Foundation:

### Published journal articles:

1. **Gardner, A.J.**, Iverson, G.L., Wojtowicz, M.A., Makdissi, M., Quinn, T., Shultz, S.R., Wright, D., & **Stanwell, P.** (2015). A systematic Video Analysis of Concussion in the National Rugby League: a preliminary study. *Brain Injury*, online first.
2. **Gardner, A.J.**, Tan, C.O., Ainslie, P.N., van Donkelaar, **Stanwell, P.**, **Levi, C.R.**, & Iverson, G.L. (2015). Cerebrovascular reactivity assessed by transcranial Doppler ultrasound in sport-related concussion: a systematic review. *British Journal of Sports Medicine*, in press.
3. **Gardner, A.**, Iverson, G.L., & McCrory, P. (2014). Chronic traumatic encephalopathy in sport: a systematic review. *British Journal of Sports Medicine*, 48 (2), 84-90.
4. **Gardner, A.J.**, Iverson, G.L., Williams, W.H., Baker, S. & **Stanwell, P.** (2014). A systematic review and meta-analysis of concussion in rugby union. *Sports Medicine*, 44 (12), 1717-1731.
5. **Gardner, A.**, Iverson, G.L., **Levi, C.R.**, Schofield, P.W., Kay-Lambkin, F.J., Kohler, R. & **Stanwell, P.** (2014). Systematic review of concussion in rugby league. *British Journal of Sports Medicine*, online first April, 10.

### Conferences:

1. **Gardner, A.J.**, Iverson, G.L., Wojtowicz, M.A., Makdissi, M., Quinn, T., Shultz, S.R., Wright, D., & **Stanwell, P.** (2015). A systematic Video Analysis of Concussion in the National Rugby League. Oral presentation and poster presented at American Academy of Neurology Annual Meeting, Washington, DC, USA.

2. **Gardner, A.J, Levi, C.L., Stanwell, P., & Iverson, G.I.** (2015). A video analysis of the use of the 'concussion interchange rule' during the first year of implementation in the National Rugby League. Poster Presented at International Neuropsychological Society Annual Mid-Year Conference, Sydney, NSW, Australia.
3. **Gardner, A.J., Iverson, G.L., Wojtowicz, M., Levi, C.R., Kay-Lambkin, F., Schofield, P.W., Zafonte, R., Shultz, S.R., Lin, A.P. & Stanwell, P.** (2015). Magnetic Resonance Spectroscopy Findings in Retired Professional Rugby League Players. Poster Presented at American Sports Neuropsychology Society Symposium, Atlanta, GA, USA.
4. **Gardner, A. & Stanwell, P.** (2013). Neuropsychological correlates of a remote history of multiple sports concussions in a sample of retired elite level collision sport athletes: pilot data. Poster presented at the 4th Australian Neurotrauma Symposium, Hobart, Tasmania.

### ***Hypothesis vs Findings***

*Hypothesis:* We proposed to correlate the findings of neuroimaging, genotyping, neuropsychological and psychosocial results to develop a risk/likelihood profile, in an attempt to reduce the rates of dementia in retired athletes.

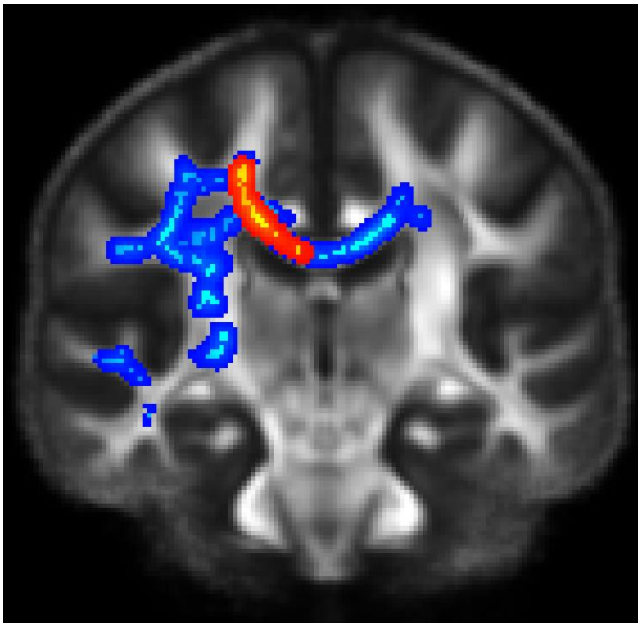
*Findings:* We found group differences in DTI and MRS metrics as well as neuropsychological measures in retired rugby league players vs. age, gender and education matched controls.

### ***Unanswered Questions***

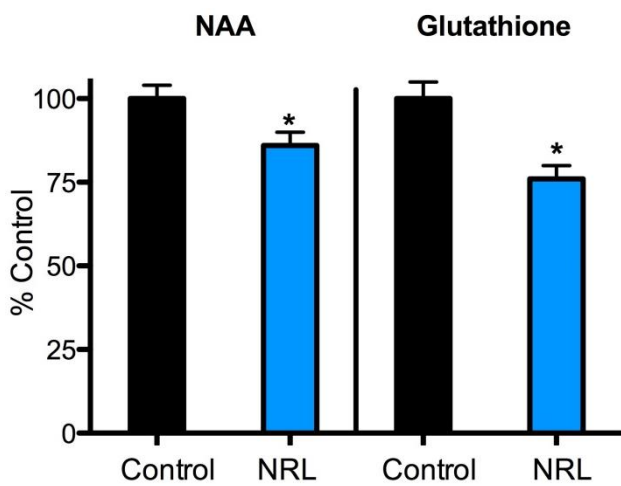
Whether these differences are pre-existing or due solely to exposure to concussion. Thus we are proposing a prospective study with measures before and after concussion.

### ***What these research outcomes mean***

Further research is required to study the evolution of concussion with players studied at baseline and serially tracked following a concussive brain injury to study the true nature of sport-related concussion.



**Fig 1. DTI in concussed NRL players.** We have found decreased FA (red) and increased mean diffusivity (blue) in the white matter of current NRL players who have suffered previous concussions vs. age/education/gender matched controls with no concussion history.



**Fig 2. MRS in retired NRL players with history of concussion.** We have found decreased NAA, a marker of neuronal health, and decreased glutathione, an anti-oxidant, in retired NRL players with a history of concussion. \* =  $p < .05$ .