# ENERGY CRISIS: PREVALENCE, SEVERITY, TREATMENT AND PERSISTENCE OF FATIGUE AFTER MILD TRAUMATIC BRAIN INJURY

A dissertation presented in partial fulfilment of the requirements

for the degree of Doctor of Philosophy in Psychology

at

Massey University,

Palmerston North,

New Zealand

**Joan Norrie**

**2012**

*TO*

*James and Marjorie Boyle*

*John, Catherine and Helen Norrie*

# ABSTRACT

The objectives of this research were to investigate the prevalence and severity of post-mild traumatic brain injury (MTBI) fatigue in a non-litigant New Zealand sample and to evaluate the effectiveness of a treatment programme. Subsequently, a third objective evolved – the investigation of the natural history of post-MTBI fatigue and the degree to which reliable clinically significant change occurred over time regardless of intervention type. The research took the form of two studies where analysis was based on group data followed by analysis of the Study Two data at an individual participant level.

Study One, a longitudinal prospective study examined fatigue prevalence, severity, predictors and co-variates over six months post mild traumatic brain injury (MTBI). Participants completed the Fatigue Severity Scale (FSS), Rivermead Postconcussion Symptoms Questionnaire (RPSQ), Hospital Anxiety and Depression Scale (HADS) and the Short Form 36 Health Survey-Version 2 (SF-36v2). Complete data were available for 159 participants. Key measures; prevalence - RPSQ Item 6: severity - FSS. The effect of time on fatigue prevalence and severity was examined using ANOVA. Multiple regression analysis identified statistically significant covariates. The study found post-MTBI fatigue prevalence was 68%, 38% and 34% at 1 week, 3 and 6 months respectively. There was a strong effect for time over the first three months and moderate to high correlations between fatigue prevalence and severity. Early fatigue strongly predicted later fatigue. Depression, but not anxiety, was a predictor. Fatigue was seen as laziness by family or friends in 30% of cases. Conclusions for Study 1 were that post-MTBI fatigue is a persistent postconcussion

symptom, exacerbated by depression but not anxiety. It diminishes in the first three months and then becomes relatively stable, suggesting the optimum intervention placement is at three months or more post-MTBI.

Study Two was a quasi-experimental longitudinal prospective controlled study which had a two by three, treatment by time, repeated measures research design. Participants with a history of MTBI were recruited from three Concussion Clinics. Post-MTBI fatigue was identified through Item 6 of the Rivermead Postconcussion Symptoms Questionnaire (RPSQ) and the outcome measures were the FSS, Fatigue Assessment Scale, RPSQ, Hospital Anxiety and Depression Scale and Sydney Psychosocial Re-integration Scale. All treatment group participants ($N$ = 18) came from the same Concussion Clinic as the principal researcher, and control participants ($N$ = 23) came from other Concussion Clinics. The question of whether the participants thought their significant others perceived them as lazy was also explored in Study Two. A 12 week manualised programme (PERT) was developed specifically for Study Two and was delivered by either a clinical psychologist or occupational therapist through a combination of personal and phone sessions. No significant time by group effect was found for any of the outcome measures. A time effect was found for all of the outcome measures. During the search for explanations for these findings it was discovered that the two conditions were more similar than expected. The majority (85.7%) of the control group had, in accordance with current rehabilitation practice, engaged in exercise and/or received interventions similar to the treatment group which presented a confound to the study. The data from the two groups was combined and analysed for information regarding reliable clinically significant change RCSC in individual participants. No significant correlations with demographic variables such as time since

injury, age, gender, level of education, work type and injury type were found. Female gender was related to positive RCSC at three months post-baseline but not at six months post-baseline. Fatigue severity was significantly positively related to participants' belief that relatives perceived them as lazy. Study Two provided no evidence to support this treatment for post-MTBI fatigue. Prevalence and severity of post-MTBI fatigue reduced over the six months of Study Two, however on examination of individual data the majority of the participants showed no reliable clinically significant change, supporting the need for further research into finding an effective post-MTBI fatigue treatment. The small sample size and the similarity of the treatment and control group conditions were major factors in confounding the findings of the study.

There is a comparatively large percentage of individuals reporting prevalence and severity of post-MTBI fatigue in New Zealand samples and, although the combined psychoeducation and aerobic exercise approach could not be evaluated, the postconcussion and general literature suggests there is merit in continuing research into its effectiveness in treating post-MTBI fatigue.

# ACKNOWLEDGMENTS

I set out on this journey wondering if I was going to lose my lifestyle but I have managed to get this far successfully combining job, thesis, family, fun and friends. Many weekends I have sat at home fascinated by the things I was reading about MTBI, fatigue and exercise. I tried out the exercise therapy myself when my mental processes slowed down and found that it worked and I could return to the project refreshed. On other weekends I packed up my gear and went skiing, kayaking, hiking or visiting friends. Over the six years I have experienced tremendous support from my supervisors, my colleagues, my employer, my friends and my family.

I want to thank everyone who has provided me with encouragement, knowledge, experience, friendship, fun and love during the last six years.

Thank you to Professor Janet Leathem, PhD and Ross Flett, PhD my doctoral supervisors for the wonderful way you guided and shaped my progress. Your feedback has been invaluable and was presented in a respectful and helpful manner so I could get the most from it. I have chosen to work alone a lot of the time and I appreciate that you have accepted this but then have helped whenever I asked.

Thank you to John Glass, Kieran Yates and the other clinical psychologists who helped me recruit control participants from the Taranaki and Porirua Concussion Clinics. Thank you for taking time out of your busy clinic days to tell the clients about the study and asking their permission for me to contact them.

Thank you to Pauline Andrews and Sheena Lapwood, occupational therapists for your wonderful work in providing the PERT programme to treatment participants.

Thank you to Dr Richard Seemann for being a great colleague in the Concussion Clinic and teaching me so much about the medical aspects of mild traumatic brain injury. Also, thank you for reading extracts where I felt out of my depth and fearful of making inaccurate statements about neuroanatomy and neuroendinchrinology processes. Thank you for the encouragement and support.

Thank you to Ian Wishart for encouragement and for all the friendship and support you have given over the years of this project.

Thank you to Massey University School of Psychology for the practical support which allowed me to carry out the project. Thank you to Harvey Jones, the man who helped me to learn new and tricky ways to do things on the computer so that I could prepare this document for publication.

Thank you to Shane Harvey, PhD and all of the team at the Psychology Clinic for all the big and little ways you encouraged and helped me progress this research.

Thank you to the friends in far flung places who stored the draft for safekeeping in these literally shaky times. You all gave me peace of mind as I neared the end of the project.

The project was approved by the Central District Ethics Committee, CEN/09/02/02, and this was endorsed by the Massey University Human Ethics Committee, 22 April, 2009.

# THESIS RESEARCH OUTPUTS

Parts of this thesis research have been published in refereed journal literature and presented at national and international conferences.

Norrie, J. (2005, August). *"Hitting the wall": Fatigue and traumatic brain injury.* Paper presented at the TBI Functional Rehabilitation Conference: 'Get Real' Top Ten Challenges in TBI Rehabilitation.

Norrie, J.M. (2005, November) Fatigue and Mild Traumatic Brain Injury. Paper presented at the Rehabilitation: Challenges of Participation and Reintegration Conference, New Zealand Rehabilitation Association, Auckland, New Zealand.

Norrie, J., Heitger, M., Leathem, J., Anderson, T. & Jones, R. (2006, September). *Fatigue and post-concussion syndrome following mild traumatic brain injury: A preliminary report from a New Zealand sample*. Paper presented at the Joint Conference of the Australian Psychological Society and New Zealand Psychological Society, Auckland, New Zealand.

Norrie, J. M., Heitger, M.H., Leathem, J.M., Anderson, T.J., Jones, R.D. (2007, August). *Fatigue following mild traumatic brain injury: Early results from a longitudinal prospective study*. . Paper presented at the TBI Functional Rehabilitation Conference: Seize the Moment: Opportunities for intervention in everyday life.

Norrie, J. M., Heitger, M.H., Leathem, J.M., Anderson, T.J., Jones, R.D. (2007, June). *Mild traumatic brain injury and fatigue: Preliminary findings from a longitudinal prospective study*. Paper presented at the 5th Annual Conference of the American Academy of Clinical Neuropsychology.

Norrie, J., Heitger, M., Leathem, J., Anderson, T., Jones, R., & Flett, R. (2010). Mild traumatic brain injury and fatigue: A prospective longitudinal study. *Brain Injury, 24*(13-14), 1528-1538. doi:10.3109/02699052.2010.531687

# ABBREVIATIONS

| | |
|---|---|
| 5HT | 5-Hydroxytryptamine or Serotonin |
| ANOVA | Analysis of Variance |
| APOE | Apolipoprotein E |
| CBT | Cognitive Behaviour Therapy |
| CDC | Centres for Disease Control and Prevention |
| CFS | Chronic Fatigue Syndrome |
| CMRO2 | Cerebral Metabolic Rate of Oxygen |
| CT | Computed Tomography |
| DAI | Diffuse Axonal Injury |
| DSM-IV | Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition |
| DTI | Diffusion Tensor Imaging |
| FAS | Fatigue Assessment Scale |
| FSS | Fatigue Severity Scale |
| DWI | Diffusion Weighted Imaging |
| GCS | Glasgow Coma Scale |

| | |
|---|---|
| HADS | Hospital Anxiety and Depression Scale |
| ICD | International Classification of Diseases |
| IQ | Intelligence Quotient |
| LOC | Loss of Consciousness |
| MCID | Minimum Clinically Important Difference |
| MS | Multiple Sclerosis |
| MTBI | Mild Traumatic Brain Injury |
| NIH | National Institutes of Health |
| OEF | Oxygen Extraction Fraction |
| PCS | PostConcussion Syndrome |
| PET | Positron Emission Tomography |
| PMRS | Proton Magnetic Resonance Spectroscopy |
| PPCS | Persistent PostConcussion Syndrome |
| POMS | Profile of Mood States |
| PERT | Postconcussion Energy Recovery Training |
| PTA | PostTraumatic Amnesia |
| PTSD | PostTraumatic Stress Disorder |

| | |
|---|---|
| QOL | Quality Of Life |
| rCBF | regional Cerebral Blood Flow |
| RCI | Reliable Change Index |
| RCT | Randomised Controlled Trial |
| RPSQ | Rivermead Postconcussion Symptoms Questionnaire |
| SPECT | Single Photon Emission Computed Tomography |
| SPRS | Sydney Psychosocial Reintegration Scale |
| TBI | Traumatic Brain Injury |
| WAIS-R | Wechsler Adult Intelligence Scale – Revised |
| WHO | World Health Organisation |

# TABLE OF CONTENTS

# LIST OF TABLES

**Tables** **Page**

# LIST OF FIGURES

**Figures** **Page**

# LIST OF APPENDICES



: