Department of Corrections

Office of the Chief Psychologist

Traumatic Brain Injury:

Impact on Offending and Management of Offenders in Prison

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Prepared by

Dr Stephen Haines

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Executive Summary

Background and description of project

Traumatic Brain Injury (TBI), commonly resulting from motor vehicle accidents, sport, assault or falls, is associated with deterioration in cognitive, physical, emotional or independent functioning. Although these effects are likely to have important implications for offender sentencing, management, rehabilitation and reintegration, brain injury has been largely neglected within the criminal justice system, both as a health issue and as a factor in offending and rehabilitation.

A recent review of the literature (Haines, 2014[1]) found compelling evidence of a very high prevalence rate of TBI in offenders in custody relative to the general population, emerging evidence of a link between TBI and offending, and an associated need for appropriate intervention and management approaches to address the unique responsivity and co-morbidity issues present in this group. Addressing the rehabilitative needs resulting from brain injury is likely to deliver benefits in terms of reducing offending, improving lives and saving money in public services.

The report detailed a number of key action points to enable more effective management of brain injury in prisoners, offenders, and those coming into the criminal justice process. In particular, a need was identified for affected individuals to be detected early because accurate identification of TBI can be crucial for effective correctional management and rehabilitative and reintegration efforts. In this regard, it was recommended that the initial focus of any such initiative should be to develop and trial a TBI screening approach for use in the New Zealand prison system.

Unfortunately, the nature of brain injury presents challenges to the systematic identification of TBI in a correctional environment. There is no biomarker for TBI and medical imaging is not sensitive to all TBIs. Offenders moreover, tend to have limited medical records, unreliable self-reported history and have injuries that received no medical attention at all. While comprehensive neuropsychological assessment is considered to be the best way to identify cognitive functioning problems, the cost of such assessments, and the time and specialized training required to undertake them, makes systematic assessment difficult in correctional settings.

Although there is no current gold standard for easily identifying TBI affected offenders, the semi-structured interview format, in particular employing measures such as the Traumatic Brain Injury Questionnaire (TBIQ[2]), is emerging as the most cost effective way in both time and money to capture the frequency and severity of lifetime head injury experience and the gradations of resultant impairment or disability in a prison population.

The current report summarizes the findings of a pilot study evaluating the utility of the TBIQ to identify affected individuals and in the process, identify the prevalence of TBI in the NZ prison population. The Department's unique data sets were then utilized to explore the correlations between TBI and risk of re-offending and prisoner management (misconducts, incidents, security classification). The identification of affected individuals will provide a baseline to track the impact of TBI on recidivism over time.

Implementation

The TBIQ is a structured clinician-administered instrument developed for use with offenders that probes for whether the respondent has ever experienced a head injury, details of the injuries sustained and the frequency and severity of symptoms commonly associated with brain injury. Between five and thirty minutes are required to administer depending on the individual's history of head injury. Eight prison units at Rimutaka prison were approached during November and December 2015 for volunteers, representing a potential subject pool of 272 offenders out of the total prison muster of 857 to provide a representative sample from the prison general population. Based on their responses, participants were allocated to two groups (High Probability Group/Low Probability Group) based on the likelihood of experiencing long-term symptoms resulting from TBI. The groups were compared on a number of outcome measures (e.g.,

[1] Haines, S. G. (2014) unpublished.

[2] Diamond, P. M., Harzke, A. J., Magaletta, P. R., Cummins, A. G., & Frankowski, R. (2007). Screening for traumatic brain injury in an offender sample: a first look at the reliability and validity of the Traumatic Brain Injury Questionnaire. *The Journal of Head Trauma Rehabilitation*, *22*(6), 330–338.

offending history, risk of re-offending, prison security classification, misconducts, etc) using data obtained from the Department of Corrections' electronic databases.

Key Results

A total of 96 adult male inmates were interviewed. At least one head injury incident was reported by 90 (93.75%) of the men interviewed. Of these, only four (4.16%) reported a single injury event with no loss of consciousness (LOC) (e.g., only dazed or concussed). A further 13 (14.4%) reported two or more events with no LOC. Seven participants reported a history of multiple concussions sustained as a child, typically spanning a period of some five years of their childhood: these were counted as 10 injuries for classification purposes. Nine (10%) participants reported multiple (>10) events with LOC: these were also recorded as 10 for classification purposes. In all, a total of 731 identified head injury events were reported and the median number of injuries was 4.5 events, with a lower quartile of 2 events and an upper quartile of 9.75 events. Some 41% (322) of the head injury events resulted in some form of LOC and medical care of any form was only sought or obtained for 136 (42.2%) of these injuries. Many participants reporting being disinclined to gain attention for injuries received during criminal activity (e.g., car conversion, fighting) or not wanting to appear weak on the sports field. In most cases, medical attention appeared to have focused on physical injuries; however it possible that some form of head injury screening was undertaken of which the respondent was unaware. Only four participants (4.1%) reported receiving specialist head injury assessment or follow-up, and only one participant was able to recall being given a Glasgow Coma Scale (GCS) score.

The two TBI Probability Groups showed significant differences on the various outcomes measures.

- Offenders at a high probability of experiencing TBI related symptoms were found to present a greater estimated recidivism risk in the five year period following their release than those at a low probability of TBI related problems.
- There was a clear association between offending history and a history of TBI with those at a high probability of TBI more likely to have a greater mean number of prior convictions.
- A high probability of having TBI related symptoms was associated with a greater number of violence convictions.
- The High Probability Group incurred more minor discipline infractions in prison than the Low/Moderate Probability Group.
- Offenders with a history of TBI began offending at an earlier age.
- *Prisoners in the High* Probability Group were more likely to have been detected using drugs while incarcerated during their current sentence.
- Similarly, the High Probability Group had a greater number of drug convictions during their lifetime.
- Likely associated with their propensity to substance use, the High Probability Group had a higher likelihood of having a conviction for driving while intoxicated (54.5%) than their counterparts in the Low/Moderate Probability Group (28.6%).

Summary and Recommendations

Consistent with prior research in TBI in offenders, a very high rate of head injuries was found in the prison sample, with 90 out of 96 (93.75%) of participants having incurred some form of head injury in their lifetime. The results were also consistent with the hypothesis that a chronic history of TBI is associated with greater offending and with more difficulties while incarcerated. Based on their offending history and related actuarial factors, prisoners meeting this study's criteria for a high probability of TBI sequelae had a greater estimated risk of re-offending in the five year period following their release from prison. Supporting this finding, prisoners at higher risk of TBI sequelae showed a clear association between TBI and prior

offending with a higher rate of overall offending, a higher number of violence, drug and drink driving convictions, and a younger age at first sentencing. Similarly, while incarcerated, prisoners at a higher probability of TBI associated problems experienced more minor behaviour infractions and were more likely to have been detected using drugs during their current sentence. Given the observed impact of TBI on offending and prisoner behaviour, Corrections would benefit from considering TBI in treatment, rehabilitation and prisoner management strategies and policy. The following recommendations are made:

- Many of the cognitive impairments following TBI present significant responsivity barriers to successful treatment or programme completion. Identifying affected individuals will allow compensatory strategies to be implemented to facilitate successful treatment and programme completion.

- Psychiatric disturbance, especially mood and anxiety disorders, is common in both the acute and chronic stages of recovery following TBI and there are often changes in personality. Screening all prisoners on intake for TBI will allow early identification and enhanced assessment of affected individuals to determine their needs (i.e., referral for further assessment such as neuropsychological evaluation or psychiatric assessment. Documentation of TBI status on prisoners' files will identify the need for tailored intervention and alert prison staff to appropriate management strategies.

- Common TBI related problems (i.e., problems with attention, memory, irritability and anger) will also impact on the management of prisoners. There is a need for staff training to identify and appropriately respond to prisoners' brain injury related behaviour problems with effective strategies and for specific individual behaviour, management plans.

- Prisoners with a TBI are particularly at risk from re-integration difficulties. Case managers will benefit from an understanding of the functional impairments in TBI in order to facilitate TBI affected prisoners' transition back to the community, including providing family or supporters with education and recommendations for resource support in the community.

- As with prison staff, community corrections staff will benefit from training to recognise and respond to TBI affected individuals and from access to appropriate consultation with professionals with expertise in TBI.

- The current study supports the utility of a multiple item, structured interview format cueing recall across a range of categories and explicitly evoking memories of remote injurious events to identify affected individuals.

- While the initial focus of TBI intervention in prisons should be on identification of affected individuals and training and education for prison staff, future research should look to expanding knowledge of the impact of TBI on rehabilitation.

- Finally, while most of the extant studies on the impact of TBI on offenders have focused on male offenders, female offenders are likely to be at higher risk of TBI, experience different risk factors for head injury and are likely to have experienced more multiple head injuries than male offenders. Affected female prisoners are also likely to require different management strategies than their male counterparts. Future research should focus on the impact of TBI on female offenders as findings from male offenders may not to generalise to this population.

1.0 Introduction

Prisoners with disabilities are commonly identified as requiring differential management or treatment. However, while many correctional agencies have specific policies and practices for disabled prisoners, most tend to focus on those with an intellectual, psychiatric or physical disability. As in other jurisdictions, the New Zealand correctional system rarely considers Traumatic Brain Injury (TBI) when assessing the rehabilitative needs of offenders and similarly, there is limited understanding of its prevalence or impact in the correctional system.

Although there are relatively few studies of TBI in offender populations, prevalence rates of between 25% and 87% (Barnfield & Leatham, 1998[3]; Diamond, et al., 2007) have been found in various correctional settings compared to the general population rate of 8.5% (Wald, Helgeson, & Langlois, 2008[4]; New Zealand Guidelines Group, 2006[5]). It is not surprising that TBI is likely to be overrepresented in offender populations given that the risk factors for sustaining a TBI are similar to those for offending, i.e., low socioeconomic status, low education, male gender and propensity to engage in violence (Farrer & Hedges, 2011[6]).

Moreover, given that changes in cognition (e.g., inattention), emotion (e.g., irritability), and somatic function (e.g., headache) are frequent sequelae of TBI, it should also be expected that TBI affected offenders will present challenges to management and rehabilitation efforts in prisons (e.g., anti-social behaviour; (Mobbs, Lau, Jones & Frith, 2007[7]) and ability to maintain rule-abiding behaviour during incarceration (Shiroma, Ferguson, & Pickelsimer, 2010[8]). Unfortunately, research on the relationship between TBI and these areas is limited.

Recently, Piccolino and Solberg (2014)[9] investigated the impact of TBI on prison health service utilization and offender management. Drawing on TBI screening data previously obtained from a large sample of 998 adult male offenders admitted to the Minnesota Department of Corrections, the authors found a clear association between a history of TBI and increased use of correctional medical/psychological services and higher recidivism rates. A trend towards higher rates of prison rule breaking infractions and lower rates of chemical dependency treatment completion was also observed among prisoners at higher risk of experiencing TBI related sequelae. Piccolino and Solberg's (2014) study was also interesting because they employed a semi-structured interview format with a clinician-administered TBI instrument (TBIQ: Diamond et al., 2007), a process that has been advocated as an emerging gold standard for identifying a history of TBI (Corrigan & Bogner, 2007a[10]).

[3] Barnfield, T., & Leathem, J. (1998). Incidence and outcomes of traumatic brain injury and substance abuse in a New Zealand prison population. *Brain Injury*, *12*(6), 455–466.
[4] Wald, M. M., Helgeson, S. R., & Langlois, J. A. (2008). Traumatic brain injury among prisoners. *Brain Injury Professional*, *5*(1), 22–25.
[5] New Zealand Guidelines Group (2006). *Traumatic brain injury: Diagnosis, acute management and rehabilitation*. Wellington, New Zealand: Author.
[6] Farrer, T. J., & Hedges, D. W. (2011). Prevalence of traumatic brain injury in incarcerated groups compared to the general population: a meta-analysis. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *35*(2), 390–394.
[7] Mobbs, D., Lau, H. C., Jones, O. D., & Frith, C. D. (2007). Law, Responsibility, and the Brain. *PLoS Biology*, *5*(4), e103. http://doi.org/10.1371/journal.pbio.0050103.
[8] Shiroma, E. J., Ferguson, P. L., & Pickelsimer, E. E. (2010). Prevalence of traumatic brain injury in an offender population: A meta-analysis. *Journal of Correctional Health Care*, *16*(2), 147–159.
[9] Piccolino, A. L., & Solberg, K. B. (2014). The impact of traumatic Brain Injury on prison health services and offender management. *Journal of Correctional Health Care, 20*(3), 203-212.
[10] Corrigan, J. D., & Bogner, J. (2007a). Screening and identification of TBI. *Journal of Head Trauma Rehabilitation, 22*(6), 315-317.

In an attempt to further explore TBI history and its impact on offending, delivery of correctional services and offender management in prison, the current study employed the TBIQ to examine the relationship between TBI and offending behaviour, risk of re-offending, and offender behaviour in prisons. It was hypothesized that a history of TBI would be associated with an increased risk of anticipated recidivism, higher rates of prior general, substance and violent offending, and higher rates of prison rule violations. Moreover, the current study would provide a test of the utility of the TBIQ to screen for TBI in the NZ correctional system and provide an estimate of the current prevalence of TBI in NZ prisons.

1.2 Methodology

TBI Identification

TBI injuries are classified as mild, moderate or severe according to the depth of coma, or loss of consciousness (LOC) in the first 24 hours post injury and the duration of post-traumatic amnesia (PTA). Depth of coma, the period of unconsciousness or unawareness in the first few hours after brain injury, provides an important early indicator of severity and is typically assessed when a person with suspected TBI presents to an Emergency Department using observations on the Glasgow Coma Scale (GCS) (Teasdale & Jennett, 1974[11]). PTA, the length of time a person is alert but unable to take on new information, is calculated from the time of the accident including any period of loss of consciousness. Duration of PTA correlates well with residual cognitive impairment and recovery (Sohlberg & Mateer, 2001[12]).

Unfortunately, in the lack of any biomarker for brain injury (Corrigan & Bogner, 2007a), identifying TBI affected individuals from medical records is problematic because those incurring a mild TBI frequently do not report for medical treatment (Turkstra, Jones, & Toler, 2003[13]) and, even if they have done, medical records may not easily obtainable (NZ Guidelines Group, 2006). Medical documentation and/or imaging records are likely to be even less useful with offender populations, who tend to be less likely to present to medical services in general, and may be particularly circumspect in seeking help for head injuries incurred during illegal activities (e.g., fighting, assaults, drunk driving, drug use, speeding or car conversion). Similarly, prisoners may also under-report or deny a head injury to medical staff for fear of implicating their criminal associates (Iverson, Franzen, Demarest &Hammond, 1993[14]). As Corrigan, Bogner, and Holloman (2012[15]) note, the existence, let alone the availability of a GCS score is a luxury that few TBI researchers enjoy.

Head injury identification among offenders therefore tends to rely on self-report and retrospective measures. However, these may be subject to inaccuracies due to reliance on recall of event injury and identification and assessment of TBI-related outcomes (Diamond et al., 2007), while neurological impairment itself may undermine accurate reporting symptoms of brain injury (Daoust et al., 2006[16]). For example, a routine intake question asking if the inmate ever had a head injury only identified 10 (1%) of the 998 inmates reporting a head injury compared with 826 (83%) who reported having had at least one head injury during a more detailed interview (Wald, Helgeson, & Langlois, 2008). Similarly, Diamond et al. (2007)

[11] Teasdale, G., & Jennett, B., (1974). Assessment of coma and impaired consciousness. *The Lancet*, ii, 81-84.
[12] Sohlberg, M. M., Mateer, C. A., (2001). *Cognitive rehabilitation: An integrative neuropsychological approach*. Andover: Taylor and Francis Books Ltd.
[13] Turkstra, L., Jones, D., & Toler, H. L. (2003). Brain injury and violent crime. *Brain Injury*, *17*(1), 39–47.
[14] Iverson, G. L, Franzen, M. D., Demarest, D. S., Hammond, J. A. (1993). Neuropsychological screening in correctional settings. *Criminal Justice and Behavior*, *20*(4), 347.
[15] Corrigan, J. D., Bogner, J., & Holloman, C. (2012). Lifetime history of traumatic brain injury among persons with substance use disorders. *Brain Injury*, *26*(2), 139–150.
[16] Daoust, S. W., Loper, A. B., Magaletta, P. R., Diamond, P. M. (2006). Neuropsychological dysfunction and aggression among female federal inmates. *Psychological Services, 3*(2): 88-96.

reported that a one-item self-administered screening tool used during prison admission detected only 19% of the TBIs later identified via structured interview.

While the lack of a standardized assessment has compromised much research in the area (Diamond et al., 2007), a semi-structured interview with an informed professional appears to be emerging as the gold standard for determining the lifetime history of TBI (Corrigan & Bogner, 2007a). In recent years a number of such approaches have emerged, including the Ohio State University TBI Identification Method (Corrigan & Bogner, 2007b[17]) and the Traumatic Brain Injury Questionnaire (TBIQ; Diamond, et al., 2007), with the latter being developed and intended for use with offenders.

The TBIQ is a structured clinician-administered instrument developed and intended for use with offenders. It comprises three sections: Section I consists of items asking whether the respondent has ever experienced a head injury from 12 situations associated with such injuries (e.g., vehicle crashes, falls, assaults). Section II probes for details of the head injuries reported in Section I. Questions include age at the time of the injury, whether there was any loss of consciousness or post-traumatic amnesia, and what care was received. Section III assesses the frequency and severity of 15 cognitive and physical symptoms commonly found with head injury (e.g., trouble concentrating or remembering, dizziness or headaches). The TBIQ takes between 5 to 30 minutes to administer depending on the extent of the individual's injury history, with the only requirements being that the individual have sufficient language and cognitive abilities to be able to be interviewed. Preliminary results indicate that the TBIQ shows adequate reliability and validity for assessing lifetime history of TBI, TBI severity, and measurement of cognitive, emotional, and behavioural sequelae frequently associated with TBI (Diamond et al., 2007[18]).

Accordingly, in the current study the TBIQ was employed to assess prisoners' experience of head injury. Like Piccolino and Solberg (2014) the interest was in identifying prisoners at increased risk of experiencing long-term cognitive and behaviour effects of TBI. As Piccolino and Solberg note, due to a myriad of co-morbid conditions that may confound endorsing any casual relationship between TBI and offender behaviour, it would be prudent to identify those offenders most at risk of experiencing chronic TBI related sequelae. Piccolino and Solberg used LOC to estimate TBI severity, however estimates of Post Traumatic Amnesia (PTA) were not used because these have been shown to be unreliable when based solely on self-report (van der Naalt, 2001[19]). In a departure from Piccolino and Solberg's study where the authors set the criteria for a likelihood of experiencing TBI sequelae as LOC > 60 minutes, the current investigation set the criteria at LOC > 30 minutes to align with the most commonly employed research and diagnostic criteria. As Piccolino and Solberg note, an issue with the TBIQ is that the LOC assessment category only includes a range of > 5 to < 60 minutes whereas most commonly employed measures use a LOC of 30 minutes to indicate severity (i.e., LOC > 30 minutes = moderate/severe TBI; LOC < 30 minutes = mild TBI). Therefore, in the current study, offenders reporting a LOC > 5 to < 60 minutes were additionally probed as to whether their LOC was greater or less than 30 minutes.

Identification of TBI categories

As in the Piccolino and Solberg (2014) study, participants were initially allocated into three groups based on the TBIQ assessment. The Low Probability Group, considered very unlikely to experience long-term sequelae resulting from TBI, was comprised of offenders who did not report any history of head injuries. A

[17] Corrigan, J. D., & Bogner, J. (2007b). Initial reliability and validity of the Ohio State University TBI Identification Method. *Journal of Head Trauma Rehabilitation, 22*(6), 318-329.

[18] Diamond, P. M., & Magaletta, P. R. (2006). The short form of the Buss-Perry Aggression Questionnaire (BPAQ-FF): a validation study with federal offenders. *Assessment*, *13*, 227-240.

[19] van der Naalt, J. (2001). Prediction of outcome in mild to moderate head injury: A review. *Journal of Clinical and Experimental Neuropsychology, 23*, 837–851.

second group comprised offenders reporting only one or two events in which a TBI occurred, both of which involved either no LOC or an LOC of less than 30 minutes. This group was identified as the Moderate Probability Group, reflecting the moderate probability of having long-term TBI sequelae. The third group comprised offenders likely to experience long-term TBI sequelae; reporting either at least three separate head injuries and/or at least one injury that resulted in an LOC for greater than 30 minutes. This group was identified as the High Probability Group, denoting a high likelihood of experiencing TBI sequelae.

Study Sample

The sample comprised 96 adult male inmates residing in the New Zealand Department of Corrections' facility at Rimutuka Prison. Eight prison units were selected: Three Low-Medium security units, four High-Medium security units and a Special Treatment Unit for high risk violent offenders. These units represented a potential subject pool of 272 offenders out of the total prison muster of 857 during the study. For a variety of reasons, the majority of participants were obtained from the Low-Medium units (53%) and Special Treatment unit (22%) compared to the High-Medium units (22% of total participants). To meet inclusion criteria, offenders had to be sentenced prisoners and understand sufficient English to be interviewed. Inmates were initially approached by prison officers, and in some cases the author, and asked to take part in an interview. A total of 103 inmates were approached and 96 agreed to attend the interview.

Those agreeing to interview were seen individually by the author – a doctoral-level registered clinical psychologist – and were advised that the interview was screening for head injuries they may have experienced. Participants were provided with information about the study and signed consent was obtained.

Outcome Measures

Additional data used in this study (e.g., offending history, risk of re-offending, prison security classification, misconducts, etc) was obtained from the Department of Corrections' electronic databases.

Risk of Re-offending. The Risk of re-Conviction x Risk of re-Imprisonment (RoC*RoI) (Bakker, Riley, & O'Malley, 1999[20]) is the primary recidivism measure for the New Zealand Department of Corrections to predict the likelihood of an offender committing further offences that would result in imprisonment. This combined actuarial measure represents an expression of the likelihood that an offender will be both re-convicted (RoC) for a future offence and be sentenced to a term of imprisonment for that offence (RoI) in the five year post release period. The RoC*RoI was based on static predictors from criminal history information of more than 133,000 offenders convicted of an imprisonable offence in 1983, 1988 and 1989, and their further offending over the next five years. The measure also includes an index of the seriousness of their offending. As a probability estimate, the RoC*RoI provides a score between 0 and 1, which according to departmental studies has an overall predictive accuracy for imprisonment of 74%.

Conviction History. Participants' adult conviction histories were investigated as a gauge of prior recidivism. Convictions were collapsed across violent, sexual and general offending categories to give an overall count of previous convictions.

History of violence. Participants' adult conviction histories were investigated to determine the total count of violence convictions for each offender.

Misconduct behaviour in prison. In order to provide an indication of the impact of TBI associated misbehaviour in prison, incidents considered likely to create serious violations to safety and security were

[20] Bakker, L. W., Riley, D., O'Malley, J, (1999). *ROC, Risk of Conviction: Static models predicting four types of re-offending*. Wellington: New Zealand Department of Corrections.

coded as major discipline infractions (e.g., attempts at escape, assaults, having weapons or cellphones). Other infractions not meeting this definition (e.g., disobeying instructions, smoking, drug use, tattooing) were coded as minor discipline infractions. The total number of each type of infraction was obtained for each of the offenders in the study sample.

Age at entry into criminal justice system. Similarly, participants' age at first sentencing for any offence was extracted from the Corrections' database.

Current IDU Status. Prisoners are classified in prison as having an Identified Drug Use (IDU) status during their current sentence based on returning a positive or diluted urine sample for drug testing. For the purpose of the current study, IDU status was coded as present or absent.

Drug Conviction History and Drink Driving Convictions. Similarly, prior or current convictions for drug or drink driving convictions were coded on a dichotomous scale as present or absent.

2.0 Results

As noted, the sample was originally stratified into three groups defined by head injury history as described in the section "Identification of TBI categories." Initial review of the data, however, revealed that this resulted in most of the sample (81%) being categorized as having a Moderate Probability of TBI sequelae, with only 6% categorized in the Low Probability Group and 12% in the High Probability Group. It was further noted that a significant number of individuals reported a striking history of multiple concussions and brief (<30 minutes) LOC, often occurring on a regular basis over a period of years in childhood, or many sporting or assault injuries in adolescence or adulthood. The original criteria would have classified these individuals alongside those experiencing only one injury that resulted in being simply dazed or unconscious for seconds, effectively confounding the goal of identifying those most likely to experience TBI related problems. Unfortunately, there is currently no consensus as to how many head mild injuries equate to a moderate or severe TBI. While Diamond et al., (2007) report "little cognitive and/or behavioural difference between those reporting 3 or 4 injuries and those who report a dozen of similar severity" (pp. 337), others (e.g., Barnfield & Leathem, 1998) note that counting just the most severe TBI does not always provide an accurate estimate of the individual's experience of TBI, as research suggests a cumulative negative effect on neuropsychological functioning.

Accordingly, and in general agreement with NZ Guidelines Group (2006) and World Health Oganization criteria for mild TBI, it was decided to categorize those reporting any alteration to their consciousness event (e.g., dazed, concussed) and LOC events of less than 30 minutes duration into a Low/Moderate Probability Group for TBI sequelae. All participants reporting at least one event with a LOC of greater than 30 minutes, or more than 10 events with LOC less than 30 minutes were allocated to the High Probability Group. Additionally, in recognition of the likely effect of a history of multiple head trauma over many years during developmental years (e.g., Williams, 2012[21]), individuals reporting such a history were allocated to the High Probability Group, even if reporting no TBI event with LOC greater than 30 minutes. Based on this revised categorization, the Low/Moderate Probability Group had 63 offenders (65.6%) with the High Probability Group comprising 33 (34.4%) of the sample group.

[21] Williams, W. H. (2012). *Repairing Shattered Lives*: Brain injury and its implications for criminal justice. Retrieved from Centre for clinical Neuropsychology Research, University of Exeter website: http://www.barrowcadbury.org.uk/wp-content/uploads/2012/11/Repairing-shattered-Lives_Report.pdf.

2.1 *Rate of TBI*

A total of 96 adult male inmates were interviewed. Age range was between 20 years and 79 years and the median age was 39.75 (*SD* = 13.5 years). At least one head injury incident was reported by 90 (93.75%) of the men interviewed. Of these, only four (4.16%) reported a single injury event with no LOC (e.g., only dazed or concussed). A further 13 (14.4%) reported two or more events with no LOC. Seven participants reported a history of multiple concussions sustained as a child, typically spanning a period of some five years of their childhood: these were counted as 10 injuries for classification purposes. Nine (10%) participants reported multiple (>10) events with LOC: these were also recorded as 10 for classification purposes. In all, a total of 731 identified head injury events were reported and the median number of injuries was 4.5 events, with a lower quartile of 2 events and an upper quartile of 9.75 events. Some 41% (322) of the head injury events resulted in some form of LOC, and medical care of any form was only sought or obtained for 136 (42.2%) of these injuries. Many participants reporting being unwilling to seek attention for injuries received during criminal activity (e.g., car conversion, fighting) or due to not wanting to appear weak on the sports field. In most cases, medical attention appeared to have focused on physical injuries; however it possible that some form of head injury screening was undertaken of which the respondent was unaware. Only four participants (4.1%) reported receiving specialist head injury assessment or follow-up, and only one participant was able to recall a GCS score.

2.2 *Outcome Measures*

Recidivism Risk. Comparison of RoC*RoI scores for the two TBI Probability groups is shown in Figure 1. Offenders in the High Probability Group are estimated as being at greater recidivism risk in the five year period following their release than those in the Low/Moderate Probability Group. The difference between these groups was found to be statistically significant ($F(1,94) = 11.67398$, $\rho < .0009$, two-tailed).

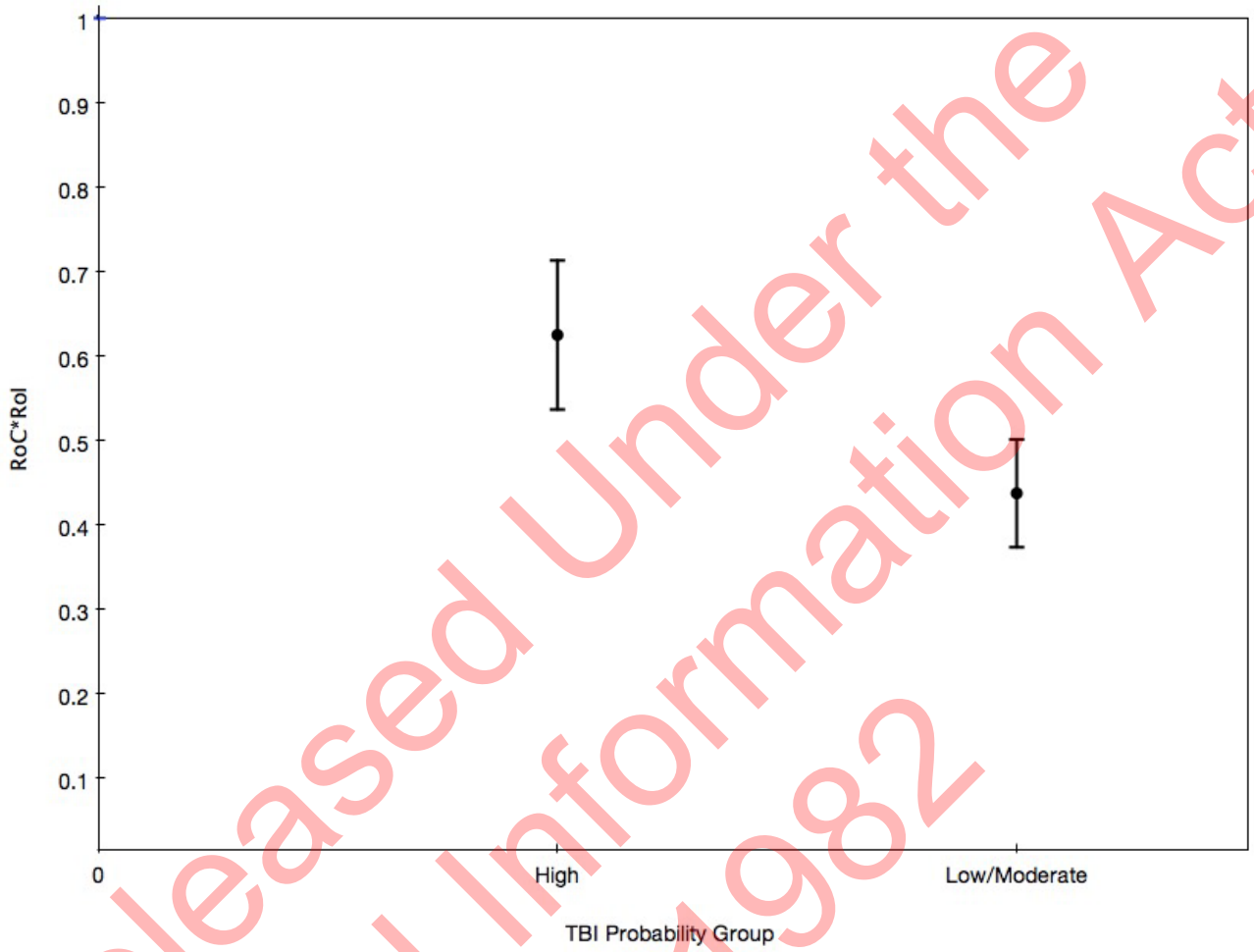

Figure 1. RoC*RoI score for each TBI probability group. Error bars show standard error for the group means

Conviction History. To further investigate the association between TBI and offending, participants' mean number of prior convictions were collapsed across violent, sexual and general offending and compared across groups. Figure 2 shows the mean number of convictions for the two TBI groups. There is a clear association between offending history and a history of TBI. The High Probability Group was significantly more likely to have a greater mean number of convictions than the Low Probability Group *(F(1, 94)* = 8.5229*, ρ < .0044)*.

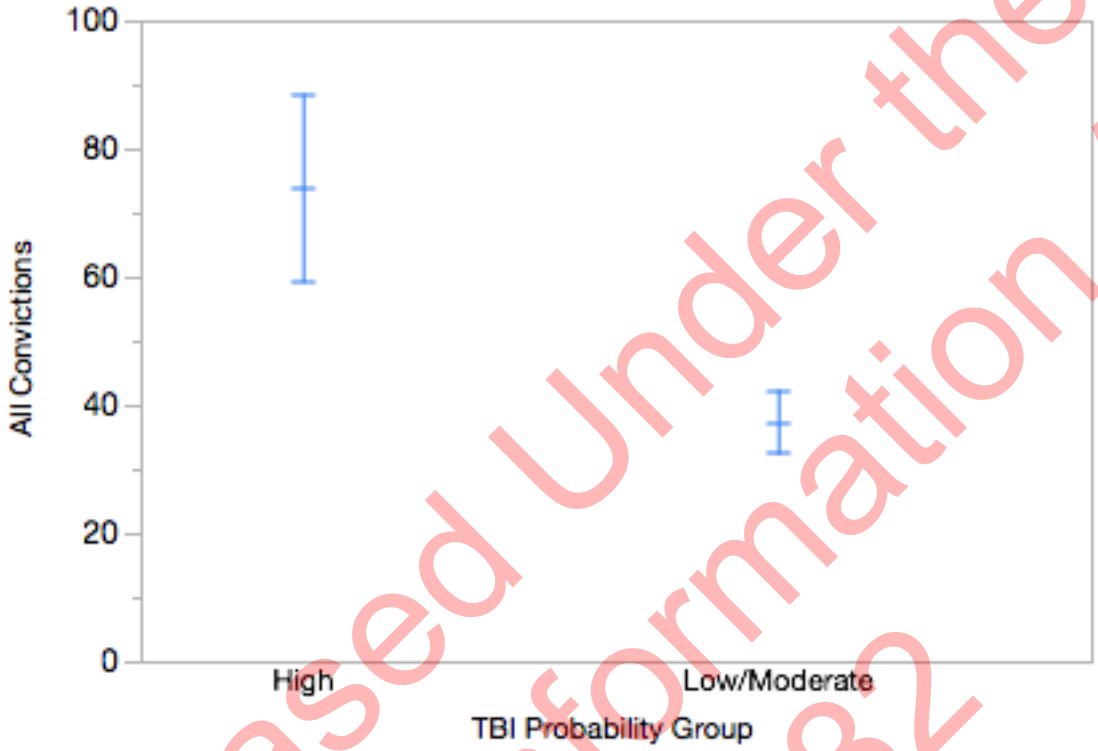

Figure 2. Mean count of overall convictions for TBI probability group (any type). Error bars show standard error for the group means.

History of Violence. A High Probability of having TBI sequelae (Figure 3) was associated with a significantly higher number of violence convictions compared to those at a Low Probability of having complications from a TBI, $F(1, 94) = 8.6816$, $\rho < .0041$.

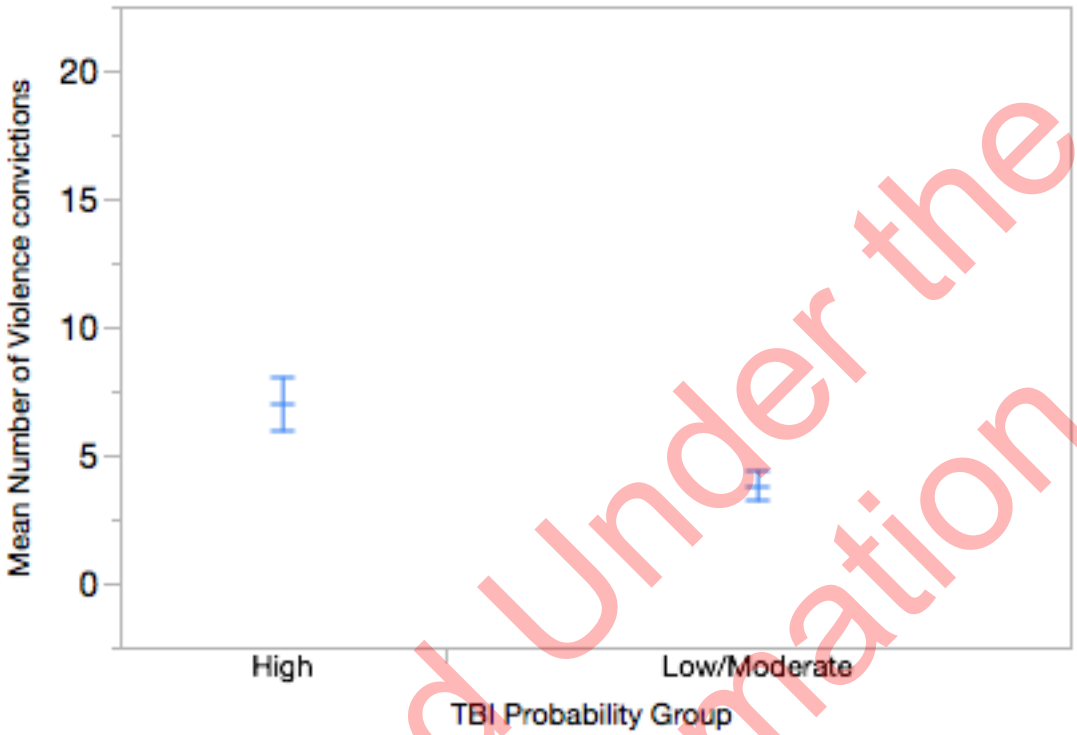

Figure 3. Mean number of violence convictions for each TBI probability group. Error bars show standard errors for the group means

Misconduct in Prison. An association was observed between history of TBI and minor misconducts in prison with the High Probability Group incurring significantly more mean minor discipline infractions (3.0) than the Low/Moderate Probability Group (1.2), $F(1,94) = 4.7046$, $\rho < .0326$. As shown in Figure 4, offenders in the Low Probability Group were somewhat less likely to have been reported for major misconduct incidents while incarcerated than those in the High Probability Group, however, this difference was small and not statistically significant.

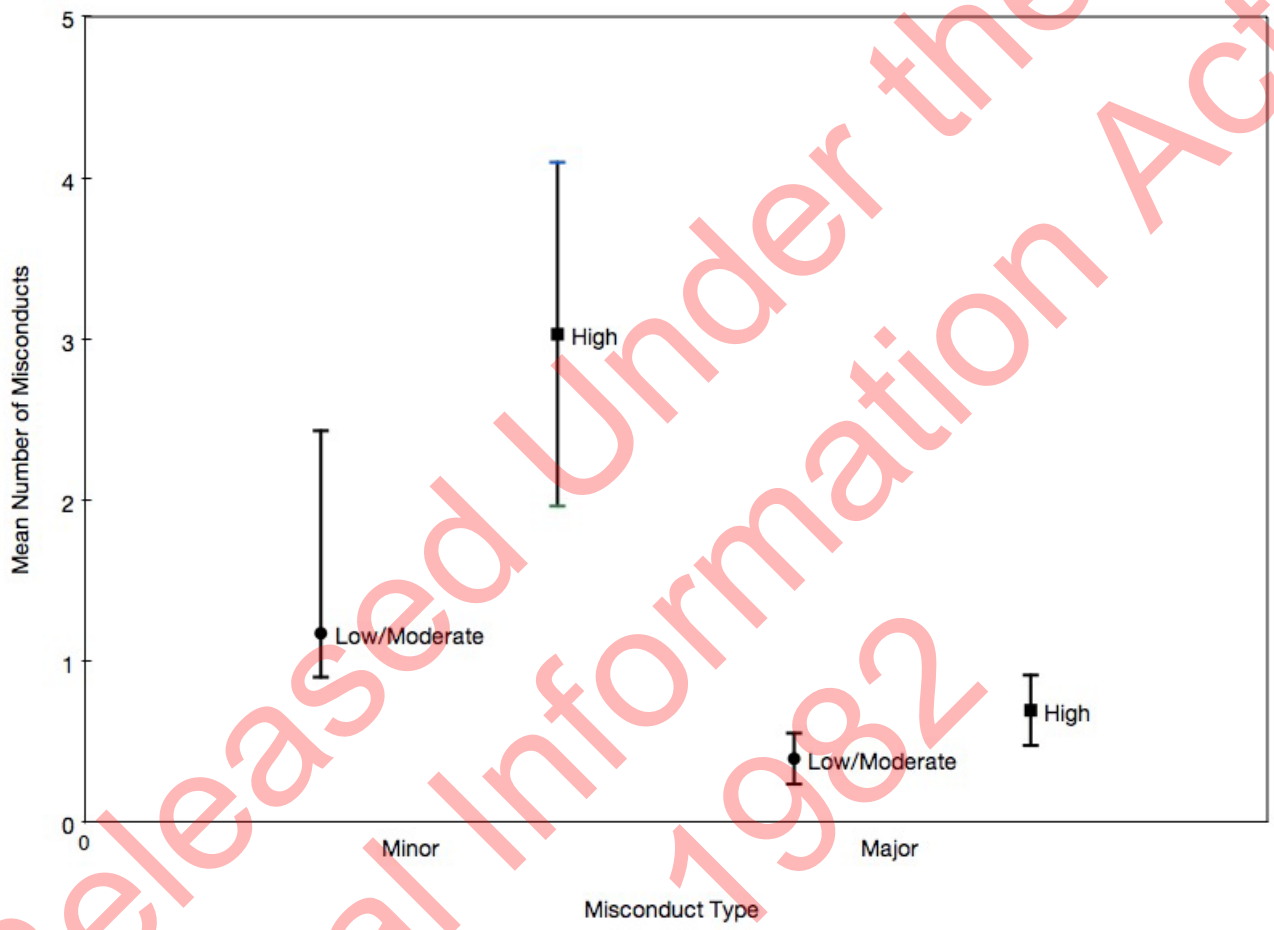

Figure 4. Major and minor misconducts for each TBI probability group. Error bars show standard errors for the group means

Age at entry into criminal justice system. Comparison of the mean age at first sentencing for any offence (Figure 5) revealed that offenders in the High Probability Group were significantly younger at first conviction, being just 19.7 years old (SD = 7.4), compared to those in the Low Probability Group who were 26.8 years of age, $F(1,94) = 6.6568$, $\rho < .0114$.

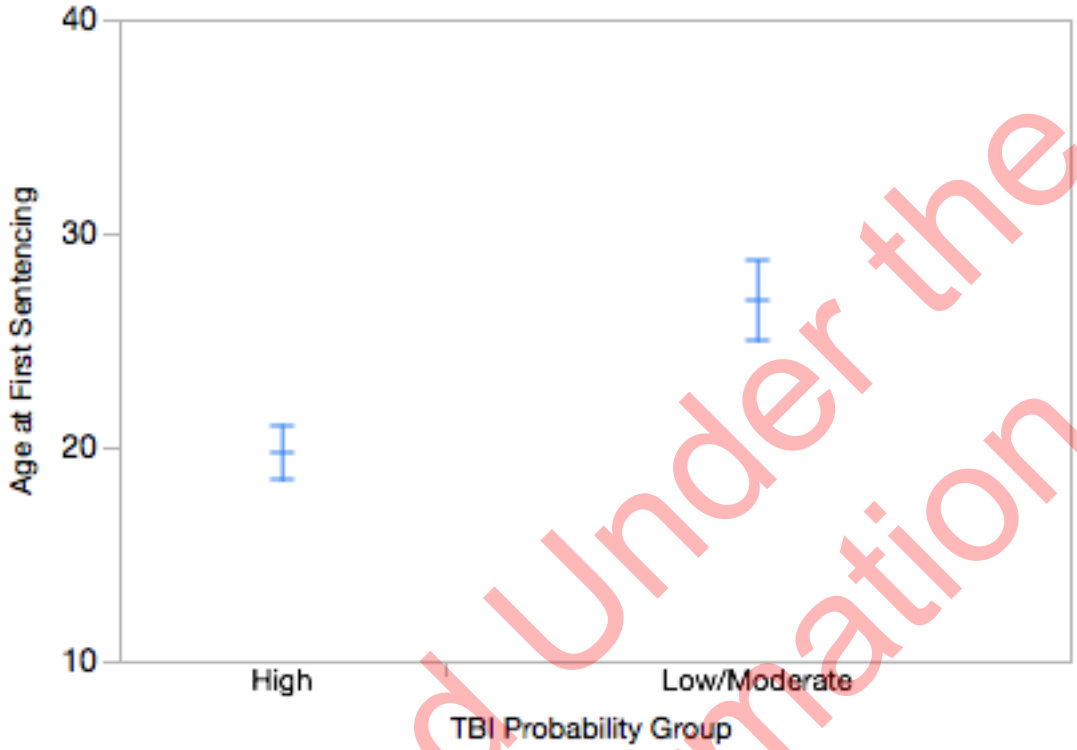

Figure 5. Age at first sentencing (any offence) for each TBI probability group. Error bars show standard errors for the group means

The two TBI probability groups (Low/Moderate, High) were then compared on each of the dichotomous outcome measures. Table 1 details the results for outcome measures, which were coded simply as absent or present (e.g., IDU status). Frequency counts and percentages are provided for both TBI categories for each measure. Results of a chi-square test of independence are reported for each comparison.

Table 1. Relationship Between the Probability of TBI Sequelae and Dichotomous Outcome Measures

		Probability of TBI Sequelae					
		Low/Moderate		High			
Measure		N	%	N	%	χ^2	p
Current IDU status	Yes	15	23.81	21	63.64	14.6	.0001*
	No	48	76.19	12	36.36		
Any Drug Conviction History	Yes	39	38.10	29	87.88	7.792	.0052*
	No	24	61.90	4	12.12		
Any Drink Drive Convictions	Yes	18	28.57	18	54.55	6.164	.0130*
	No	45	71.43	15	45.55		

*Significant at .05 level

Current IDU Status. As shown in Table 1, individuals in the High Probability Group were more likely to have been detected using drugs while incarcerated during their current sentence (63.6%) than the Low Probability Group (23.8%).

Drug Conviction History. Similarly, the High Probability Group had a greater likelihood of having a history of drug convictions during their lifetime (87.9%) than the Low Probability Group (57.3%).

Drink Driving Convictions. Consistent with the high co-morbidity with substance use in TBI, the High Probability Group had a higher likelihood of having a conviction for driving while intoxicated (54.5%) than their counterparts in the Low/Moderate Probability Group (28.6%).

3.0 Conclusions and Recommendations

Consistent with prior research in TBI in offenders, a very high rate of head injuries was found in the prison sample, with 90 out of 96 (93.75%) of participants having incurred some form of head injury in their lifetime. While this high rate of head injuries on its own did not discriminate among the imprisoned group examination of prisoners chronic history of TBI was associated with greater offending and with more difficulties while incarcerated. Based on their offending history and related actuarial factors, prisoners meeting this study's revised criteria for a high probability of TBI sequelae had a greater estimated risk of re-offending in the five year period following their release from prison. Supporting this finding, prisoners at higher risk of TBI sequelae showed a clear association between TBI and prior patterns of offending with higher a rate of overall offending, a higher number of violence, drug and drink driving convictions, and a younger age at first sentencing. Similarly, while incarcerated, prisoners at a higher probability of TBI associated problems experienced more minor behaviour infractions and were more likely to have been detected using drugs during their current sentence.

These findings are consistent with prior research into the association between TBI and a history of general offending (Williams, Cordan, Mewse, Tonks, & Burgess, 2010a[22]), violent offending (Williams, Mewse, Tonks, Mills, Burgess, & Cordan, 2010b[23]; Kenny & Lennings, 2007[24]; Fazel, Lichtenstein, Grann, & Långström, 2011[25]), younger age at entry into the justice system (Timonen, et al., 2002[26]; Williams, et al., 2010b), substance abuse (McKinlay et al., 2008[27]) and disciplinary infractions in prison (Piccolino & Solberg, 2014). The current study adds to the TBI research showing that a history of TBI is associated with increased risk of recidivism, more drink driving convictions and a higher rate of drug use incidents in prison and extends the literature to include variables that have previously received little research focus (i.e., risk prediction).

Several limitations to the current study are noted. Firstly, TBI identification was limited to participants' self-report, which has the potential for inaccuracies and recall biases. However, the observed consistency of the findings with regard to previous TBI prevalence data, lack of apparent secondary gain from misreporting injuries and the established criterion validity of the TBIQ (Diamond et al., 2007) suggest any such effects were minimal. A greater potential confound was the categorization of multiple mild TBI events, particularly those occurring over years in childhood. As discussed earlier, despite evidence of a cumulative negative effect on neuropsychological functioning in TBI, there is currently no consensus for the accurate estimation of the impact of an individual's experience of multiple TBI. The criteria employed in the present study appears to have usefully differentiated those at risk of long term TBI sequelae, however future research will

[22] Williams, W. H., Cordan, G., Mewse, A. J., Tonks, J., & Burgess, C. N. W. (2010a). Self-reported traumatic brain injury in male young offenders: A risk factor for re-offending, poor mental health and violence? *Neuropsychological Rehabilitation*, *20*(6), 801–812.

[23] Williams, W. H., Mewse, A. J., Tonks, J., Mills, S., Burgess, C. N. W., & Cordan, G. (2010b). Traumatic brain injury in a prison population: Prevalence and risk for re-offending. *Brain Injury*, *24*(10), 1184–1188.

[24] Kenny, D. T., & Lennings, C. J. (2007). The relationship between head injury and violent offending in juvenile detainees. *Contemporary Issues in Crime and Justice, 107.*

[25] Fazel, S., Lichtenstein, P., Grann, M., & Långström, N. (2011). Risk of Violent Crime in Individuals with Epilepsy and Traumatic Brain Injury: A 35-year Swedish population study. *PLoS Medicine*, *8*(12): e10011150. doi:10.1371/journal.1001150.

[26] Timonen, M., Miettunen, J., Hakko, H., Zitting, P., Veijola, J., Wendt, von, L., & Räsänen, P. (2002). The association of preceding traumatic brain injury with mental disorders, alcoholism and criminality: The Northern Finland 1966 Birth Cohort Study. *Psychiatry Research*, *113*(3), 217–226.

[27] McKinlay, A., Grace, R. C., Horwood, L. J., Fergusson, D. M., Ridder, E. M., & MacFarlane, M. R. (2008). Prevalence of traumatic brain injury among children, adolescents and young adults: Prospective evidence from a birth cohort. *Brain Injury*, *22*(2), 175–181.

be necessary to develop a clearer understanding of the variety of factors that may determine the impact of multiple injuries.

The relatively small size of the sample compared to some studies (e.g., Piccolino & Solberg, 2014: 1029 offenders) may limit the generalization of findings. However the sample size was also akin to smaller studies finding similar incidences and effects (e.g., Barnfield & Leathem, 1998: 118 offenders; Williams et al., 2010b: 196 offenders). Nonetheless, there is obvious utility to extend the sample to the wider prison population. Finally, the sample may not be as randomly selected as desirable. Because the author was generally not permitted to enter the prison unit yard to canvass volunteers, selection was dependent on prison officers' approach of prisoners. Despite clear instructions to approach all prisoners for volunteers, it was observed that officers at times proudly presented prisoners who "definitely have a head injury." A response bias may also have been present, with prisoners with a head injury history potentially being more likely to volunteer out of personal interest. Similarly, those with no history may have been reluctant to volunteer, believing they had nothing to contribute. These factors may account for the somewhat higher incidence found compared to other studies, but are unlikely to have affected the clear association with the various outcome measures observed. A larger study interviewing an entire prison population or interviewing all prisoners on intake would provide a more representative sample.

Finally, while an apparent effect was observed for offenders more likely to experience TBI sequelae to have their first conviction at a younger age, establishing any causal relationship may be confounded by the difficulty establishing the age at which the seminal head injury occurred, particularly for those with a history of multiple concussions but no identifiable LOC event.

Although the current study adds to the evidence of a correlation between TBI and offending, the nexus is not necessarily causative and a range of possible mechanisms are likely to be involved, including TBI-related behavioural dysregulation (Schofield et al., 2015[28]), exacerbation of pre-morbid personality tendencies toward violence (Iverson, et. al., 1993), and compromised insight and awareness (Williams, 2012). Moreover, the relationship can be bi-directional, with those who are already more prone to risky behaviour such as criminal acts being more likely to find themselves in contexts where head injury occurs. Unfortunately, there can be a certain vicious cycle whereby the behavioural and cognitive problems seen in offenders such as impulsivity, poor planning and consequential thinking tend to resemble the deficits observed in brain-injured individuals. As Miller (1995[29]) notes, such deficits increase the risk of sustaining a brain injury, which, if it occurs, is likely to exacerbate the anti-social behaviour: 'those most prone to sustain a brain injury are also most likely to have the worst reaction to it." Overall, despite the limitations of correlational research, the current study add to the evidence that brain injury can be a significant variable in criminal and prison behaviour and should be considered factor in the management, treatment and rehabilitation of offenders.

Recommendations

Given the observed impact of TBI on offending and prisoner behaviour, correctional systems would benefit from considering TBI in treatment, rehabilitation and prisoner management. Many of the cognitive impairments following TBI will present significant responsivity barriers to successful treatment or programme completion. Functional difficulties in TBI can include areas of memory, attention and concentration, language, problem solving, abstract thinking, insight, judgment, planning, information processing, and organization (New Zealand Guidelines Group, 2006), while impairment in executive

[28] Sarapata, M., Herrmann, D., Johnson, T., & Aycock, R. (1998). The role of head injury in cognitive functioning, emotional adjustment and criminal behaviour. *Brain Injury*, *12*(10), 821–842.

[29] Miller, N. S. (1995). Diagnosis and treatment of addictions in traumatic brain injury. *Alcoholism Treatment Quarterly*, *13*(3): 15–30.

functioning and insight may present as lack of motivation to attend programmes or work. Individuals with history of TBI are likely to experience difficulty processing new information and retaining treatment content from session to session and will require tailored learning strategies such as repetition, reminders, writing things down, avoiding complex instructions and providing more time for the individual to process information (Jackson et al., 2011[30], Manchester, Hodgkinson & Casey, 1997[31]).

Psychiatric disturbance, especially mood and anxiety disorders, is common in both the acute and chronic stages of recovery following TBI (Slaughter, Fann & Ehde, 2003[32]) and there are often changes in personality (Miller, 1995). As Jackson et al., (2011) observe, the high incidence of psychological problems coupled with higher than community rates of substance use disorder among prisoners, highlight the complicated health issues associated with imprisonment for TBI offenders. Screening all prisoners on intake for TBI will allow early identification and enhanced assessment of affected individuals to determine their needs (i.e., referral for further assessment such as neuropsychological evaluation or psychiatric assessment. Documentation of TBI status on prisoners' files will identify the need for tailored intervention and alert prison staff to appropriate management strategies.

Similarly, TBI sequelae (i.e., problems with attention, memory, irritability and anger) will impact on the management of prisoners. While those with a mild TBI may be able to function reasonably well in the highly structured routine of a prison environment, those with severe cognitive problems are likely to present more significant management challenges (Jackson et al., 2011). As a result, these individuals may often be inappropriately subject to prison management regimes for behaviour posing a risk to the good order of the prison. Jackson identified a need for staff training to identify and appropriately respond to prisoners' brain injury related behaviour problems and for specific individual behaviour management plans. Developing support strategies for prison staff can follow from an understanding of cognitive deficits and remedial/coping strategies such as repetition, reminders, and writing instructions and rules down. Similarly, avoiding complex instructions and giving prisoners more time to process information will also help those with impaired attention and concentration. Although TBI specific management approaches have not been documented, prisoners with TBI often respond well to standard correctional management and communication strategies (Magaletta & Diamond, 2007). Calm and direct communication, avoiding arguments, rephrasing or breaking problems, rules and instructions are all effective strategies that may be used. Encouraging prisoners to ask questions and use memory aid may also be helpful. Staff training will be necessary to assist corrections officers in identifying, understanding and responding appropriately to problem behaviour arising from TBI with appropriate strategies.

As previously noted, prisoners with a mild to moderate TBI may function relatively well in the structured prison environment, however problems associated with brain injury are likely to become more apparent following release to the community or movement to lower security prison environments. Although many prisoners on release face important challenges to successfully reestablishing community life, including difficulties with securing and maintaining housing and employment, accessing medical, mental health, and substance abuse treatment (Kushel, Hahn, Evans, Bangsberg & Moss, 2005[33]), offenders with a TBI are particularly at risk from re-integration difficulties. Homelessness has been shown to pose a significant risk of further TBI, while increased risk of substance abuse and can impact on released prisoners' ability to

[30] Jackson, M., Hardy, G., Persson, & Holland, S. (2011). *Acquired brain injury in the Victorian prison system*. Melbourne, Victoria: Department of Justice.

[31] Manchester D., Hodgkinson A., Casey T. (1997). Prolonged, severe behavioural disturbance following traumatic brain injury: What can be done? *Brain Injury, 11*, 605–617.

[32] Slaughter, B., Fann, J. R., & Ehde, D. (2003). Traumatic brain injury in a county jail population: prevalence, neuropsychological functioning and psychiatric disorders. *Brain Injury*, *17*(9), 731–741.

[33] Kushel, M. B., Hahn, J. A., Evans, J. L., Bangsberg, D. R., & Moss, A. R. (2005). Revolving doors: Imprisonment among the homeless and marginally housed population. *American Journal of Public Health*, *95*(10), 1747–1752.

meet parole conditions (Hwang et al., 2008[34]). Without appropriate support, re-integration difficulties can increase the likelihood of further offending and enhanced release planning and post-release referral and support will be necessary to avoid a revolving door scenario (Jackson, et al., 2011). Treatment of concurrent alcohol or substance abuse, referral to rehabilitation and other appropriate community services and appropriate living environments, particularly for individuals with more severe TBI are fundamental to community integration (Kushel, et al., 2005). In this regard, case managers will benefit from an understanding of the functional impairments in TBI in order to facilitate TBI affected prisoners transition back to the community, including providing family or supporters with education and recommendations for resource support in the community (Diamond et al., 2007; Piccolino, 2008; Wald et al., 2008). Lastly, as with prison staff, community corrections staff will benefit from training to recognize and respond to TBI affected individuals and from access to appropriate consultation with professionals with expertise in TBI.

With respect to the identification of affected individuals, it was noted that many participants who did not identify a history of head injury during the initial introduction to the assessment went on to recall more TBI events as the interview progressed and questions were posed in the four categories (vehicle, falls, sports and assaults). The current study supports the utility of a multiple item, structured interview format cueing recall across a range of categories and explicitly evoking memories of remote injurious events to document retrospective information on lifetime head injury that would otherwise be at risk from telescoping, the tendency noted in public health research to forget past injuries.

The current study further underscores the limitations of relying on a medical records or imaging for identification of TBI history, particularly in the offender population, with only 42.2% of participants reporting receiving or seeking medical attention following a head injury event. This is consistent with previous studies showing that 42% of persons in the general population responding to an internet based survey received no medical attention of any kind following a TBI (Corrigan & Bogner, 2007a), while 61% of all TBIs reported by prisoners received no medical care at the time (Diamond et al., 2007).

While it is important to improve offender TBI identification and screening, future research should begin focus on expanding knowledge of the impact of TBI on offending and rehabilitation. The present study adds to the emerging research in this area, however the offender sample unfortunately did not provide an opportunity to examine the impact of TBI on treatment completion rates. Given the well documented negative consequences of TBI on cognitive ability and the increasing focus on rehabilitation in prisons, this area should be a priority for future research.

Finally, while most of the extant studies on the impact of TBI on offenders have focused on male offenders, female offenders are likely to experience different risk factors for injury (Jackson, Nutall, & Diller, 2002[35]). Certainly, preliminary survey evidence from a US prison study suggests that TBI among women in prison is very common, with 96% of female prisoners meeting the criteria for having sustained a head injury compared to 82% for male prisoners. In contrast to male prisoners, more female prisoners met the criteria for moderate and severe TBI (45% & 29% respectively) than male prisoners (10.3% & 14%) (Diamond &, Magaletta, 2007). Female offenders are also likely to have experienced more multiple head injuries than male offenders, usually associated with domestic violence. Moreover, as a result of gender differences observed in the cognitive deficits profiles of prisoners with brain injury, female offenders may require different management strategies (Jackson, Hardy, Persson & Holland, 2011). Future research should focus on the impact of TBI on female offenders as findings from male offenders may not to generalize to this population.

[34] Hwang, S. W., Colantonio, A., Chiu, S., Tolomiczenko, G., Kiss, A., Cowan, L., et al. (2008). The effect of traumatic brain injury on the health of homeless people. *Canadian Medical Association Journal*, *179*(8), 779–784.

[35] Jackson, H., Philp, E., Nuttall, R. L., & Diller, L. (2002). Traumatic brain injury: A hidden consequence for battered women. *Professional Psychology: Research and Practice*, *33*(1), 39–45.