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University of Glasgow

The Prevalence of Cognitive Impairment and Disability Associated with Head Injury in Scottish Prisoners.

& Clinical Research Portfolio

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M.Sc, M.A. Hons.

Submitted in partial fulfilment of the requirements for the degree of
Doctorate in Clinical Psychology (DClinPsy)

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Chapter One: Systematic Review

The Relationship between Childhood Head Injury and Subsequent Offending Behaviour in Adolescence and Adulthood: A Systematic Review.

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Abstract

Background

Reports claim that Head Injury (HI) in childhood is a causal factor of offending as research suggests HI is over-represented in offender settings, regardless of age. Head Injury (HI) can lead to disability and poor social, emotional and behavioural outcomes, and some argue that HI in early childhood may result in poorer outcomes. Links have been found between violence and HI however some argue those likely to commit violent offenses, are more at risk of sustaining a HI.

Methods

Database searches were carried out using Medline, Embase, CINAHL, PsycINFO, Web of Science and ASSIA. Reference lists of meta-analyses, policy reports and systematic reviews in this area were scrutinised, and included papers were assessed for risk of bias.

Results

Six studies investigating childhood HI and offending behaviour were identified. Generally, HI appears to be a risk factor for offending, irrespective of age. Overall, there was high risk of bias in the methodology of the studies, particularly in relation to assessing the severity of HI and the impact of HI in relation to outcome.

Conclusions

There is no evidence to support the claim that childhood HI is more strongly associated with offending behaviour, compared with HI sustained in adulthood. Further research is needed comparing offending between those with HI in childhood and HI as adults.

Keywords: Systematic review, child, head injury, offending, risk factor.

Introduction

Policy reports take the view that childhood head injury (HI) causes offending. Some claim; HI increases the risk of offending by 50% (Parsonage, 2016), childhood HI is associated with earlier criminal activity and more serious, frequent crime (Hughes et al, 2012; Williams, 2012), and children and young people represent 25% of the prison population (BPS, 2015). Research reveals, HI is over-represented in the criminal justice system for both adults (Shirmoa, Ferguson and Pickelsimer, 2010), and children, with one review suggesting that juvenile offenders are three times more likely to have had a HI, than non-offending juveniles (Farrer, Frost and Hedges, 2013). Furthermore, 37-46% of adolescents in custody self-report a HI with loss of consciousness (William et al, 2010), a factor of relevance when determining severity of HI and considering long term outcome.

Implications of HI in Childhood

Head Injury (HI) in childhood may cause death, lifelong disability (Tagliaferri et al, 2006) and poor outcomes in education, social relationships (Janusz et al, 2002), neurocognitive functioning (Tonks et al, 2011) and behavioural skill development (Scott et al, 2015). Most HI's are mild and many show good recovery, however for some with moderate to severe HI, there may be persisting effects (Carroll et al, 2004). One study found that sustaining a severe HI in early childhood (aged 3-7 years) resulted in poorer neurocognitive outcome, compared to children who sustained a HI aged 8-12 years (Anderson et al, 2005). Evidence suggests the social brain does not reach its full potential until early adulthood (Blakemore, 2012) consequently; children who sustain a HI are at a stage of brain immaturity which may increase impulsivity, risk taking behaviours and emotional dysregulation. Some researchers support claims that HI during development may predispose individuals to a range of difficulties in adolescence and early adulthood, one of which is offending (Leon-Carrion and Ramos 2003).

Associations between HI and offending

Raine and colleagues investigated cognitive impairments in lifelong offenders and those whose offending behaviour was limited to childhood or adolescence only. Findings revealed lifelong, persistent offenders and childhood limited offenders had cognitive impairments, however lifelong offenders had sustained a greater number of HI's (Raine et al, 2005) suggesting multiple HI is a factor related to criminal behaviour. Evidence suggests externalising behaviour (aggression and rule breaking) is prevalent in 25% of delinquents with childhood HI (Ryan et al 2015) suggesting HI in childhood may be a risk factor for criminal behaviour. Furthermore, associations have been found between HI and violence (Hawley and Maden, 2003) with one study revealing HI increases the risk of violence to three times greater than in the general population (Fazel et al, 2009).

In contrast, some researchers draw caution when interpreting links between HI and offending, as findings suggest while aggression is a risk factor to sustaining a HI, it is also an outcome following HI (Cole et al, 2008). One study found several factors associated with criminal arrests after HI (e.g. age, pre HI offending and HI sustained from a violent cause), do not differ from factors associated with arrests in the general population (Elbogen et al, 2015). Hence HI, as one factor, cannot exclusively cause offending. Moreover, young people aged 15-19 years old are a cohort most commonly committing crime, highlighting adolescence as a time of risk for criminal behaviour, regardless of HI (Richards, 2011).

These findings mainly use adult populations and do not infer that childhood HI predicts offending, which makes it difficult to establish whether having a HI in childhood is a predictive factor for offending behaviour, or whether offenders are on a trajectory towards criminal activity prior to the HI (Farrer, Frost and Hedges, 2013).

A recent systematic review investigating the impact of childhood HI on risk taking behaviour in adolescence, reported mixed results with regards to HI predicting behaviour

outcomes (Kennedy, Cohen and Munafò, 2017). This review does not aim to establish whether childhood HI predicts offending and as such the search terms include ‘psychosocial’ and definitions of risk behaviour include: substance use, crime and conduct issues. This resulted in many of the included articles focusing on general predictors of psychosocial development, and childhood behaviour difficulties, which for most studies does not equate to criminal behaviour. The age criterion was restricted to 13 years or less; also likely to limit relevant studies. As the brain continues to develop beyond age 13 (Blakemore 2012), studies on children having a HI after age 13, should arguably be included.

From reviewing the literature, no studies comment on the gender differences in the relationship between HI in childhood and subsequent offending behaviour. Given that the majority of offenders are male, gender discrepancies could add insight into the extent to which childhood HI, after controlling for gender, predicts offending. Finally, HI severity is likely to be linked to the extent of disability and impairment. This is often understood through duration of loss of consciousness (LoC) and more recently researchers have suggested severity is linked with multiple HI’s. Establishing whether HI in childhood predicts offending requires a review of the role of multiple HI.

Given the increased prevalence of HI in young offenders, this review will consider research relating to childhood HI as a causal factor in offending. The review intends to establish whether there is evidence to support a temporal relationship by investigating discrepancies between offenders who have HI in childhood compared to as adults, and the ability of childhood HI to predict offending after considering confounding variables such as gender, education and socio-economic status. Furthermore this review will consider HI severity in relation to offending and the quality of studies, in terms of risk of bias.

Aim

To systematically examine the evidence related to childhood HI as a predictor of offending behaviour.

Research Questions

1. Is the prevalence of offending higher after childhood HI, than adult HI?
2. Is first conviction more often associated with HI in childhood than HI in adulthood?
3. Does childhood HI predict offending when socio-demographic factors are controlled?
4. What is the evidence for an association between multiple HI's in childhood and risk of offending?
5. Does childhood HI predict offending equally in males and females?

Methods

Search strategy

The following databases were searched on 21.06.17 for relevant published research: Ovid Medline, Ovid Embase, Ebsco PsycINFO, Ebsco CINAHL, Web of Science and Proquest ASSIA. Search terms were chosen by examining published systematic reviews conducted in similar fields of research and following a discussion with a librarian. Subject headings were searched for brain injuries, criminality and risk factors. The following search terms were used to search titles, abstracts and keywords:

1. head OR brain OR skull adj2 injur* OR fractur* OR concuss* or TBI
2. offend* OR offend* OR offens* OR crime* OR criminal* OR convict* OR prison* OR inmate* OR correctional* OR incarcerat*
3. predict* OR risk factors OR subsequent* or incidence or prevalen*
4. 1 and 2 and 3

The search and selection process was not checked by a second rater. Only published studies were included.

Inclusion and exclusion criteria

Quantitative studies were eligible for inclusion if they met the following criteria:

- Participants had a HI in childhood (age 0-16 years¹)
- Participants had evidence of criminal behaviour resulting in contact with the criminal justice system²

¹ This was decided based on the literature suggesting earlier childhood HI leads to changes in brain development, leading to on-going neuropsychological difficulties. By age 16, brain development is likely to be more sophisticated than in childhood years, therefore HI sustained over 16 years, may confound results and include young adults.

- The paper made attempts to investigate the relationship between childhood HI and subsequent offending behaviour
- The paper was printed in English

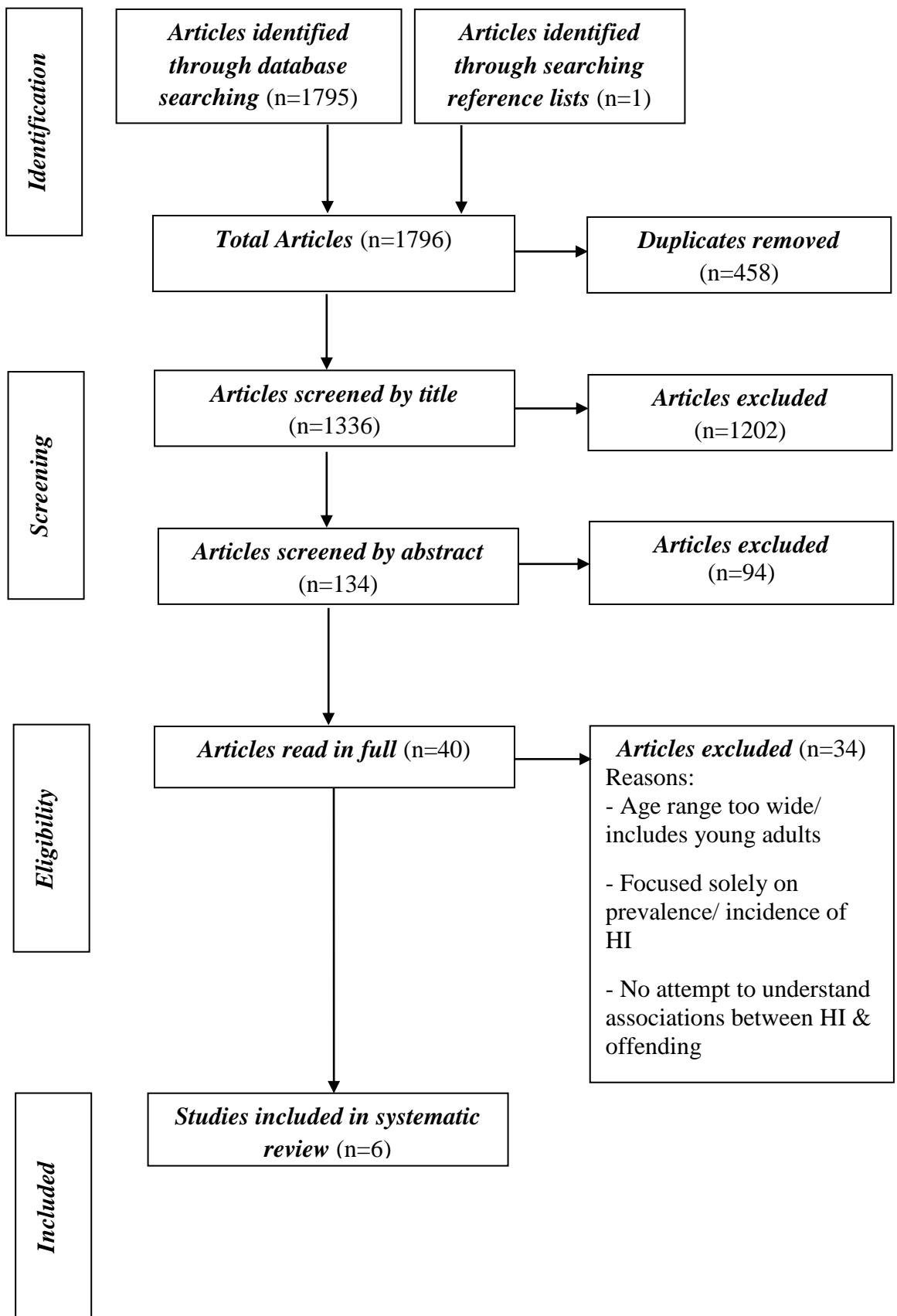
Studies were excluded if they did not meet the inclusion criteria or if there are no available data to review. Duplicate titles between databases were excluded. Titles and abstracts were screened, and those that did not meet inclusion criteria were excluded. Full texts were read and screened against inclusion criteria.

Search Results

In total 1795 articles were identified by search plus one additional article identified from reviewing the reference lists of policy reports (Hughes 2012; BPS 2015), a meta-analysis (Farrer, Frost and Hedges, 2013) and systematic review (Hughes et al, 2015). Of these, 459 duplicates were removed. The remaining 1336, articles were screened by title, leaving 134 which were screened by abstract. The resulting 40 articles were read in full. Six studies were used in the final review (see figure 1).

² Due to the differences in law and defining legal age of criminal responsibility as well as procedures for managing children involved in criminal activity this criteria is wide enough to capture details of criminal activity whilst limiting delinquent behaviour that may not come to attention of the court system.

Figure 1. Flow chart detailing search results



Quality Rating

Five domains were used to assess risk of bias. Domains are based on criteria developed for use in observational studies in epidemiology (Sanderson, Tatt and Higgins, 2007) and modified for use in reviews in HI and offending (Moynan and McMillan, in preparation). For studies to be low in their risk of bias, the following criteria must be met:

1. Methods for selecting study participants: Inclusion and exclusion criteria are clear.
2. Methods for assessing study variables:
 - (a) Identification of HI in childhood: (i) Use of assessment methods which are recognised internationally in HI/child populations, (ii) Use of definitions of HI severity which are internationally recognised, (iii) Assessment of the number and severity of HI using expert consensus, (iv) Use of a matched control group.
 - (b) Assessment of the impact of childhood HI, in terms of estimating, disability, mental health and neuropsychological outcomes: (i) Use of tools which are validated and relevant to outcomes in HI (ii) Comparison of prevalence of these outcomes to (a) offenders with HI sustained in adulthood and/ or (b) offenders without HI.
3. Design-specific confounders: (i) Sample should be demographically representative of
 - (a) the larger population of interest (e.g. a prison population), and (b) the larger geographical area (general population, prison population as a whole).
4. Methods to control confounding: These may include factors such as misuse of substances, accounting for missing data, cross-referencing self-report with hospital records and demographic variables e.g. age, gender, socioeconomic status.
5. Design and analysis plan: Examination of the temporal relationship between HI and contact with the CJS taking into account first conviction and age of HI, using regression or similar models.

Articles were rated for susceptibility to bias in each of these domains by two raters and additional information was used to guide the raters (appendix 1.2). Domains were categorised as ‘high’ or ‘low’ in risk of bias. There was inter-rater agreement for 44/48 (92%) of ratings (appendix 1.3). Four disagreements (from three domains) were resolved by discussion.

Results

Four studies were population birth cohorts and two were cross sectional. The risk of bias was high for 54% of study variables, with regard to understanding the relationship between HI in childhood and offending (see table 1). Risk of bias was lowest for selection of study participants, and was mixed for HI definition, matched control groups, design specific confounds, controlling confounding variables and design/ analysis plan. Particular issues were identified in relation to HI severity and the impact of HI in terms of outcome. Papers are summarised below in relation to the five domains. Table 2 details characteristics of each paper.

1. Methods for selection of study participants

Overall, there was low risk of bias with regard to selecting study participants. One study (paper 3) does not detail inclusion and exclusion criteria. Three papers include young and adult offenders, one includes adult offenders, and two include young offenders. All six papers include males and females, however two of these do not analyse female data due to small numbers.

Table 1: Risk of Bias defined as low or high.

| | Selection of participants | Assessing study variables | | | | Design confounds | Confounding variables | Design and analysis plan |
|---|-------------------------------------|--|--|-----------------------------------|------------------------------|--|--|---------------------------------|
| | Inclusion/exclusion criteria | HI definition & assessment tool | Assessment of number & severity of HI | Assessment of impact of HI | Matched control group | Comparisons to population of interest | Adjusts for confounding variables | Temporal relationship |
| 1:Brewer-Smyth et al 2015 | Low | Low | High | High | High | High | High | High |
| 2:Fazel et al 2011 | Low | Low | High | High | Low | Low | Low | Low |
| 3:Lewis & Shanok, 1979 | High | High | High | High | High | High | High | High |
| 4:McKinlay et al 2014 | Low | High | High | High | Low | Low | Low | Low |
| 5:Rantakallio, Koiranen & Mottonen, 1992 | Low | Low | High | High | High | Low | Low | Low |
| 6:Timonen et al 2002 | Low | Low | High | High | High | Low | High | Low |

Table 2: Characteristics of papers reviewed

| Paper number, author (s), year & country | Sample or population | Design | Prevalence of offending behaviour: HI in childhood & adulthood. | Association between HI & offending: child & adult HI | Temporal Relationship: child HI before first conviction | Multiple HI: association between number of HI and offending | Gender: male and female offenders with HI |
|--|---|-------------------------|--|---|--|---|---|
| 1:Brewer-Smyth et al 2015 (US) | 636 male and female young and adult offenders | Cross sectional, cohort | Not addressed: All participants are offenders: 37% of all offenders committed violent crime | Not addressed | Not addressed | Addressed: Offenders with an increased number of HI's before age 15, were more likely to commit a violent crime than a non-violent crime | Addressed: Male gender is associated with offending, for all participants, regardless of age of HI |
| 2:Fazel et al 2011 (Sweden) | 252,032 males and females | Population birth cohort | Addressed: <16: 6.7% offend >16: 9.4% offend | Addressed: Younger age at HI linked with lower risk of violent crime compared to HI as adult | Addressed: HI before age 16 years 1 st conviction before 16 years | Not addressed | Not addressed |

| Paper number, author (s), year & country | Sample or population | Design | Prevalence of offending behaviour: HI in childhood & adulthood. | Association between HI & offending: child & adult HI | Temporal Relationship: child HI before first conviction | Multiple HI: association between number of HI and offending | Gender: male and female offenders with HI |
|--|----------------------|--------------------------------|---|--|--|--|---|
| 3:Lewis Shanok, 1979 (US) | 162 male and female | Retrospective, cross sectional | Not addressed: All are offenders | Not addressed | Not addressed | Addressed: Offenders with child HI had a greater number of HI's compared with non-offenders, by age 4 and by age 16 | Not addressed |
| 4:McKinlay et al 2014 (New Zealand) | 1265 male and female | Population birth cohort | Not addressed | Addressed: HI in childhood increases risk of offending. HI as adult also increases risk of offending | Addressed: HI before 16 years 1 st conviction from age 16 | Not addressed | Addressed: Gender is not associated with offenders who have HI regardless of age at HI |

| Paper number, author (s), year & country | Sample or population | Design | Prevalence of offending behaviour: HI in childhood & adulthood. | Association between HI & offending: child & adult HI | Temporal Relationship: child HI before first conviction | Multiple HI: association between number of HI and offending | Gender: male and female offenders with HI |
|--|---------------------------|-------------------------|--|--|---|---|---|
| 5: Rantakallio, Koiranen & Mottonen, 1992 (Finland) | 355 male and female | Population birth cohort | Addressed: – only for child HI: 10.3% of children (up to age 14) with HI, have a criminal record | Not addressed | Addressed: HI up to age 14 1 st conviction from age 15 | Not addressed | Not addressed |
| 6: Timonen et al 2002 (Finland) | 5589 male and 5345 female | Population birth cohort | Addressed: – only for child HI 3.7% of children with HI, commit crime, compared with 2.5% of the general population | Not addressed | Addressed: HI up to age 15 1 st conviction from age 15 | Not addressed | Not addressed |

2. Assessing study variables

(i) HI definition and assessment

Four papers were rated as low in risk of bias for defining and assessing HI (1, 2, 5 and 6). Studies use International Classification of Diseases codes (ICD 10) specific to HI, from hospital records (papers 2 and 6) or hospital recorded ‘skull fracture’, ‘concussion’ and ‘cerebral contusion’ (paper 5). Paper one uses the Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID), a screening tool using self-report to identify HI, which includes questions about whether participants were dazed or lost consciousness as a result of HI. Although medical records were used in the other papers (3 and 4), HI is defined using simple descriptors including ‘head injury’ and for some participants, but not all, ‘skull fracture’, ‘concussion’ or ‘suspected TBI’. These were rated high in risk of bias, as it is unclear if recognised diagnostic systems were used to diagnose and assess the severity of HI.

(ii) HI severity definition, multiple HI and data comparison

Definition of HI severity was rated as having high risk of bias in all studies. No study directly distinguishes between mild or moderate to severe childhood HI, using internationally accepted definitions. Paper one describes the duration of loss of consciousness (LoC) to estimate HI severity, however, does not make distinctions between those injured as children and adults. Papers two and three use simple descriptors to define HI severity; includes ‘skull fracture’ or ‘concussion’. Paper four defines severity of HI as having LoC of twenty minutes, or hospitalisation for two days or more or, Post Traumatic Amnesia (PTA) of two hours or more, or Glasgow Coma Scale score (GCS) of greater than thirteen. These cut offs are not in keeping with the international consensus statement which defines moderate to severe HI as duration of LoC greater than thirty minutes, PTA greater than twenty four hours or GCS of less than thirteen, (Carroll et al 2004). This may result in

mild HI being misclassified as moderate to severe HI, and overall, result in high risk of bias.

(iii) Assessing of the impact of HI

All papers were high in risk of bias for assessing the impact and outcomes of childhood HI. Literature on long term outcomes following childhood HI, suggest disability, cognitive impairment and emotional and behavioural problems are common (Janusz et al 2002; Tonks et al 2011). Paper one assesses mental health, trauma and a number of factors that may be associated with offending, but not as outcomes of HI. Paper four assesses alcohol and drug dependence after HI. The remaining papers (2, 3, 5 and 6) do not mention the impact of HI or attempt to assess outcomes. This is necessary when aiming to understand the impact of HI and the service needs of this population in the CJS.

(iv) Matched control group

Risk of bias was high in four papers (1, 3, 5 and 6) and low in two papers (2 and 4). Studies, use sibling controls (paper 4), children with no HI (papers 2, 4, 5 and 6), children with no history of offending (paper 3) and offenders with HI in adulthood, aged >16 (paper 2) or 16-21 (paper 4). In paper one, the control group comprises offenders convicted of non-violent crimes, and there was no non-offender control group. While consistent with the aims of this study, this limits understanding of the specificity of childhood HI as a predictor of subsequent offending.

3. Design specific confounds

Risk of bias varied in relation to whether findings were representative of the wider population of interest, with four low in bias and two high. Four birth cohort studies are representative of the geographical area representing 100% (paper 2), 97% (paper 4) and 96% (paper 5 & 6) of the population of interest; e.g. people born within the study

timeframe. Paper one sampled males and females separately to compare equal proportions, but findings are not representative of gender mix in prisons. Finally paper three, does not provide data on the representativeness of their findings.

4. Controlling confounding variables

Three studies were rated as low in risk of bias (2, 4, and 5) and three high (1, 3 and 6). Social factors including marital status of mother, social class of father, socio-economic status (ses) and place of residence at time of birth, were controlled for in all but one study (1). Age and gender were controlled for in three studies (2, 3 and 4) and substance use in two (1, 2 and 4). Papers four and five considered several family related confounds such as parental employment, number of siblings and parents substance use. Paper four cross-referenced self-report of HI with hospital records. Paper one controlled for age, gender, childhood abuse and ‘neighbourhood adversity’, but does not cross-reference with hospital records. Paper six controlled for some confounding variables but not age or substance use and paper three did not control for confounds; hence the latter three were rated as high risk of bias.

5. Design and Analysis Plan

Four studies were low in risk of bias for design and analysis plan (2, 4, 5 and 6). Associations were computed between HI in childhood in different age bands (0-5 years, 6-15 years and 16-21 years), ensuring HI preceded arrests and convictions (paper 4). Findings revealed HI of any severity to be associated with criminality regardless of age at injury. The risk of criminal conviction may be lower in younger children (sustaining HI between 0-5 years), as the risk is reduced when substance use is added as a covariate for this age group. Regression analysis reveals associations between offending and HI before age 16 (in paper 2), age 15 (in paper 6) and age 14 (in paper 5). All, found evidence for an increased risk of offending following HI in childhood compared to children with no HI, in

the general population (OR of 2.0, 1.6, and 1.9, respectively). Paper three suggests that the number of HI's by age 16 is associated with offending (Chi Squared; offenders had an average of one HI compared with non-offenders (mean 0.3) and by age four HI was more common in juvenile offenders (mean (0.21) than non-offending juveniles (0.05). Paper one found that if having a HI before age 15, offenders were less likely to commit a violent crime than non-violent crime. However, neither paper one nor paper three provides details of the age of first conviction, making it difficult to establish whether the HI occurred first.

Risk of bias for temporal relationships between conviction and age at first HI seems low in most studies, but three (rated as low risk of bias) use samples where the criminal age of responsibility is 15 years. This could introduce bias because children may have committed criminal acts prior to age 15 and prior to HI but would not have a criminal record.

Discussion

1) Is childhood HI associated with a higher prevalence of offending than adult HI?

Research investigating the prevalence of HI in offender populations suggests links between offending and HI irrespective of age (Shiroma, Ferguson and Pickelsimer, 2010; Hughes et al, 2012). Few studies investigate whether child HI is linked with a higher prevalence of offending than adult HI. The prevalence of offending, in adults who sustained a HI as a child ranges between 3.7% and 10.3% (papers 2, 5 and 6). If considering papers with lower risk of bias the range is slightly reduced to 3.7%-6.7% (papers 2 and 5). There is little evidence on offending that compares those with first HI sustained as a child or as an adult, but studies which do make this comparison suggest a higher prevalence of offending if injured as an adult (9.4%) than as a child (6.7%; paper 2). None of these studies assess or define HI severity which makes it difficult to answer this question with confidence. At present, there is not enough evidence to suggest HI in childhood (versus in adulthood) is linked with a higher prevalence of offending.

2) Is first conviction more often associated with HI in childhood than HI in adulthood?

Recent reports take the view (Williams et al, 2010; Parsonage, 2016) that childhood HI affects the developing brain and increases risk of offending, however, it is not clear whether this is because any HI increases risk, or whether HI in childhood increases risk. Studies investigating this association suggest HI in childhood increases the risk of conviction by 1.6-2, times and this risk remains when considering papers low in risk of bias (papers 2, 5 and 6). Papers highlight that HI appears to be a risk factor for offending but provide limited evidence about risk relative to age at injury. There is not enough evidence to suggest HI in childhood further increases risk of offending.

3) *Does childhood HI predict offending when socio-demographic factors are controlled?*

Factors such as child abuse, parenting and gender are associated with offending (Farrington, Gaffney and Ttofi, 2017) and need to be considered in relation to HI as a cause of offending. Studies with low risk of bias that control for socio-demographic factors suggest that there is a 2 fold increase in risk of offending after HI in childhood (papers 2 and 5). Other studies with high risk of bias suggest no risk (paper 1) or an increased risk of offending of 1.6 times (paper 6). Socio-demographic and family factors may be associated with offending (Farrington Gaffney and Ttofi, 2017), however childhood HI is a greater risk factor for offending. Nonetheless these papers (1 and 6) are limited by high risk of bias in other domains; some lack appropriate control comparisons and others do not control for all potentially confounding variables. Evidence is weighted to suggest childhood HI is linked to offending, when other variables are controlled. However studies lack comparisons with the risk of offending in those with HI as adults, It is difficult to assert whether the increased risk is linked with HI in childhood specifically or with HI, irrespective of age.

4) *What is the evidence for an association between multiple HI's in childhood and increased risk offending?*

Multiple mild HI's may increase the risk of poor outcome (Guskiewicz et al, 2005), but few studies investigating HI in childhood and offending, consider this. Findings suggest an increased number of HI's in childhood is associated with offending and offenders have an increased number of HI's compared with population controls (papers 1 and 3). These papers are high in risk of bias in most domains except for selection of study participants

and assessment and definition of HI. Overall there is a dearth of quality data on HI frequency in studies on childhood HI and offending. More broadly, evidence is lacking in relation to whether repeat HI leads to persisting disability and impairment. Some suggest there is no evidence for this (Collie, McCrory and Makdissi, 2006). Currently, it is not possible to determine whether, the risk of offending after multiple HI's is specifically associated with childhood HI.

5) Does childhood HI predict offending equally in males and females?

Research on HI in offenders has primarily focused on males however prevalence figures suggest HI is common in male and female offenders (Shiroma, Ferguson and Pickelsimer 2010). Studies vary in findings related to the role of gender in understanding the association between HI in childhood and offending. Two papers considered the impact of gender; one found gender did not change the rates of arrests or convictions (paper 4), while the other found an association between being male and violent crime (paper 1). However, the latter relates to males being associated with offending generally as opposed to males injured in childhood, or males with HI. Furthermore, if considering papers with low risk of bias, gender does not impact on the ability of childhood HI to predict offending. Overall, the literature is sparse regarding the role of gender in the relationship between child HI and offending and is not sufficient to answer this question.

Strengths and Limitations of this review

This review could be improved by having a second rater check the search and selection process. Using a cut off age of 16 to separate child from adult HI was necessary to

understand differences between sustaining a HI during key stages of brain development, compared to young adulthood when the brain is largely developed. Unfortunately, much of the literature combines data on HI in childhood, adolescence and in young adults. This restricts the number of relevant papers eligible for review. Using a cut off age of 19 would have resulted in four additional papers for review. It is unlikely these papers would have changed the outcome of this review as no paper reviews the risk of offending drawing comparisons between HI in childhood versus adulthood. The risk of bias tool was useful in examining interpretations that may over-estimate associations between HI in childhood and offending. This is imperative when considering policy and service implications.

Future research

Future, high quality studies should focus on comparisons of child and adult HI across different age bands, to contrast associations between offending and those head injured in early childhood, adolescence, as young adults and adults. Extra consideration should be given to the methods used to establish first contact with the CJS, as discrepancies in the age of criminal responsibility may introduce bias, complicating the task of synthesising the literature. Moreover, researchers must review the role of gender in this population, use established definitions to assess HI severity and measure outcome appropriate to HI.

Conclusion

This is the first systematic review to assess the quality of studies and the evidence base for childhood HI, as a predictor of offending. While policy papers suggest childhood HI causes offending (BPS, 2015; Hughes 2012), the evidence base specific to the risk of childhood HI is limited. Appropriate studies to investigate this relationship are lacking and available evidence is limited to isolated findings. Although evidence suggests HI increases the risk of offending, after controlling for confounding variables, there is not compelling support for the suggestion that childhood HI adds to this risk. More research is required to determine the prevalence of childhood HI in offenders, and the reasons for this. This is essential before considering the development of services for young people in the CJS in relation to rehabilitation and prevention of crime.

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Chapter Two: Major Research Project

The Prevalence of Cognitive Impairment and Disability Associated with Head Injury in Scottish Prisoners.

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Plain English Summary

Background

Head Injury (HI) can result in on-going cognitive difficulties such as problems with memory, attention, planning, and can lead to lifelong disability. The Scottish Government is keen to consider the needs of prisoners with HI and understand rates of disability in this population. Studies have found between 25% - 87% of prisoners self-report having had a HI however there is a lack of research investigating the lasting impact in terms of disability. This makes it difficult to understand how many prisoners with HI require assessment and intervention. In summary, research into the rates and impact of HI in prisoners is incomplete. Further research is necessary to identify the needs of this population and determine whether they differ from typical offender populations.

Aims and Hypothesis

This study estimates the numbers of prisoners with moderate-severe HI who are disabled and who may require assessment or intervention. It is predicted that:

- cognitive impairment and disability are more often associated with self-report of moderate-severe HI, than mild HI
- anxiety and depression are more common in prisoners with moderate to severe HI, than mild HI.

Methods

81 males aged 21 years and over from one Scottish prison (HMP Shotts) were recruited via the National Prisoner Healthcare Network (an NHS group aiming to improve healthcare for prisoners). Prisoners were unable to participate if not fluent in English, if having severe mental health difficulties, a deteriorating neurological condition or if posing risk to researchers. Participants were interviewed and completed several tests. The Glasgow

Outcome at Discharge Scale (GODs) was used to determine whether a person is disabled and to what extent they are disabled in relation to having a HI. Mood and cognitive impairments were also measured. Prisoners were grouped by severity of HI (mild or moderate to severe HI, and by number of HI's). Group scores were compared to estimate the level of need in relation to disability and cognitive impairment.

Main Findings and Conclusion

All prisoners excluding one, self-reported HI (80% reported mild HI and 20% reported moderate-severe HI). Findings suggest cognitive impairment (50%), anxiety (56%) and disability (31.3%) are related to moderate-severe HI. Based on the relationship between HI severity and outcomes, this study estimates approximately 31.3-56% of prisoners with moderate to severe HI require follow up assessment. More research is necessary on a larger scale and to establish what 'follow up' might involve.

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Abstract

Introduction: Head injury (HI) is associated with impairments in cognition, behaviour, emotion and lasting disability. HI in offender populations is higher than in the general population however studies do not report prevalence of disability. This study estimates the occurrence of disability, cognitive impairment, anxiety and depression in prisoners, and the numbers who may require assessment or intervention.

Methods: A cross-sectional, between subjects design comparing severity of disability in 81 male prisoners with HI. Severity of HI was screened and outcome measures administered including the Glasgow Outcome at Discharge Scale (GODs), the Hospital Anxiety and Depression scale (HADs) and neuropsychological tests. Participants were grouped by duration of loss of consciousness (LoC) of greater (moderate-severe) or less (mild) than 30 minutes, and by number of HI's.

Results: Overall, between 31.3-56% of prisoners with moderate to severe HI are likely to require assessment and possibly intervention. HI was mild in n=65 and moderate-severe in n=16. Symbol Digit Modalities, clinical anxiety, and disability by HI were associated with duration of LoC after adjusting for covariates.

Conclusions: Cognitive impairment, disability and clinical anxiety are more common in prisoners with moderate to severe HI with 31.3-56% likely to require follow up. Findings are preliminary and further large scale research is required.

Keywords: prisoners, head injury, disability, prevalence

Introduction

There is increasing interest in the prevalence of head injury (HI) in offender settings. In Scotland, a report for the Scottish Government recommended further research in relation to the prevalence of disability in prisoners with HI and understanding the needs of this population (NPHN, 2016).

HI can result in widespread damage to brain structures (McAllister, 2008). Neuropsychological deficits, emotional difficulties (McAllister, 2008) and disability (Whitnall et al, 2006) may persist over time. Meta analyses estimate the prevalence of HI in prisoners as 50-60% (Shiroma et al 2010; Farrer, Frost and Hedges, 2013). Effects of HI on behaviour may increase the risk of offending. For example, cognitive impairment, impulsivity, aggression and disinhibited behaviour can make it difficult to regulate behaviour and to learn from mistakes (Shiroma et al, 2010). Offenders with HI are convicted of more violent crimes (Hawley & Maden, 2003) and have higher recidivism rates compared to offenders with no HI (Shiroma et al, 2010). Finally, offenders with HI are more difficult to manage in prison and to re-integrate into the community (Merbitz et al, 1995; Shiroma et al, 2010). This suggests a relationship between HI, offending behaviour and poor outcome which may indicate that the needs of this population differ from a typical offender population.

A systematic review of the prevalence of HI in prisoners (Moynan & McMillan, in preparation) found few studies consider the impact of HI especially in relation to disability. Disability is defined as impairments, limitations in activity and restrictions in participation related to the interaction between an individual and their environment (WHO, 2011). Definitions of HI and severity were inconsistent across studies. Self-reported duration of loss of consciousness (LoC) was often referenced, however arbitrary cut off scores were

used and duration of LoC was not corroborated with hospital records (Moynan & McMillan, in preparation).

In order to develop services for prisoners with HI there is a need to understand more about the numbers with associated disability and their needs. This study will investigate disability outcome in relation to severity of HI in prisoners.

Aims

Primarily, this study aims to estimate the number of prisoners with moderate-severe HI who are disabled and who may require assessment or intervention. It is hypothesised that cognitive impairment and disability are more often associated with self-report of moderate-severe HI, than self-report of mild HI and, that anxiety and depression are more common in prisoners with moderate-severe HI, than with mild HI.

Methods

Ethics

This project was approved by the NHS Research Ethics Committee, WOSREC 16/WS/0216 (appendix 2.4), and the Scottish Prison Service Ethics committee, 01/12/2016, (appendix 2.5).

Participants & Study Site

The study took place in Her Majesty's Prison (HMP) Shotts, a maximum security prison accommodating over 500 adult males aged 21 and over. This prison was selected because prisoners are serving lengthy sentences and therefore a stable population. Furthermore Shotts contains a National Integration Centre (NIC) accommodating 60 prisoners at the start of sentences equal to or greater than 5 years and forms part of the residence. The NIC prepares prisoners by supporting them to adjust to the prison regime and occasionally supports prisoners struggling to integrate within mainstream residential halls. Additionally HMP Shotts management team expressed interest and were practically able to support the study. Researchers met with participants in private rooms in residential halls or in the health centre. Equipment included outcome measures, questionnaires and neuropsychological testing equipment. Prison officers in the role of 'personal officer' were recruited to answer proxy measures of the Glasgow Outcome at Discharge Scale (GODs).

Eligibility Criteria

Prisoners were included if (i) fluent in English, (ii) having capacity to give consent, (iii) having no deteriorating neurological condition, (iv) no active, severe mental health difficulties (v) no severe communication difficulties and (vi) did not pose imminent risk of violence to researchers. Personal officers who completed proxy GODs questionnaire were included if they knew the prisoner well enough to answer the questions on the GODs.

Design

This is a quantitative, cross-sectional, between subjects design comparing level of disability, cognitive impairment and mood outcome of prisoners with HI. Ratings on the primary outcome measure, the GODs, and mood and neuropsychological measures, were compared between HI severity groups (duration of loss of consciousness (LoC), and number of HI's). Research suggests a cumulative impact of repeat HI (Guskiewicz et al, 2005). A parallel trainee project focused on understanding the practicality and validity of two screening tools for identifying HI in prisoners. The same dataset was collected for both studies and shared between projects.

Research & Recruitment Procedures

An outline of the study was distributed to HMP Shotts via the National Prisoner Healthcare Network (NPHN, 2016). Prison officers agreed to display recruitment posters (appendix 2.8) and invited prisoners to participate via an information (appendix 2.3; 2.5) and sign-up sheet. Recruitment took place between January and May, 2017. The researchers received Scottish Prison Service (SPS) training on Boundaries, Key training and Personal Protection prior to recruitment, carried personal alarms and followed prison procedures.

A semi-structured interview and assessment was completed with each participant; each trainee carrying out approximately half of the 83 assessments. Informed consent (appendix 2.4; 2.6) was obtained prior to interview, confidentiality limits were discussed with participants and data were anonymised and stored in accordance with NHS and university guidelines. A pilot (n=5), where both researchers were present and alternately administered screening tools and measures was arranged to ensure inter-rater reliability and limit practicality issues. This data was included in the final dataset.

During interview, participant information was recorded on a 'Data Capture Form' (appendix 2.7). HI was identified through self-report using one of two HI screening tools

(see screening tools³). Participants were randomly assigned to receive one screening tool, using a random number generator (Microsoft Excel, 2010). Demographic information was gathered for age, ethnicity, socioeconomic background (Scottish Index of Multiple Deprivation (SIMD, 2012)), years of education, school type, most recent occupation, problematic alcohol and substance use, number and nature of offenses, age of first offense, duration of time spent in custody and longest sentence given. Interview time ranged from 40 to 100 minutes, with most lasting 40 to 60 minutes. Participants were invited to ask questions following the assessment and researchers asked them if they found any aspects of the study upsetting and if needing on-going support. This occurred for no participants. A follow up meeting or phone call took place with each prisoner's personal officer to complete proxy ratings of the GODs.

Primary Outcome Measure: Disability

The Glasgow Outcome at Discharge Scale (GODs), McMillan et al, 2013

The GODs is based on the Glasgow Outcome Scale Extended (GOSe), (Wilson, Pettigrew and Teasdale, 1998) for use with inpatients at the point of discharge from hospital. These scales are specifically designed to assess disability following HI and encompass eight categories of disability established through a structured interview. The GODs has good predictive validity and has high inter-rater reliability (98%). Some questions were adapted relevant to a prison setting. For example specific words such as 'ward' were replaced with 'prison area' and 'shopping' was replaced with 'canteen shop'.

³ A question was added to the BISI screening tool asking whether participants lost consciousness for more than 30 minutes or up to 30 minutes. This was necessary to establish duration of LoC for grouping participants.

Mood Outcome Measure

The Hospital Anxiety and Depression Scale (HADS), Zigmond & Snaith, 1983

The HADS can detect depression and anxiety in people with HI (Whelan-Goodinson, Ponsford and Schönberger, 2009b). The scale consists of 14 items each rated on a 4-point Likert scale with a cut off score of 11 for anxiety or depression indicating clinical caseness.

Neuropsychological Outcome Measures

List Learning from The Adult Memory Information Processing Battery (AMIPB), Coughlan and Hollows 1985

The participant is asked to recall 15 unrelated words that are read to them; this procedure is repeated for five trials to test learning and memory. Test re-test reliability is high and people with an acquired brain injury perform below tests norms, with large effect sizes, suggesting adequate sensitivity (Lezak, 2012, pp531).

The Symbol Digit Modalities Test (Smith, 1982)

This is an assessment of information processing including attention, visual scanning, and motor speed. Participants identify nine different symbols which correspond with numbers 1-9. They have ninety seconds to write the correct number under the symbol and scores are recorded for the total number correct. It has high test-retest reliability (Lezak, 2012, pp421), and is sensitive to the effects of HI (Strauss, Sherman and Spreen, 2006, pp625).

Trail Making Test (TMT), Armitage (1946)

This test assesses divided attention and mental flexibility. The test has two parts. Participants were asked to draw a continuous line between circled numbers in ascending order, then later, alternate between circled numbers and letters. The total time taken to

complete each part is recorded (Lezak, 2012, pp423). Good sensitivity for neurological disorders has been found (Burgess et al 1998).

Hayling Sentence Completion Test (Burgess and Shallice, 1997)

This assesses verbal response inhibition. The participant is asked to complete sentences with meaningful context. They are then asked to complete sentences with a word that is meaningless in the context of the sentence, suppressing the dominant response to answer correctly. Adequate test-retest reliability ($r=0.72-0.93$) and internal consistency ($\alpha=0.62-0.76$) have been demonstrated (Burgess and Shallice, 1997).

Word Memory Test (WMT), Green, Lees-Haley and Allen 2003.

Valid neuropsychological assessment should include a test of effort and offender samples are a group who may be likely to feign symptoms or under-perform. Participants are asked to learn 20 word-pairs followed by an immediate recall task then a 30 minute delayed recognition task. Failure on any part of the test is considered evidence of poor effort. Sensitivity in detecting simulators was found to be 96-100% and validated in forensic samples (Green, Lees-Haley and Allen 2003).

Screening Tools

The Brain Injury Screening Index (BISI), (appendix 2.9)

This tool contains eleven questions which screen for HI based on self-report. A HI index score is calculated by multiplying the number of injuries by the longest LoC. Pitman and others (2014) found medium to large effect sizes when correlating scores on the BISI with behavioural and psychological outcomes in prisoners ($d>0.55$ for all dependent variables; $n=189$).

The Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID),
(appendix 2.10)

This structured interview uses self-report. It comprises five questions with five indicators that identify whether an individual is ‘likely’ or ‘not likely’ to have on-going problems after HI. It has good test-retest reliability ($r>0.6$) with large effect sizes when comparing OSU TBI-ID scores with several cognitive, psychiatric and behavioural outcomes (Bogner & Corrigan, 2009).

Justification of sample size

No studies compare disability relevant to HI severity on the primary measure used in this study. One study detected a difference between good and poor outcome following HI using the GOSe in non-offenders, ($n=40-45$; Whitnall et al, 2006). Pitman and colleagues (2014) found moderate-large effect sizes ($n=189$) comparing prisoners with and without HI on neuropsychological measures.

G*power (Faul et al, 2009) indicated $n=82$ is required to detect a medium effect ($r^2=0.3$) with 80% power, $\alpha= 0.05$, using correlation. To detect large effects ($r^2=0.5$), with the same analysis, 80% power, $\alpha= 0.05$, $n=26$, would be required. A G*power calculation indicated $n=85$ would be required to detect a medium effect ($f^2=0.15$), with power of 80%, $\alpha= 0.05$ using multiple linear regression with four predictor variables specified. To detect a large effect ($f^2=0.35$), $\alpha= 0.05$, $n=40$ would be required.

Grouping Participants for Data Analysis

Definition of severity of HI is important when predicting outcome. Duration of LoC is agreed as a method of defining mild (<30 minutes) and moderate-severe HI (>30 minutes), (Carroll et al, 2004a). LoC was divided in this way and also into no LoC, LoC 0-30 minutes 30 minutes to 24 hours and over 24 hours, to consider HI severity in more detail.

Researchers are concerned about effects of repeat mild HI; some suggest that three or more HI's may be associated with persisting impairment (Guskiewicz et al, 2005). In addition to duration of LoC, number of HI is considered.

Data Analysis

Statistical analysis was undertaken using IBM SPSS v22 (IBM, 2013). Demographic data are presented as measures of central tendency (mean and standard deviation, or percentages). Dependent variables are outcome measures and independent variables are duration of LoC and number of HI's. All inferential tests were two-tailed. Data did not meet parametric assumptions therefore Spearman correlations were used to understand the relationship between HI severity (duration of LoC & number of HI's) and outcome. Multiple linear regression was used to understand whether HI severity predicted outcomes. Variables considered as potential risk factors for outcomes were added as covariates (age, years of education, effort score and previous problematic alcohol and or substance use). Linear regression assumptions were not checked. Chi squared was used to compare HI severity and effort scores.

Cognitive Impairment

Raw scores were converted to z scores based on normative data used in clinical practice. Norms were computed for List Learning (Coughlan and Hollows 1985), Symbol Digit Modalities (Kiely et al, 2014), and Trail Making Test A & B (Tombaugh, 2004). Tombaugh offers norms based on age and education, but education was not relevant to this sample⁴ thus norms were specific to age alone. The Hayling manual does not provide age norms and instead splits normative data into four groups: healthy controls and three groups

⁴ Years of education were relevant for calculating norms for participants aged 50 years and older. Only one individual (younger than 50) had more than 12 years education therefore years of education were not relevant to calculating norms in this sample.

categorised by focal lesion location. Healthy control normative data was used to compute z scores (Burgess and Shallice 1997).

Mood

The HADs uses clinical cut offs for mild, moderate and severe anxiety and depression. Raw scores of 11 and above were considered ‘cases’ for anxiety or depression (Whelan-Goodinson, Ponsford and Schönberger, 2009b).

Disability (primary outcome)

The GODs assesses disability caused by HI and also captures disability from any cause. Disability was rated as, from any cause, or from HI.

Effort

The delayed recognition (DR) trial of the WMT was used to establish whether effort impacted performance on outcomes. WMT-DR scores were recoded as binary (pass or fail) and entered into multivariate analyses between HI severity and outcomes. This trial was chosen as the delay makes it the most likely trial to detect low effort (Strauss, Sherman and Spreen, 2006, pp1185).

Results

Demographic Data

Of 83 participants that volunteered, one was excluded due to a deteriorating neurological disorder and one who reported no HI.⁵ The mean age of the remaining 81 was 36.8 years (range: 21-67). 74% lived in the highest areas of deprivation prior to sentencing. SIMD categorises deprivation based on postal codes and is presented here as quintiles 1 (highest deprivation) to 5 (lowest deprivation). Table 1 displays age bands and SIMD quintiles for the sample and the male prison population in Scotland taken from a 2015 census (McMillan et al, in preparation). Chi squared suggests that the sample is representative⁶ of the male prison population for age: $\chi^2 (2) = 0.520$, p= >0.05; ⁷odds ratio (OR) 0.89; 95% CI 0.56, 1.40) and socio-economic background ($\chi^2 (1) = 1.3$, p>0.05; OR 1.49, 95% CI 0.80, 2.79).

Table 1: Sample compared with the Scottish prison population

| | Sample n (%) | Male prison population n (%) |
|------------------------------------|-------------------------|---|
| Age bands 16-29 | 22 (26.8) | 2557 (35.2) |
| 30-39 | 31 (37.8) | 2390 (32.9) |
| 40-49 | 15 (18.3) | 1400 (19.3) |
| 50-79 | 13 (15.9) | 913 (12.6) |
| Social Deprivation 1 (high) | 40 (49.4) | 3861 (53.7) |
| 2 | 20 (24.7) | 1669 (23.2) |
| 3 | 6 (7.4) | 887 (12.3) |
| 4 | 3 (3.7) | 525 (7.3) |
| 5 (low) | 3 (3.7) | 244 (3.4) |

⁵ The participant who reported no HI was excluded from data analysis as there was little meaning that could be drawn from individual data.

⁶ It is possible prisoners from the sample may overlap with those in the Census data.

⁷ Data were combined into two groups for age: 16-29&30-39, 40-49&50-79; SIMD: 1&2, quintiles 3,4&5.

| | | |
|-----------|----------|---------|
| Not known | 9 (11.1) | 2 (2.7) |
|-----------|----------|---------|

93% of participants were white, 3.7% Asian and 2.4% were Black. 58.5% of participants reported previous problematic alcohol use and 68.3% previous problematic substance use. Participants reported convictions for violence (84%), property (43%) and other offenses including fraud and breach of the peace (66%). The average number of convictions was 17.6 and average total prison time served 10 years, (see appendix 2.11).

Education and Occupation History

Years of education ranged from 7-14 (m 10; SD 1.3). 53.7% went to mainstream school, 11% received learning and/or behaviour support within mainstream school and 35.4% attended specialist schools for learning or behaviour difficulty. Participants frequently reported missing school through truancy (84%), serious illness (16%) or suspension (78%). Approximately 67% reported being employed prior to sentencing; 33% as unskilled/low skilled and 34% skilled/professional.

Head Injury History

All participants reported at least one HI (73% with LoC) and 90%, more than one (see table 2).

Table 2: Head Injury Descriptive Data; mean and SD or N (%)

| | |
|---|--------------|
| Age at first HI | 11.62 (8.93) |
| Number of HI's | 4.35 (2.27) |
| Estimated total no of days in hospital | 9.74 (29.71) |
| HI with Loss of Consciousness (LoC) | 59 (73) |
| Maximum LoC duration <30 minutes | 65 (80) |
| Maximum LoC duration >30 minutes | 16 (20) |

Cognitive Impairment

Defined as 1.5 SD or more below normative means (within the bottom 7% of the population), this was found in 10-60% depending on the test. Cognitive impairment was more common after moderate-severe HI except on Trail Making Test A and Hayling B (see Table 3). Correlations between cognitive impairment and HI severity (duration of LoC as a continuous variable) indicate a significant association between Symbol Digit Modalities and duration of LoC (table 4). Cognitive impairment significantly correlated with duration of LoC. 8 (50%) prisoners with moderate to severe HI were impaired.

Table 4: Spearman correlations between cognitive impairment outcomes and HI severity

| Cognitive test scores (mean z norms) | LoC duration (0, 1-30mins, 30 mins-24 hrs, >24hrs) | Number of HI's (1-12) |
|---|--|----------------------------------|
| | <i>r (p)</i> | <i>r (p)</i> |
| List Learning (n=80) | -0.083 (0.46) | 0.54 (0.64) |
| Symbol Digits (n=79) | -0.33 (0.003)* | -0.185 (0.10) |
| Trail Making A (n=79) | 0.02 (0.89) | 0.187 (0.10) |
| Trails Making B (n=78) | -0.08 (0.50) | -0.063 (0.58) |
| Hayling A (n=81) | -0.01 (0.92) | 0.065 (0.57) |
| Hayling B (n=80) | -0.05 (0.65) | -0.005 (0.97) |
| Hayling C (n=80) | -0.20 (0.07) | -0.062 (0.58) |

*represents statistically significant correlation

Table 3: Prevalence of Cognitive Impairment 1.5 SD below the clinical mean of zero.

| Cognitive Test | Impairment in sample n (%) | Mild HI (<30 minutes LoC) | | Moderate-severe HI (>30 minutes LoC) | | Less likely to have persisting effects (<3 HI) | | More likely to have persisting effects (3-12 HI's) | |
|-------------------------|-------------------------------|------------------------------|--------------|---|--------------|---|--------------|---|--------------|
| | | Impaired | Not impaired | Impaired | Not impaired | Impaired | Not impaired | Impaired | Not impaired |
| List Learning (n=80) | | n=64 | | n=16 | | n=16 | | n=64 | |
| | 48 (60) | 36 (56) | 28 (44) | *12 (75) | 4 (25) | *12 (75) | 4 (25) | 36 (56) | 28 (44) |
| Symbol Digit (n=79) | | n=63 | | n=16 | | n=16 | | n=63 | |
| | 17 (22) | 9 (14) | 54 (86) | *8 (50) | 8 (50) | *4 (25) | 12 (75) | 13 (21) | 50 (79) |
| Trails A (n=79) | | n=63 | | n=16 | | n=16 | | n=63 | |
| | 29 (37) | *26 (41) | 37 (59) | 3 (19) | 13 (81) | *7 (44) | 9 (56) | 22 (35) | 41 (65) |
| Trails B (n=78) | | n=63 | | n=15 | | n=16 | | n=62 | |
| | 45 (58) | 36 (57) | 27 (43) | *9 (60) | 6 (40) | *10 (63) | 6 (37) | 35 (56) | 27 (44) |
| Hayling A (n=81) | | n=65 | | n=16 | | n=16 | | n=65 | |
| | 24 (30) | 19 (29) | 46 (71) | *5 (31) | 11 (69) | *7 (44) | 9 (64) | 17 (26) | 48 (74) |
| Hayling B (n=80) | | n=64 | | n=16 | | n=15 | | n=65 | |
| | 8 (10) | *7 (11) | 57 (89) | 1 (6) | 15 (94) | *2 (13) | 13 (87) | 6 (9) | 59 (91) |
| Hayling C (n=80) | | n=64 | | n=16 | | n=15 | | n=65 | |
| | 25 (31) | 19 (30) | 45 (70) | *6 (37.5) | 10 (62.5) | *6 (40) | 9 (60) | 19 (29) | 46 (71) |

*represents % impairment > sample % impairment

Mood

31 (38%) participants were ‘cases’ (score of 11 or higher) for anxiety and 11 (14%) for depression, (table 5). Of those with moderate to severe HI 9 (56%) were ‘cases’ for anxiety.

Table 5: Prevalence of ‘cases’ with anxiety or depression

| Mood | Cases (11+) in sample n (%) | LoC n (%) | | Number of HI’s n (%) | |
|---|--|-------------------------------|-------------------------------|-------------------------------|-----------------------------|
| | | <30 mins (n=65) | >30 mins (n=16) | < 3 HI’s (n=16) | 3-12 HI’s (n=65) |
| Anxiety Scores 11+ (n=81) | 31 (38) | 22 (34) | 9 (56) | 5 (38) | 26 (40) |
| Depression Scores 11+ (n=81) | 11 (14) | 9 (14) | 2 (12) | 3 (25) | 8 (12) |

Anxiety was significantly associated with duration of LoC ($r=0.292$, $n=81$, $p=0.008$) and number of HI’s ($r=0.318$, $n=81$, $p=0.004$). Depression was significantly associated with duration of LoC ($r=0.228$, $n=81$, $p =0.04$) and not with number of HI’s ($r=0.135$, $n=81$, $p=0.229$).

Disability

Prevalence was 44% by any cause and 21% disabled specifically by HI.

Table 6: Prevalence of disability associated with HI

| | Good recovery | Disabled |
|-----------------------|----------------------|-----------------|
| LOC<30 mins | 53 (82%) | 12 (18%) |
| LOC>30mins | 11 (69%) | 5 (31%) |
| | 64 (79%) | 17 (21%) |

Using Spearman correlation, LoC duration and disability associated with HI was significant ($r=0.291$, $n=81$, $p=0.008$) and no significant association was found between LoC duration and disability by any cause ($r=-0.161$, $n=81$, $p=0.151$). Similarly, number of

HI's were significantly associated with disability by HI ($r=-0.223$, $n=81$, $p<0.045$) and not with disability by any cause ($r=-0.178$, $n=81$, $p=0.112$). Of those with moderate-severe HI, 31.3% were disabled by HI.

Effort

Overall, 50% of the sample failed the effort test, 49% with mild HI and 53% with moderate-severe HI. More participants with shorter LoC duration passed the effort test. A chi squared test indicated no significant association between LoC duration and the delayed memory, effort score ($\chi^2= 0.082$, $p>0.05$), suggesting effort was not significantly related to severity of HI.

Correlations between the delayed memory effort score, and tests of attention indicate significant associations for Symbol Digit Modalities $r= 0.309$, $n=79$, $p= 0.006$, List Learning $r= 0.445$, $n=80$, $p= 0.001$, Trail Making Test A $r= 0.268$, $n=79$, $p=0.018$ and Trail Making Test B $r= 0.366$, $n=78$, $p= 0.001$.

Multivariate Analysis

Multiple linear regression was used to further examine significant associations between outcome variables and LoC duration (Symbol Digit Modalities; anxiety, depression), number of HI (anxiety, GODs HI) after adjusting for age, years of education, effort scores and previous problematic alcohol and/or substance use, and between LoC duration (GODs HI), with adjustment for previous problematic alcohol and/or substance use. Table 7 shows results for all models (see appendix 2.12 for additional model data).

Table 7: Coefficients, p values and confidence intervals for all regression analyses

| <i>Outcome variable and covariates</i> | <i>Coefficient</i> | <i>p 0.05</i> | <i>95% Confidence interval (CI)</i> |
|--|--------------------|---------------|-------------------------------------|
| <i>SDMT</i> | | | |
| LoC | -0.315 | *0.006 | -0.559, -0.100 |
| Drug/ alcohol | -0.099 | 0.398 | -0.741, 0.298 |
| Effort | -0.157 | 0.169 | -0.688, 0.123 |
| Education | -0.021 | 0.853 | -0.169, 0.140 |
| Age | -0.006 | 0.956 | -0.020, 0.019 |
| | | | |
| <i>Anxiety</i> | | | |
| LoC | 0.217 | *0.042 | 0.052, 2.591 |
| Drug/ alcohol | -0.016 | 0.882 | -2.958, 2.546 |
| Effort | 0.003 | 0.975 | -2.172, 2.243 |
| Education | -0.274 | *0.012 | -1.921, -0.245 |
| Age | -0.234 | *0.031 | -0.219, -0.011 |
| | | | |
| <i>Depression</i> | | | |
| LoC | 0.152 | 0.145 | -0.356, 1.812 |
| Drug/ alcohol | 0.175 | 0.185 | -0.613, 4.088 |
| Effort | 0.001 | 0.991 | -1.875, 1.897 |
| Education | -0.070 | 0.549 | -0.932, 0.499 |
| Age | 0.059 | 0.615 | -0.066, 0.111 |
| | | | |
| <i>GODs HI</i> | | | |
| LoC | -0.278 | *0.011 | -0.595, -0.080 |
| Drug/ alcohol | -0.197 | 0.069 | -1.039, 0.039 |
| | | | |
| <i>Anxiety</i> | | | |
| No. of HI's | -0.194 | 0.071 | -0.040, 0.949 |
| Drug/ alcohol | -0.017 | 0.878 | -2.984, 2.555 |
| Effort | 0.016 | 0.882 | -2.050, 2.380 |
| Education | -0.285 | *.009 | -1.965, -0.286 |
| Age | -0.211 | 0.056 | -0.209, 0.003 |
| | | | |
| <i>Gods HI</i> | | | |
| No. of HI's | -0.129 | 0.245 | -0.163, 0.042 |
| Drug/ alcohol | -0.197 | 0.077 | -1.059, 0.056 |

*significant predicted outcome

Discussion

Prisoners who self-reported moderate-severe HI have greater cognitive impairment, disability and clinical anxiety than prisoners with mild HI. Duration of LoC predicted mood, cognitive impairment and disability, after adjusting for factors that might be independently associated with these outcomes. The number of HI's did not predict disability or anxiety after these adjustments. Overall, if considering cognitive impairment, clinical anxiety and disability associated with moderate to severe HI, 31.3-56% of prisoners in the sample might benefit from some form of follow up assessment. This is felt reasonable given the practicalities of developing a system capable of providing further neuropsychological assessment and follow up. Given the large numbers of prisoners with HI and various other disabilities, focusing on those with more severe HI is likely to distinguish prisoners with persisting disabling effects (NPHN 2016; Carroll et al, 2004b). Those with mild HI could be offered a lower intensity 'educational intervention' initially.

Cognitive Impairment

A cut off impairment score of 1.5 standard deviations below the mean (zero) was used to define impairment (Skandsen et al, 2010; Zimmermann et al, 2011). A cut off score of one standard deviation would represent performance within the low average-average range and would not be sufficiently specific to be practical in detecting prisoners requiring assessment or intervention. Performance below 1.5 SD on cognitive tests is in the lowest 7% of the normal population (Strauss, Sherman and Spreen, 2006, pp5). Across the sample, impairment in memory (List Learning) and executive function (Trail Making B) was observed in more than half the sample. A larger proportion of prisoners with self-reported moderate-severe HI were impaired in memory compared with prisoners with mild HI. Symbol Digit Modalities performance suggested that 50% of prisoners self-reporting moderate-severe HI were impaired and after adjusting for confounding variables, duration

of LoC predicted performance on this test. However on Trails B impairment was frequent in both HI groups.

Memory and executive function difficulties are common after moderate-severe HI (McAllister, 2008) and can impair independent living. Similar difficulties are reported in prisoners (Meijers et al, 2015) and there may be reasons for these impairments in addition to HI. Pitman and colleagues (2014) found that self-reported HI in offenders was associated with impairment of memory and executive functions. Their study differed from the present in their test selection and larger sample size, which may explain some differences in findings. In the present study, impairment was relatively uncommon on the Hayling Sentence Completion Test, perhaps suggesting spared function in terms of verbal inhibition. Alternatively the test may not be as sensitive in detecting executive impairment in prisoners. Observations suggested that once prisoners were given a prompt for parts B and C during the pre-test example, they then used a strategy that improved their performance on this test. Perhaps tests of behaviour inhibition and ecologically valid information from incident reports would be a more appropriate in future.

Mood

Following HI, depression and anxiety are common and are often new diagnoses (Whelan-Goodinson et al, 2009a). 56% of prisoners self-reporting moderate-severe HI reported clinical anxiety. These prisoners may require follow up and this is in keeping with other studies on prisoners (Pitman, et al, 2014). On this basis it is estimated that approximately half of prisoners reporting moderate-severe HI may require HI follow up.

Disability

Most HI's are mild with many showing good recovery; however, for some, with moderate-severe HI, there may be persisting disability (Carroll et al, 2004a). Twenty-one percent of prisoners reported disability associated with HI suggesting 31.3% of prisoners with

moderate to severe HI require further assessment. A recent census study of prisoners in Scotland using hospital admissions for HI, defined ‘more severe’ HI’s as intracranial HI’s or repeat HI’s. Results suggested the prevalence of ‘more severe’ HI was 10% (McMillan et al in preparation). Taken together with findings from the present study, at least one third of prisoners with hospital records of ‘severe’ HI, may be disabled by HI and likely to require follow up. Further research may focus on understanding what this follow up would entail; this is beyond the scope of this study. Furthermore, disability from any cause was present in almost half of prisoners indicating a need to distinguish disability specific to HI if developing a service for HI. Future studies may consider establishing the validity of disability tools associated with HI in the prison population. Preliminary findings from this study support the use of duration of LoC to distinguish whether disability is associated with HI as opposed to another cause e.g. physical disability.

Effort

Half failed the effort test and this could be due to poor motivation, an attempt to deceive, limited specificity of the WMT leading to false positives or alternatively severe attention difficulties (Batt, Shores and Chekaluk 2008). Evidence supports the latter in that effort scores were positively correlated with attention scores. Additionally, evidence suggests the WMT has such high specificity that it may detect poor effort in people who are in fact cognitively impaired (Greiffenstein et al, 2008). Regardless, findings in the present study remained significant even after adjusting for effort.

Limitations

The study was limited by the absence of a non-head injured control group, probably because of a bias in recruitment. The study was advertised as a ‘Head Injury’ research study and despite stating that participants need not have had a HI, prisoners and prison officers seemed under the impression that only people with HI could participate. This was addressed mid-way through recruitment whereby all prison officers were informed anyone could take part but a change in recruitment pattern did not occur. In future, a poster advertising a study related to prisoner’s health needs, may reduce recruitment bias. Furthermore, several prisoners who enquired about taking part asked if they could take part despite no history of HI however following screening for HI, it became clear they did not recognise previous blows to the head, as HI. This suggests education regarding HI in prisoners may be limited. The study is limited in that parametric assumptions were not checked for multiple linear regression. Furthermore, the issue of multiple statistical testing which may increase the likelihood of error, limits the findings. As this is a preliminary study, this will be reviewed following additional data collection.

Inevitably, characteristics of the sample suggest prisoners do not represent the general population with 35.4% attending specialist schooling for behaviour and learning needs however, are representative of prisoners with one study suggesting 30.7% have considerable learning needs (Hayes et al, 2007); an attempt was made to consider this in the linear regression.

Finally, self-report is a convenient measure of HI severity however, some argue a need to triangulate this with hospital records (Mckinlay, Horwood and Ferguson 2016). Previous research found hospital recorded prevalence of HI in Scottish prisoners to be 25%, and in ‘more severe’ HI 10%, (McMillan et al in preparation). This is in keeping with the findings of the present study.

Conclusion

Cognitive impairment, disability and clinical anxiety are more common in prisoners with moderate-severe than mild HI. About 31.3-56% of prisoners with moderate to severe HI are likely to require assessment. This study is unique in its contribution to HI in prisoners specifically as it expands on investigating neuropsychological correlates (Pitman et al, 2014) and estimates disability associated with HI. Clinically, these findings provide a rough estimate of the extent of HI disability in prisoners and could influence stepped care approaches to assessment within prison health care. This study should be considered preliminary and further research with a larger sample, including prisoners reporting no HI, is needed.

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Appendix 1.1: Author guidelines for submission to the Journal of Head Trauma Rehabilitation

SCOPE

The *Journal of Head Trauma Rehabilitation* (JHTR) is a bimonthly journal devoted to presenting scientific information on restoring function and limiting disability due to traumatic brain injury (TBI). The primary aim of JHTR is to disseminate original research to professionals from multiple disciplines who study and/or treat persons who have experienced a TBI. All published research manuscripts receive masked peer review.

Articles appearing in JHTR address functional effects of TBI and interventions intended to ameliorate those effects. Findings should inform the treatment of individuals and families affected by TBI, the systems of care in which services are provided, or the epidemiologic and public health issues relevant to TBI. Manuscripts are expected to address questions that would be of interest to the wide range of professionals involved in TBI care--articles that are narrowly focused or relevant to only a single discipline typically are not published.

Populations of interest. Research reported in JHTR is generally limited to human subjects with a history of TBI, the families and caregivers of individuals with TBI, and/or the systems of care in which TBI services and research are undertaken. Studies may address injuries of any severity, sustained by any age group. If a study's sample includes individuals with acquired brain injuries other than TBI, analyses must be included to confirm that the findings reported for the entire sample are specifically true for those with a history of TBI.

Case ascertainment. Procedures used to determine that participants incurred a TBI must employ proven clinical techniques or validated research methods of TBI identification.

Transparency and openness. Please state in the article whether data, programming code or other materials are available to other researchers and, if so, how to access them. Data or code that was not the authors' own should be cited in the text and listed in the reference section.

Randomized controlled trials must be preregistered on *clinicaltrials.gov* or similar independent, institutional registry, prior to the initiation of data collection. Preregistration, including of pre-analysis plans, is recommended for all study designs. If a trial is preregistered, a link to the registry should be provided in the main text.

Inclusion of diverse participants. Please provide sex or gender-specific and racial/ethnic-specific data in describing the outcomes of experimental and observational analyses, or specifically state that no sex-based or racial/ethnic-based differences were present. Where applicable, authors should explain why people of a particular age, race, ethnicity, gender or sex were excluded from a study.

The term "sex" should be used as a classification, generally as male or female, according to the reproductive organs and functions that derive from the chromosomal complement. In the study of human subjects, the term "gender" should be used to refer to a person's self-representation as male or female, or how that person is responded to by social institutions on the basis of the individual's gender presentation.

MANUSCRIPT SUBMISSION

Article types: Original articles may employ experimental, observational or qualitative designs. JHTR will publish replication studies. Systematic reviews, scoping reviews and meta-analyses are also of interest.

Commentaries and Letters to the Editor will be reviewed and accepted at the discretion of the Editors. Other special communications must be discussed with the Editor-in-Chief prior to submission.

Investigations of the efficacy of interventions using only quasi-experimental designs typically are not accepted. Case studies or case series, unless they address a seminal clinical condition or procedure that has not been previously reported in the published literature, will not be reviewed.

Authors are strongly encouraged to consult relevant guidelines for research reporting found at <www.equatornetwork.org>. Authors have the option of uploading a completed checklist with page and line numbers indicated for each criterion met. Unless an author has been invited by an issue editor to submit a manuscript for a topical issue, all original research should be submitted as "Unsolicited (Focus on Clinical Research)".

Article length: Manuscripts should not exceed 3500 words excluding abstract, references, tables, and figure legends. If the author(s) feels a longer manuscript is necessary, please contact the Editor-in-Chief in advance of submission. Typically, except for review articles, the number of references should not exceed 50. Authors are encouraged to use Supplemental Digital Content (SDC) for manuscript details that enhance but are not central to the comprehension of the paper. SDC is linked to the article indefinitely via the JHTR website (for more information, see description below). As of 2016, JHTR will accept brief reports that do not exceed 2000 words, 3 tables and/or figures and 15 references.

Online manuscript submission: All manuscripts must be submitted online through the Web site at www.edmgr.com/jhtr, which can also be accessed through the journal's Web page.

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CONFLICTS OF INTEREST

Authors must state all possible conflicts of interest in the Title Page of the manuscript, including financial, consultant, institutional, and other relationships that might lead to bias or a conflict of interest. If there is no conflict of interest, this should also be explicitly stated as none declared. All relevant conflicts of interest and sources of funding should be included on the title page of the manuscript with the heading "Conflicts of Interest and Source of Funding:". For example:

Conflicts of Interest and Source of Funding: Author A has received honoraria from Company Z. Author B is currently receiving a grant (#12345) from Organization Y and is on the speaker's bureau for Organization X—the CME organizers for Company A. For the remaining authors none were declared. In addition, each author must complete and submit the journal's copyright transfer agreement, which includes a section on the disclosure of potential conflicts of interest based on the recommendations of the International Committee of Medical Journal

Editors, "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" (www.icmje.org/update.html).

A copy of the form is made available to the submitting author within the Editorial Manager submission process. Co-authors will automatically receive an Email with instructions on completing the form upon submission.

LWW AUTHOR'S MANUSCRIPT CHECKLIST FOR JOURNALS

Authors should pay particular attention to the following items before submitting their manuscripts:

Manuscript Preparation

- *JHTR* uses the *American Medical Association Manual of Style*, 10th edition.
- *JHTR* requires authors to use person-first language—avoid phrasing such as “the brain-injured participant” or the “TBI patient” and replace with “participant with a brain injury” or “patient with a TBI.”
- Manuscripts should be line numbered in their original format (eg, Microsoft Word line numbering).
- Manuscripts should be double-spaced, including quotations, lists, references, footnotes, figure captions, and all parts of tables. Do not embed tables in the text.
- Manuscripts should be ordered as follows: title page, abstracts, text, references, appendices, tables, and any illustrations.
- To maintain a masked review process, it is the author’s responsibility to make every attempt to mask all information in the manuscript that would reveal the identity of the author to the reviewer. This version of the manuscript is referred to as the “masked” manuscript when uploading documents.
- An accompanying cover letter should include attestations that (1) the work is original and has not been published or under review elsewhere; (2) all authors contributed to the work; and (3) the research was conducted consistent with ethical guidelines for the conduct of research.
- The cover letter should also summarize any conflicts of interest affecting any authors.
- Title page including (1) title of the article; (2) author names (with highest academic degrees) and affiliations (including titles, departments, and name and location of institutions of primary employment); (3) all possible conflicts of interest including financial, consultant, institutional, and other relationships that might lead to bias or a conflict of interest; (4) disclosure of funding received for this work including from any of the following organizations with public or open access policies: National Institutes of Health (NIH), National Institute on Disability Independent Living and Rehabilitation Research, Veterans Administration, Wellcome Trust, and the Howard Hughes Medical Institute; and (5) any acknowledgments, credits, or disclaimers.
- A structured abstract of no more than 200 words should be prepared. Authors should use telegraphic language where possible, including omission of introductory clauses. Headings should typically include the following: Objective, Setting, Participants, Design, Main Measures, Results, and Conclusion. The Conclusion section should encapsulate the clinical implications of the results, not merely restate the findings.
- Include up to 10 key words that describe the contents of the article such as those that appear in the Cumulative Index to Nursing and Allied Health Literature (CINAHL) or the National Library of Medicine’s (NLM’s) Medical Subject Headings (MeSH).
- There should be a clear indication of the placement of all tables and figures in text.
- The author is responsible for obtaining written permission for any borrowed text, tables, or figures.

References

- References must be cited in text and styled in the reference list according to the *American Medical Association Manual of Style*, 10th edition, copyright 2007 American Medical Association. They must be numbered consecutively in the order they are cited and listed in that sequence (not alphabetically); reference numbers may be used more than once throughout an article. Page numbers should appear with the text citation following a specific quote. References should be double-spaced and placed at the end of the text.
- References should not be created using Microsoft Word's automatic footnote/endnote feature.

Figures

A. Four Steps for Submitting Artwork

1. Learn about Digital Art creation [here](#).
2. Create, Scan, and Save your artwork according to the Digital Artwork Guideline Checklist.
3. Upload each figure to Editorial Manager in conjunction with your manuscript text and tables.

B. Color Figures: The journal accepts color figures for publication that will enhance an article. Authors who submit color figures will receive an estimate of the cost for color reproduction in print. If they decide not to pay for color reproduction in print, they can request that the figures be converted to black and white at no charge. All color figures can appear in color in the online version of the journal at no charge. (Note: this includes the online version on the journal website and Ovid, but not the iPad edition currently.)

C. Digital Artwork Guideline Checklist Basics to have in place before submitting your digital art.

- Artwork saved as JPG, TIFF and EPS files. Do not save TIFFs as compressed files.
- Artwork created as the actual size (or slightly larger) than it will appear in the journal. (To get an idea of the size images should be when they print, study a copy of the journal. Measure the artwork typically shown and scale your image to match.)
- Crop out any white or black space surrounding the image.
- Text and fonts in any figure are one of the acceptable fonts: Helvetica, Times Roman, Symbol, Mathematical PI, and European PI.
- Color images are created/scanned and saved and submitted as CMYK only. Do not submit any figures in RGB mode because RGB is the color mode used for screens/monitors and CMYK is the color mode used for print.
- Line art saved at a resolution of at least 1200 dpi.
- Images saved at a resolution of at least 300 dpi.
- Each figure saved as a separate file and saved separately from the accompanying text file.
- For multipanel or composite figures only: Any figure with multiple parts should be sent as one file, with each part labeled the way it is to appear in print.

Remember:

- Artwork generated from office suite programs such as CorelDRAW, MS Word, Excel, and artwork downloaded from the Internet (JPEG or GIF files) cannot be used because the quality is poor when printed.
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- Number figures in the figure legend in the order in which they are discussed.
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Tables Tables should be on a separate page at the end of the manuscript. Number tables consecutively and supply a brief title for each. Include explanatory footnotes for all nonstandard abbreviations. Cite each table in the text in consecutive order. If you use data from another published or unpublished source, obtain permission and acknowledge fully.

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Example: We performed many tests on the degrees of flexibility in the elbow (see Video, Supplemental Digital Content 1, which demonstrates elbow flexibility) and found our results inconclusive.

List of Supplemental Digital Content: A listing of SDC items must be submitted at the end of the manuscript file. Include the SDC number and file type. This text will be removed by our production staff and not be published.

Example:

Supplemental Digital Content 1. Wmv

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<http://www.wkopenhealth.com/openaccessfaq.php>

Appendix 1.2: Guide to complete risk of bias

Criteria required to rate risk of bias as low

1. Inclusion/ exclusion criteria are clearly stated.
2. Defining and assessing HI
 - Hospital records indicate brain injury e.g. ICD codes for TBI, skull fracture, GCS score and data is available for all participants
 - Self-report of a blow to the head resulting in symptoms e.g. dazed and confused and/ or LoC
 - Not non-traumatic acquired brain injuries such as stroke
3. Defining and assessing HI severity
 - Must include data on childhood HI severity within sample (mild vs. moderate to severe) for all participants
 - Severity for mild (Carroll et al 2004a) includes at least one of:
 - confusion or disorientation
 - < 30 mins LoC
 - < 24 hours PTA
 - and/or other transient neurological abnormalities such as focal signs, seizure, and intracranial lesion not requiring surgery
 - GCS score of 13-15 (>30 minutes post-injury)
 - Does not use ‘simple descriptors’ such as concussion or skull fracture.
 - Additionally, must assess the number of HI’s.
4. Matched control group
 - Must compare with a control group which includes offenders with HI in adulthood
 - May also include:
 - For epidemiological population studies: siblings or general population with no HI
 - For other studies: Non-offenders
5. Assessment of impact of HI
 - Must include at least one assessed outcome relevant to HI, using validated tools e.g. disability, cognitive impairment, emotional/behavioural outcomes.
6. Design specific confounds
 - Must make reference to and be, representative of the population of interest (using data) and larger geographical area
 - Birth cohort studies will be representative of the wider geographical area
7. Controlling confounds
 - Must consider confounding variables and adjust for these
 - Appropriate confounds depend on the study but may include: ses, age, gender, missing data, cross-reference HI with hospital records, years of education, family factors e.g. abuse, parental criminality.
8. Design and analysis plan
 - Must include details of both at: age HI and age at first conviction.
 - Analysis is appropriate to the design and accounts for confounding variables

Appendix 1.3: Risk of bias results from second rater

| | Selection of participants | Assessing study variables | | | | Design specific confounds | Control of confounding variables | Design and analysis plan |
|----------------------------------|------------------------------|-----------------------------------|-------------------------|----------------------------|-----------------------|---------------------------------------|----------------------------------|--------------------------|
| | Inclusion/exclusion criteria | HI definition and assessment tool | HI severity comparisons | Assessment of impact of HI | Matched control group | Comparisons to population of interest | Use of covariates or adjustments | Temporal relationship |
| 1:Brewer-Smyth et al 2015 | Low | Low | Low | High | High | High | Low | High |
| 2:Fazel et al 2011 | Low | Low | High | High | Low | Low | Low | Low |
| 3:Lewis et al 1979 | High | High | High | High | High | High | High | High |
| 4:McKinlay et al 2014 | Low | High | Low | High | Low | Low | Low | Low |
| 5:Rantakallio et al 1992 | Low | Low | High | High | High | Low | Low | High |
| 6:Timonen et al 2002 | Low | Low | High | High | High | Low | High | Low |

Appendix 2.1: Ethics approval (NHS)

WoSRES
West of Scotland Research Ethics Service



Professor Tom McMillan
 Professor of Clinical Neuropsychology
 University of Glasgow
 1st Floor, Admin Building
 Gartnavel Royal Hospital, 1055 Great Western
 Road
 Glasgow
 G12 0XH

West of Scotland REC 4
 West Ambulatory Care Hospital
 Dalnair Street
 Yorkhill
 Glasgow
www.nhsggc.org.uk

Date 16 November 2016
 Direct line 0141-232-1806
 e-mail Wosrec4@ggc.scot.nhs.uk

Dear Professor McMillan

Study title: Head injury in Scottish Prisons: Identifying the prevalence, associated disability and validating the Brain Injury Screening Index (BISI) and the Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID) as screening tools.
REC reference: 16/WS/0216
Protocol number: N/A
IRAS project ID: 209565

Thank you for your submission of 15 November 2016. I can confirm the REC has received the documents listed below and that these comply with the approval conditions detailed in our letter dated 09 November 2016

Documents received

The documents received were as follows:

| Document | Version | Date |
|---|---------|------------------|
| Other [Participant information sheet for prisoners v4] | V4 | 15 November 2016 |
| Other [Participant information sheet prison officer V3] | V3 | 15 November 2016 |

Approved documents

The final list of approved documentation for the study is therefore as follows:

| Document | Version | Date |
|---|---------|-------------------|
| Copies of advertisement materials for research participants [Recruitment Poster v3] | v3 | 19 September 2016 |
| Covering letter on headed paper [Cover letter to prison health professionals v2] | V2 | 23 August 2016 |

| Document | Version | Date |
|---|---------|-------------------|
| Interview schedules or topic guides for participants [Data Capture Form v3] | v3 | 19 September 2016 |
| Non-validated questionnaire [Brain Injury Screening Index v1] | V1 | 21 January 2016 |
| Non-validated questionnaire [Ohio State University Traumatic Brain Injury Identification form v1] | V1 | 21 January 2016 |
| Other [CV Student Abi Rorison v1] | | 22 August 2016 |
| Other [Participant information sheet for prisoners v4] | V4 | 15 November 2016 |
| Other [Participant information sheet prison officer V3] | V3 | 15 November 2016 |
| Participant consent form [Consent form participant prisoner v2] | V2 | 19 September 2016 |
| Participant consent form [Participant consent form prison officer v1] | V1 | 23 August 2016 |
| Participant information sheet (PIS) [Participant Information sheet for prisoners v2] | V2 | 19 September 2016 |
| Participant information sheet (PIS) [Participant Information sheet prison officer v1] | v1 | 23 August 2016 |
| REC Application Form [REC_Form_19102016] | | 19 October 2016 |
| Research protocol or project proposal [Project proposal] | V4 | 22 September 2016 |
| Summary CV for Chief Investigator (CI) [CI Prof Tom McMillan CV v1] | | 30 June 2016 |
| Summary CV for student [CV Student Vicky Walker v1] | | 22 August 2016 |
| Validated questionnaire [Glasgow Outcome at Discharge Scale] | | |
| Validated questionnaire [Hospital Anxiety and Depression Scale] | | |

You should ensure that the sponsor has a copy of the final documentation for the study. It is the sponsor's responsibility to ensure that the documentation is made available to R&D offices at all participating sites.

16/WS/0216

Please quote this number on all correspondence

Yours sincerely

Sophie Bagnall
Assistant Coordinator

Copy to: Ms Emma-Jane Gault
Ms Elaine O'Neill, NHS Greater Glasgow and Clyde

Appendix 2.2: Ethics approval (SPS)

From: Tom McMillan
Sent: 30 August 2016 09:09
To: Vicky Walker; Abigail Rorison
Subject: FW: sps approval

Approval from SPS

I will sign the form and return to them

Bw

Tom McMillan
 Professor of Clinical Neuropsychology
 Institute of Health and Wellbeing
 University of Glasgow
 Tel: +44 (0)141 211 0354

From: Carnie James [mailto:James.Carnie@sps.pnn.gov.uk]
Sent: 26 August 2016 14:59
To: Tom McMillan
Cc: McKillop Forbes; Porter John (HEALTHCARE IMPROVEMENT SCOTLAND - SD039)
 (john.porter1@nhs.net); Parker Ruth
Subject: RE: planning for implementation of the BI and Offenders report

Tom

The Research Access and Ethics Committee met on Wednesday and was content to approve access for your Brain Injury study.

With the closing of Cornton Vale, the study was now focusing on Shotts and Low Moss. RAEC encouraged as broad a sampling range as possible across other establishments with different populations to include LTPs/STPs; violent/non-violent; male/female etc. prisoners.

Please sign the standard access regulations and return to me in Calton House.

RAEC wished you well with the completion of the study.

Jim

From: Tom McMillan [<mailto:Thomas.McMillan@glasgow.ac.uk>]
Sent: 22 July 2016 13:54
To: Carnie James <James.Carnie@sps.pnn.gov.uk>
Cc: McKillop Forbes <Forbes.McKillop@sps.pnn.gov.uk>; Porter John (HEALTHCARE IMPROVEMENT SCOTLAND - SD039) (john.porter1@nhs.net) <john.porter1@nhs.net>; Parker Ruth <Ruth.Parker@sps.pnn.gov.uk>
Subject: RE: planning for implementation of the BI and Offenders report

Dear James

The Brain Injury and Offenders report was recently published
: <http://www.nphn.scot.nhs.uk/nphn-brain-injury-and-offending-final-report-publication/>

We have moved on with the research proposal (attached) which relates to research questions R1 and R5 in the report and would be carried out by two Doctorate in Clinical Psychology trainees as part of their professional training (under my supervision). To do this they need to begin recruiting around September/October and finish recruiting in April 2017. We are mid-application to NHS ethics and need to apply now for approval to SPS.

This project basically is looking at (i) the practicality and usefulness of two screening tests for HI in prisoners (ii) the prevalence by self-report and (iii) the numbers who are disabled by HI and may need specialist input. We plan to do this in two prisons- Shotts (who have agreed in principle) and Low Moss –NPHN are going to make an initial approach to them.

Is there a specific application form to the SPS – or can this proceed via the attached proposal?

Best wishes

Tom McMillan

Professor of Clinical Neuropsychology

Institute of Health and Wellbeing

University of Glasgow

Tel: +44 (0)141 211 0354

**REGULATIONS CONCERNING RESEARCH ACCESS TO PRISON
ESTABLISHMENTS FOR
THE PURPOSES OF CONDUCTING RESEARCH**

All access to prison establishments for the purposes of conducting research is conditional on the

researcher(s) agreeing to abide by the undernoted requirements.

1. All data and research material arising out of the study must be dealt with on an anonymous,

unattributable and confidential basis. No individual should be named or identified. Researchers must

comply with the Data Protection Act (1998).

2. If the study is to involve interviewing respondents, all such respondents must give voluntary consent

and be informed of the purpose of the study; anticipated uses of data; identity of funder(s) (if

applicable); and the identity of the interviewer.

3. All research data and material of whatever kind (i.e. interview notes, questionnaires, tapes, transcripts,

reports, documents, specifications, instructions, plans, drawings, patents, models, designs, whether in

writing or on electronic or other media) obtained from the Scottish Prison Service shall remain the

property of the Crown. Information collected during the course of a research project must not be

supplied to another party or used for any other purpose other than that agreed to and contained in the

original research proposal. All confidential research data obtained from SPS must be held securely for

up to a maximum of 60 months on completion of the research and destroyed thereafter.

4. All researchers must abide by the ethical guidelines of their profession or discipline and must nominate

below the guidelines to which they will adhere. (e.g. Social Research Association, British Sociological

Association etc.) All researchers must arrange to be cleared with Enhanced Disclosure if contact with

prisoners in envisaged.

5. Where appropriate, research proposals may require to be submitted to the Ethics Committee of the Area Health Board (or MREC) and to receive its approval before access is granted.
6. The Chair of the SPS Research Access and Ethics Committee (RAEC) must be informed in writing and agree to any changes to the project which involve alterations to the essential nature of the agreed work.
7. The Scottish Prison Service reserves the right to terminate access to SPS establishments at any time for any Operational reason that may arise or for any breach by the researcher of the Access Regulations or for any failure on the part of the researcher to conduct the study as agreed with the RAEC. In the event of access being terminated for any reason whatsoever, all data obtained from SPS during the course of the research shall be returned to the Scottish Prison Service.
8. The Scottish Prison Service has a duty of care to staff and visitors on its premises and has public liability indemnity.
9. It is a condition of access that a copy of any final report or dissertation or other written output arising from the research MUST be submitted to SPS to be lodged in its Research Library. Any material resulting from access which is intended to be presented publicly must also be submitted to SPS. In principle, the Scottish Prison Service supports the publication and dissemination of research findings arising from approved work, but the Service reserves the right to amend factual inaccuracies.
10. Reports and presentations should be sent to the Chair of the Research Access and Ethics Committee, Analytical Services, SPS Headquarters, Calton House, Redheughs Rigg, Edinburgh EH12 9HW.
- Ethical guidelines nominated _____
- I have read the above regulations and agree to be bound by them.

(Signature)

1.12.16 (Date)

Appendix 2.3: Participant information sheet (for prisoners)



PARTICIPANT INFORMATION SHEET

Identifying Head Injury & Associated Disability in Scottish Prisons

We would like you to help us in a research study on head injury. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. If anything is unclear and you would like to ask us questions about the study please speak to a staff member who will notify us. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

We are carrying out this study to consider the needs of those with undiagnosed head injuries in prison. We aim to understand the rates of head injury and associated disability in prisons. We also aim to examine how practical and accurate screening tools are in identifying head injury and associated disability. This study will contribute towards the researchers' qualifications, and will fulfill a component of their Doctorate in Clinical Psychology.

Why have I been chosen?

You have been chosen because you are currently serving a custodial sentence in Scotland.

Do I have to take part?

It is up to you to decide whether or not to take part, and there will be no consequences for you either way except the time required to complete the study, should you decide to take part. You will be given this information sheet to keep and if you wish to partake you will be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

What will happen to me if I take part?

You will be invited to attend for a single assessment lasting approximately 60 minutes. You will be randomly allocated to a group which will use one of two questionnaires to ask you about any potential head injury you may have had. This will involve:

(i) a brief interview about recent health and history of head injury (ii) questionnaires about psychological wellbeing; (iii) tests of cognition such as concentration and memory.

Additionally, researchers will need to obtain NHS records pertaining to any hospital admission that you have had which involved a head injury, and will access details of any prison incident reports from your current custodial sentence.

Where will the assessment take place?

The assessment will take place within the prison. If you need to be excused from work to attend the study, you will not lose out on any work payments.

What do I have to do?

You just have to attend for the assessment lasting approximately 60 minutes.

What are the possible disadvantages and risks of taking part?

There are no particular disadvantages to taking part and your participation will have no impact upon your custodial sentence.

What are the possible benefits of taking part?

You will receive no direct benefit from taking part. The information collected in the study will give us a better understanding of head injury within prisons, and may allow us to make recommendations for prison health service improvements.

Will my taking part in this study be kept confidential?

You will be identified by an identity number, and any information about you will have your name removed so that you cannot be recognised from it. Information collected will be kept within the University of Glasgow department in a locked cabinet for 10 years in order to meet record keeping guidelines and for future research. Scientific publications arising from the research will not identify you or anyone taking part. Researchers will obtain information from NHS records pertaining to any hospital admission which will be kept confidential. All information collected about you during the research will be kept strictly confidential, accessible only to two researchers and study supervisors, University of Glasgow, and representatives of the study Sponsor, NHS Greater Glasgow & Clyde, who will make sure that the study is being conducted correctly. However, the following exceptions apply. If during the course of the research we become concerned that you or another person is at risk of harm, or if a crime has been committed, we are obligated to pass this information on to the Scottish Prison Service. Further, if a severe head injury, with disability, is identified, we will inform the Prison Health Service of this so that it can inform your future care.

What will happen to the results of the research study?

When the project is completed, the findings will be submitted for publication in peer reviewed international journals. Further, the results may be used in conference presentations, and will be detailed within theses to fulfill the requirements of the Doctorate in Clinical Psychology.

Who is organising and funding the research?

The research is organised by the University of Glasgow. The research is funded by the University of Glasgow and partly by the National Prison Healthcare Network.

Who has reviewed the study?

The project has been reviewed by the University of Glasgow College of Medical Veterinary and Life Sciences, the West of Scotland NHS Research Ethics Committee and the Scottish Prison Service.

Contact for Further Information

You can contact Vicky Walker, Abi McGinley or Professor Tom McMillan (0141 211 0354) who are organising the research.

Thank you for considering this request to take part in the study.

Mental Health and Wellbeing
Institute of Health and Wellbeing
College of MVLS

Version 4: 15/11/16

Appendix 2.4: Participant consent form (for prisoners)



Participant ID Number: _____

CONSENT FORM

Title: Identifying Head Injury & Associated Disability in Scottish Prisons

Please initial
box

1. I confirm that I have read and understand the information sheet dated 15/11/16 (Version 4) for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary, that it will have no effect on my custodial sentence and that I am free to withdraw at any time, without giving any reason and without my legal rights being affected.

3. I agree that if researchers believe that I or another person is at risk of harm, they will pass this information to prison staff.

4. I agree that the researchers can obtain NHS records pertaining to any hospital admission that I have had.

5. I agree that, if the researchers find evidence that I have had a significant head injury, they will inform prison staff of this so that they can consider this in terms of my care.

6. I agree that, if a severe head injury, with associated disability, is identified during the course of the study, researchers will inform the Prison Health Service of this so that it can inform future care.

7. I consent to researchers accessing my medical records to determine the details of any hospital admission that I have had involving a head injury.

8. I consent to researchers accessing prison incident reports

9. I understand that anonymous data collected during the study, will be looked at by individuals from University of Glasgow (2 researchers and study supervisors), from

representatives of the study, specifically the study Sponsor & NHS Greater Glasgow & Clyde, for audit purposes, by regulatory authorities or by the NHS Board, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

10. I agree to my data being retained for 10 years, including following loss of capacity.
I understand this is for the purpose of future research and that all data will be destroyed confidentially after this period.
11. I agree to take part in the above study.

Name of participant

Date

Signature

Name of Person taking consent

Date

Signature

Appendix 2.5: Participant information sheet (for prison officers)



**University
of Glasgow** | College of Medical,
Veterinary & Life Sciences



PARTICIPANT INFORMATION SHEET FOR PRISON OFFICERS

Identifying Head Injury & Associated Disability in Scottish Prisons

We would like you to help us in a research study on head injury. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. If anything is unclear and you would like to ask us questions about the study please speak to a staff member who will notify us. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

We are carrying out this study to consider the needs of those with undiagnosed head injuries in prison. We aim to understand the rates of head injury and associated disability in prisons. We also aim to examine how practical and accurate screening tools are in identifying head injury and associated disability. This study will contribute towards the researchers' qualifications, and will fulfill a component of their Doctorate in Clinical Psychology.

Why have I been chosen?

You have been chosen because you are currently working as a prison officer within the Scottish Prison Service, and part of your role is that of key worker to one of our participants.

Do I have to take part?

It is up to you to decide whether or not to take part, and there will be no consequences for you either way except the time required to complete the study, should you decide to take part. You will be given this information sheet to keep and if you wish to partake you will be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

What will happen to me if I take part?

You will be invited to attend for a single meeting lasting approximately 15 minutes. This can either be carried out in person or over the phone, to suit you. The meeting will involve the completion of a questionnaire, the Glasgow Outcome at Discharge Scale (McMillan et al, 2013). This is a measure which is specifically designed to detect disability following HI. It requires to be rated both by the individual who may have had a head injury, and by an informant who is able to comment on their level of functioning as they

have observed it. You will also be asked to provide incident report information relating to the participant.

Where will the meeting take place?

The meeting will take place within your working day in the prison, either face to face or over the phone.

What do I have to do?

You have to attend for the meeting lasting approximately 15 minutes. During this you will be asked questions from the GODS and to provide information on the participants' incident reports.

What are the possible disadvantages and risks of taking part?

No, there are no particular disadvantages to taking part.

What are the possible benefits of taking part?

You will receive no direct benefit from taking part. The information collected in the study will give us a better understanding of head injury within prisons, and may allow us to make recommendations for prison health service improvements.

Will my taking part in this study be kept confidential?

You will be identified by the identity number which corresponds with that which is given to the participant. Any information about you will have your name removed so that you cannot be recognised from it. Information collected will be kept within the University of Glasgow department in a locked cabinet for 10 years in order to meet record keeping guidelines and for future research. Scientific publications arising from the research will not identify you or anyone taking part. All information collected from you during the research will be kept strictly confidential, accessible only to two researchers and study supervisors, University of Glasgow, and representatives of the study Sponsor, NHS Greater Glasgow & Clyde, who will make sure that the study is being conducted correctly. However, the following exceptions apply. If during the course of the research we become concerned that you or another person is at risk of harm, or if a crime has been committed, we are obligated to pass this information on to the Scottish Prison Service.

What will happen to the results of the research study?

When the project is completed, the findings will be submitted for publication in peer reviewed international journals. Further, the results may be used in conference presentations, and will be detailed within theses to fulfill the requirements of the Doctorate in Clinical Psychology.

Who is organising and funding the research?

The research is organised by the University of Glasgow. The research is funded by the University of Glasgow and partly by the National Prison Healthcare Network.

Who has reviewed the study?

The project has been reviewed by the University of Glasgow College of Medical Veterinary and Life Sciences, the West of Scotland NHS Research Ethics Committee and the Scottish Prison Service.

Contact for Further Information

You can contact Vicky Walker: v.walker.1@research.gla.ac.uk or Abi McGinley: a.rorison.1@research.gla.ac.uk; who will be arranging and carrying out the assessments or Professor Tom McMillan thomas.mcmillan@glasgow.ac.uk (0141 211 0354); who is organising the research.

Thank you for considering this request to take part in the study.

Mental Health and Wellbeing
Institute of Health and Wellbeing
College of MVLS

Version 3: 15/11/16

Appendix 2.6: Participant consent form (for prison officers)



CONSENT FORM FOR PRISON OFFICERS

Title: Identifying Head Injury & Associated Disability in Scottish Prisons

Please initial
box

12. I confirm that I have read and understand the information sheet dated 15.11.16 (Version 3) for the above study and have had the opportunity to ask questions.
13. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my legal rights being affected.
14. As key worker for the participant, I consent to completing the Glasgow Outcome at Discharge Scale (GODS) as a measure of disability and providing incident reports for the relevant participant(s).
15. I understand that anonymous data collected during the study, will be looked at by individuals from University of Glasgow (2 researchers and study supervisors), from representatives of the study, specifically the study Sponsor & NHS Greater Glasgow & Clyde, for audit purposes, by regulatory authorities or by the NHS Board, where it is relevant to the participant taking part in this research. I give permission for these individuals to have access to my ratings on the GODS.
16. I agree to this data being retained for 10 years, including following loss of capacity. I understand this is for the purpose of future research and that all data will be destroyed confidentially after this period.
17. I agree to take part in the above study.

Name of key worker

Date

Signature

Name of Person taking consent

Date

Signature

Institute of Health and Wellbeing
College of MVLS

23.08.16 2016: V1

Appendix 2.7: Data capture form (used during interview)



Data Capture Form: Head Injury in Scottish Prisons: Prevalence, Associated Disability, and Routine Screening (v3, 19th September 2016)

| | | | | |
|---|---|------------------------------------|-----------------------------------|--|
| Participant ID no | | | | |
| Age | | | | |
| Ethnicity | White | | | |
| | Mixed or multiple | | | |
| | Asian | | | |
| | Asian/Caribbean/Black | | | |
| | Other | | | |
| Postcode - Socio-economic status (DEPCAT or SIMD scores) | | | | |
| Years of education | | | | |
| Schooling type | Mainstream | | | |
| | Mainstream with 1:1 support | | | |
| | Specialist | | | |
| | | | | |
| Did you miss any school? Approximately how often? | <20 times through school career | At least once/month (from – until) | At least once/Week (from – until) | |
| | Truancy | | | |
| | Illness | | | |
| | Suspension/exclusion | | | |
| Most recent occupation category | Managers, directors and senior officials | | | |
| | Professional occupations | | | |
| | Associate Professional And Technical Occupations | | | |
| | Administrative And Secretarial Occupations | | | |
| | Skilled Trades Occupations Caring, Leisure And Other Service Occupations | | | |
| | Sales And Customer Service Occupations | | | |
| | Process, Plant And Machine Operatives | | | |

| | | |
|--|---|----------|
| | Elementary Occupations | |
| | None | |
| Previous problematic alcohol use | Yes | |
| | No | |
| | | |
| Previous problematic substance use | Yes | |
| | No | |
| Offence history | Number of arrests | |
| | Number of charges | |
| | Number of convictions | |
| | Length of custodial sentence served to date | |
| | Offence types | Violent |
| | | Sexual |
| | | Property |
| | | Other |
| | Age at first offence | |
| Age at first HI | | |
| How many HI's | | |
| HI's occurred before or after 1994 | Before | |
| | After | |
| Loss of consciousness | None | |
| | < 30 minutes | |
| | 30 minutes – 24 hours | |
| | >24 hours | |
| Glasgow Coma Scale Score | Unknown | |
| | Mild: 13-15 | |
| | Moderate: 9-12 | |
| | Severe: 3-8 | |
| Any PTA? | Unknown | |
| | Mild: <1 hour | |
| | Moderate: 30 mins – 24 hours | |
| | Severe: >24 hours | |
| Estimated number of days spent in hospital? | | |
| What was follow up after HI? | Verbal guidance | |
| | Written guidance | |
| | Appointment with health professional | |

| | | |
|---|---|--|
| | | |
| | On-going therapy/rehabilitation | |
| | Other | |
| Brain Injury Screening Index (BISI) score | | |
| BISI category of severity | Mild (reports a blow to the head resulting in feeling dizzy/dazed) | |
| | Moderate-Severe (includes multiple)- Reports no memory after incident and told LOC | |
| | Acquired | |
| Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID) category | Likely | |
| | Not likely | |
| OSU TBI-ID category of severity | No HI | |
| | Mild (no LOC) | |
| | Mild (LOC <30 minutes) | |
| | Moderate (includes multiple) – most severe injury LOC between 30 minutes and 24 hours | |
| | Severe includes multiple most severe injury LOC > 24 hours | |
| Glasgow Outcome at Discharge Scale (GODS) category | Dead (1) | |
| | Not conscious (2) | |
| | Lower Severe Disability (Lower SD) (3) | |
| | Upper Severe Disability (Upper SD) (4) | |
| | Lower Moderate Disability (Lower MD) (5) | |
| | Upper Moderate Disability (Upper MD) (6) | |
| | Lower Good Recovery (Lower GR) (7) | |
| | Upper Good Recovery (Upper GR) (8) | |
| Glasgow Outcome at Discharge Scale (GODS) category (<i>proxy rating</i>) | Dead (1) | |
| | Not conscious (2) | |
| | Lower Severe Disability | |

| | | |
|---|---|--|
| | (Lower SD) (3) | |
| | Upper Severe Disability (Upper SD) (4) | |
| | Lower Moderate Disability (Lower MD) (5) | |
| | Upper Moderate Disability (Upper MD) (6) | |
| | Lower Good Recovery (Lower GR) (7) | |
| | Upper Good Recovery (Upper GR) (8) | |
| Hospital Anxiety and Depression Scale (HADS) score | Depression score | |
| | Anxiety score | |
| Adult Memory and Information Processing Battery (AMIPB) - List Learning Sub-Test score | | |
| Symbol Digit Modalities Test (SDMT) score | | |
| Trail Making Test (TMT) score | Part 1 score (seconds) | |
| | Part 2 score (seconds) | |
| Hayling Sentence Completion Test score (seconds) | | |
| Word Memory Test score | | |
| Scottish Morbidity Records (SMR-01) ICD-10 code(s) | S02.0Fracture of vault of skull | |
| <i>*Codes from ICD-10 start with 'S', codes from ICD-9 start with 8*</i> | S02.1Fracture of base of skull | |
| | S02.7Multiple fractures involving skull and facial bones | |
| | S02.8Fractures of other skull and facial bones | |
| | S02.9Fracture of skull and facial bones, part unspecified | |
| | S06.0Concussion | |
| | S06.1Traumatic cerebral oedema | |
| | S06.2Diffuse brain injury | |
| | S06.3Focal brain injury | |
| | S06.4Epidural haemorrhage | |
| | S06.5Traumatic subdural haemorrhage | |
| | S06.6Traumatic subarachnoid haemorrhage | |
| | S06.7Intracranial injury with prolonged coma | |
| | S06.8Other intracranial injuries | |
| | S06.9Intracranial injury, unspecified | |
| | (800) Fracture of vault of skull | |

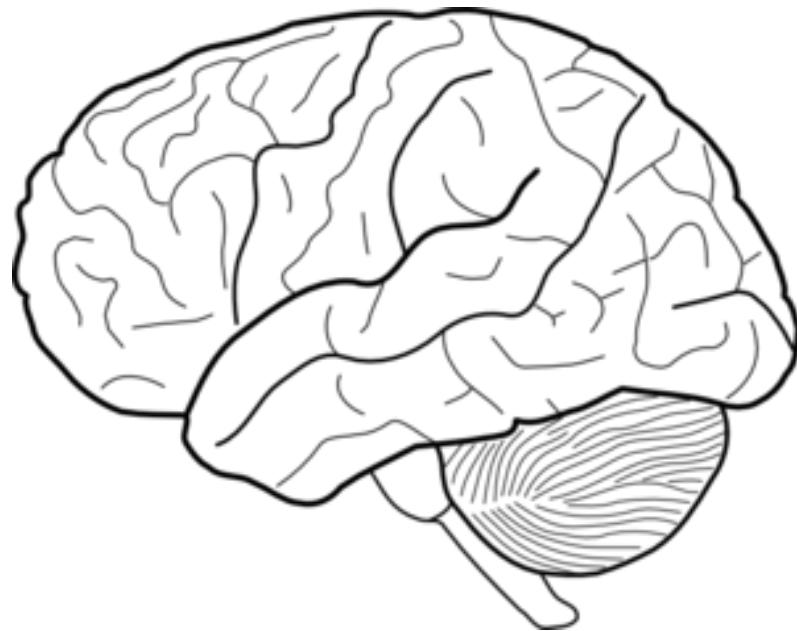
| | | |
|--|---|--|
| | (801) Fracture of base of skull | |
| | (803) Other and unqualified skull fractures | |
| | (804) Multiple fractures involving skull or face with other bones | |
| | (850) Concussion | |
| | (851) Cerebral laceration and contusion | |
| | (852) Subarachnoid, subdural, and extradural hemorrhage, following injury | |
| | (853) Other and unspecified intracranial hemorrhage following injury | |
| | (854) Intracranial injury of other and unspecified nature | |
| Worst HI (in terms of LOC- taken from SMR-01) | When | |
| | Nature of HI (e.g. RTA) | |
| | Duration of LOC | |
| Number of incident Reports | | |

Appendix 2.8: Recruitment poster

**University
of Glasgow** | College of Medical,
Veterinary & Life Sciences

NHS
Greater Glasgow
and Clyde

RECRUITING: HEAD INJURY STUDY



**WE ARE TRYING TO UNDERSTAND THE NEEDS OF THOSE IN PRISON
WHO MAY HAVE HAD A HEAD INJURY.**

**THIS STUDY IS OPEN TO ALL SERVING A SENTENCE WITHIN THE
PRISON.**

DO YOU HAVE ABOUT 40-60 MINUTES TO SPARE?

**PLEASE TAKE AN INFORMATION SHEET AND SPEAK TO A STAFF
MEMBER IF YOU ARE INTERESTED.**

Appendix 2.9: Brain Injury Screening Index (BISI)



Brain Injury Screening Index (BISI®)

Date: _____ / _____ / _____ Age: _____ Gender: Male Female Prefer not to say

Education (years of full time education and/or highest qualification obtained): _____

| 1 st Injury | | 2 nd Injury | | 3 rd Injury | | 4 th Injury | | 5 th Injury | |
|---|--|--|--|--|--|--|--|--|--|
| Q 1. Have you ever had a serious blow to the head? | <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> Ask Q 8. | | | | | | | | |
| Q 2. When and how did it happen? Record here | | | | | | | | | |
| Q 3. Did it leave you feeling dizzy, unsteady or dazed? | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO |
| Q 4. Were you able to remember what happened to you in the hours after the injury? | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO |
| Q 5. Were you told you were unconscious at the time? For how long? Record here (in minutes) | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO | <input type="checkbox"/> YES <input type="checkbox"/> NO |
| Q 6. Following the injury, did you (tick all that apply) | | | | | | | | | |
| Go to hospital | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| See a paramedic | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Do nothing | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Don't know | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other (please specify) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Q 7. Have you had any other blows to your head? How many? Record here | <input type="checkbox"/> YES <input type="checkbox"/> NO | <small>Ask Q 8. Repeat Q 2-6 for 2nd to 5th injuries</small> | | | | | | | |

| | | |
|---|---|-----------------------------|
| Q 8. Have you ever had an illness affecting your brain? | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO |
| What was it (give as many details as possible)? | Record here _____ | |
| ↑ | | |
| Q 9. Have you suffered from epilepsy, fits or blackouts? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Q 10. Do you have any significant problems with your (tick all that apply)... Memory <input type="checkbox"/> Concentration <input type="checkbox"/> Speech <input type="checkbox"/> Other (please specify) _____ | | |
| Q 11. Have you ever seen a doctor for, or been diagnosed with... Attention Deficit Hyperactivity Disorder (ADHD) <input type="checkbox"/> Learning difficulties or learning disabilities <input type="checkbox"/> Serious mental health problems <input type="checkbox"/> | Tick all that apply below | |



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Brain Injury Screening Index

GUIDANCE NOTES

The Brain Injury Screening Index [BISI®] is a validated resource to screen for head injuries and associated conditions and establish whether an individual may have sustained a brain injury.

WHO SHOULD USE IT?

Developed for use by practitioners of all levels, the BISI can be used by primary and secondary health and social care professionals, forensic and community-based services, housing support teams, probation officers, police staff and key workers.

WHY DO WE ASK THESE QUESTIONS?

The BISI records an individual's self-reported history of brain injury. Results enable professionals to ensure that the relevant support is in place to assist individuals with suspected brain injury and address complex impairments that can present following a blow to the head.

Q1. This question is designed to screen individuals who might have sustained a TBI in their lifetime. Due to the impact of a TBI on consciousness, it is possible that a person might not be aware that they have suffered a TBI.

Q2. This question gathers further detail about the injury, in particular Time Since Injury, as this variable is often correlated with outcome

Q3. This question is designed to gauge whether a brain injury is likely to have occurred.

Q4. This question gathers information as to whether Post-Traumatic Amnesia was present. This is one of the main measures of injury severity.

Q5. This question gathers information as to whether the person was unconscious. Length of loss of consciousness is another important measure of injury severity.

Q6. This question can further validate the information gathered with the BISI, but it also provides important epidemiological information, as many individuals who sustain a significant brain injury do not seek or receive adequate medical attention.

Q7. This question screens those who may have suffered more than one mild TBI and experience significant problems as a result. Research has shown that multiple mild traumatic brain injuries may have a cumulative effect that increases the long-term risk of psychiatric and neurologic problems and may be associated with longer recovery time.

Appendix 2.10: Ohio State University TBI Identification Method (OSU TBI-ID)

| | | | |
|-------------|--------------------|-----------------------------|-------------|
| Name: _____ | Current Age: _____ | Interviewer Initials: _____ | Date: _____ |
|-------------|--------------------|-----------------------------|-------------|

Ohio State University TBI Identification Method — Interview Form

(Continuation from reverse side, if needed)

1026

Current News

If more injuries with OC: How many? _____ Longest knocked out? _____ How many ≥ 30 mins.? _____ Youngest age? _____

Interpreting Findings

A person may be more likely to have ongoing problems if they have any of the following:

- **WORST**
 - One moderate or severe TBI
 - **FIRST**
 - TBI with loss of consciousness before age 15
 - **MULTIPLE**
 - 2 or more TBIs close together, including a period of time when they experienced multiple blows to the head
 - **RECENT**
 - A mild TBI in the last weeks or a more severe TBI in the last months
 - **OTHER SOURCES**
 - Any TBI combined with another way that their brain function has been impaired

For more information about TBI or the OSU TBI Identification Method visit:

- Ohio Valley Center at OSU
www.ohiovalley.org/informationeducation
 - BrainLine.org
www.brainline.org

Slagbared 11/11v 2013

Other Central Nervous System (CNS) Compromise
 {used in conjunction with the OSU TBI-ID}

The following questions are about your medical history.

1. As a child, did a healthcare professional ever diagnose you with any of the following?

- Attention deficit
- Hyperactivity
- Learning disability
- Developmental disability
- Intellectual disability or mental retardation

2. As a child, were you ever diagnosed with any of the following?

- Epilepsy/seizures
- Oxygen deprivation (anoxia)
- Cerebral palsy
- Brain infections like Meningitis

3. Did the home(s) where you grew up have high levels of lead in the paint, or if the area where you lived exposed you to poisonous chemicals? Yes No Don't Know

4. As an adult, were you ever diagnosed with any of the following?

- | | |
|--|---|
| <input type="checkbox"/> Stroke or Transient Ischemic Attack | <input type="checkbox"/> Huntington's disease |
| <input type="checkbox"/> Oxygen deprivation (anoxia) | <input type="checkbox"/> Parkinson's disease |
| <input type="checkbox"/> Epilepsy or a seizure disorder | <input type="checkbox"/> Brain infections like Meningitis |
| <input type="checkbox"/> Dementia like Alzheimer's Disease | <input type="checkbox"/> AIDS, ARC, HIV |
| <input type="checkbox"/> Multiple sclerosis | |

5. As an adult, did you ever receive chemotherapy or were you ever exposed to hazardous or poisonous substances. Yes No Don't Know

Notes:

A positive response to any condition listed in Item #1 indicates a positive history for developmental disability.

A "Child CNS" score can be computed by summing the checked or "yes" responses in items #1 to #3 above. An "Adult CNS" score can be computed by summing the checked or "yes" responses in items #4 and #5 above. An overall "Other CNS" compromise score can be created by summing the Child and Adult scores.

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The Ohio State University Traumatic Brain Injury Identification Method

The Ohio State University (OSU) Traumatic Brain Injury (TBI) Identification Method (OSU TBI-ID) is a standardized procedure for eliciting a person's lifetime history of TBI via a 3-5 minute structured interview. While not ideal for determining lifetime exposure to potentially damaging brain injury, self-report remains the gold standard for research and clinical

use. The OSU TBI-ID has proven useful in many settings, including medical, mental health, substance abuse, domestic violence, corrections and aging. Health care and social service professionals need this tool to elicit a person's history of TBI.

Why is it important to know lifetime history of TBI? Research indicates that a person's lifetime history of TBI is useful for judging current cognitive and emotional states, particularly behavior associated with the executive functioning of the frontal parts of the brain (e.g., planning, impulsivity, addiction, interpersonal abilities). Due to how TBI damages the brain, more exposure (i.e., a worse history of lifetime TBI) increases the likelihood that an individual will struggle with current life stressors, whatever they are. A person who has compromised functioning in the frontal areas of the brain:

- adapts less well in new or stressful situations
- has greater problems following through on recommendations from professionals
- has more difficulty making lifestyle changes, particularly when rewards are in the future.

How is the design of the OSU TBI-ID different from other TBI screening tools? Self-report of prior medical history is highly vulnerable to under-reporting. Previous studies have observed that the words used to elicit self-report of TBI (e.g., "head injury," "traumatic brain injury," "concussion," "knocked out," "loss of consciousness") are interpreted differently by respondents, which can affect recall of an injury (National Center for Injury Prevention and Control, 2003; Warner et al., 2005). To avoid biases created by differences in terminology, the OSU TBI-ID first elicits recall of all injuries requiring medical attention, or that should have been treated. Previous studies of the validity of injury recall methods (Warner, et al., 2005; Warner, Barnes & Fingerhut, 2000) were utilized to optimize personal recall of injuries experienced. The elicitation method subsequently concentrates on those injuries involving a blow to the head or neck, or high velocity forces capable of causing shear injury in the brain. For these injuries, the occurrence of loss of consciousness, its duration and age at injury are determined. In a final step the interviewer inquires further about periods of a person's life when they may have experienced multiple blows to the head.

How was the OSU TBI-ID validated? The validity of the OSU TBI-ID is not based on elicitation of a veridical accounting of a person's lifetime history of TBI. Instead, the OSU TBI-ID provides data for calculating summary indices reflecting the likelihood that consequences have resulted from lifetime exposure to TBI. Initial validation research has supported the psychometric qualities of these summary indices. Reliability has been demonstrated by both inter-rater and test/re-test reliability (Corrigan & Bogner, 2007; Bogner & Corrigan, 2009). Predictive validity has been shown by the relationship between indices of lifetime history and measures of cognitive performance, affective status, interpersonal functioning and aggression (Corrigan & Bogner, 2007; Bogner & Corrigan, 2009; Corrigan, Bogner & Holloman, 2012; Corrigan et al., in press; Dams-O'Conner, in press).

How is the OSU TBI-ID scored? Research to date has indicated that an adult will continue to experience consequences of TBI when any of the following is identified.

- **WORST** — there has been one moderate or severe TBI (i.e., any TBI with 30 minutes or more loss of consciousness)
- **FIRST** — TBI with any loss of consciousness before age 15
- **MULTIPLE** — had 2 or more TBIs close together, including a period of time when they experienced multiple blows to the head even if apparently without effect
- **RECENT** — a mild TBI in recent weeks or a more severe TBI in recent months
- **OTHER SOURCES** — any TBI combined with another way that their brain has been impaired.

The following summary indices have been found to be both reliable and valid:

TBI-LOC (number of TBI's with loss of consciousness from STEP 2 + number of periods of multiple injuries from STEP 3 in which the most severe injury resulted in loss of consciousness)

TBI-LOC ≥ 30 (number of TBI's with loss of consciousness ≥ 30 minutes from STEP 2 + number of periods of multiple injuries from STEP 3 in which the most severe injury resulted in loss of consciousness ≥ 30 minutes)

of periods in life with multiple or repeated injuries to the head (from STEP 3)

age at first TBI-LOC (youngest age from STEP 2 or STEP 3 where most severe injury resulted in loss of consciousness)

TBI-LOC before age 15 (if age at first TBI-LOC < 15 then =1, if ≥ 15 then = 0)

Worst Injury (1-5):

- 1 = no history of TBI if responses to #1-5 are "no"; OR in STEP 2 and STEP 3 reports never being dazed, not having memory lapses and never losing consciousness
- 2 = mild TBI without loss of consciousness If in responses in STEP 2 and STEP 3 the most severe injury reported involved being dazed or having a memory lapse but no loss of consciousness.
- 3 = mild TBI with loss of consciousness if in responses in STEP 2 and STEP 3 the most severe injury reported involved loss of consciousness but never equaled or exceeded 30 minutes.
- 4 = moderate TBI if in responses in STEP 2 and STEP 3 the most severe injury reported involved loss of consciousness between 30 minutes and 24 hours, inclusive.
- 5 = severe TBI if in responses in STEP 2 and STEP 3 the most severe injury reported involved loss of consciousness exceeded 24 hours.

For more information on the OSU TBI-ID visit <www.ohiovalley.org/tbi-id-method>.

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Appendix 2.11: Forensic history

| | |
|---|-------------|
| Number of convictions: mean (sd) | 17.6 (19.4) |
| Prison time served (in years and months): mean (sd) | 10.1 (7.2) |
| Longest given sentence: mean (sd) | 12.6 (6) |
| Age first convicted: mean (sd) | 20.2 (10.2) |
| Violent offenses: n (%) | 69 (84.1) |
| Property offenses: n (%) | 35 (42.7) |
| Other offenses* (includes breach of the peace, fraud): n (%) | 54 (65.9) |

*Individuals convicted of sexual offenses serve custodial sentences in specific SPS sites.
No participants reported sexual offenses

Appendix 2.12: Multivariate analysis supplementary data

| | | |
|----------------|-----------------------|--|
| | | |
| LOC duration | SDMT | *F=2.480, p=0.040; r ² = 0.147 |
| LOC duration | Anxiety | *F= 3.894, p=0.003; r ² =0.208 |
| LOC duration | GODs disability by HI | *F=5.152, p=0.008, r ² 0.117 |
| LOC duration | Depression | F= 1.004, p= 0.422; r ² = 0.064 |
| Number of HI's | GODs disability by HI | F=2.315, p=0.106, r ² =0.056 |
| Number of HI's | Anxiety | *F=3.665, p=0.005; r ² = 0.198 |
| | | |

*Model significant

Appendix 2.13 MRP proposal

Cover Page

Name of Assessment: MRP Proposal

Title: The Prevalence of Head Injury and Associated Disability in Scottish Prisons.

Matriculation Number: 0602550

Date of Submission: 26th May 2016

Version number: 12

Word Count: 3,457

Abstract

Background: Self-reported Head Injury (HI) appears to be over-represented in prisoners. HI is associated with lifelong disability and on-going neuropsychological sequelae although some make a good recovery. The prevalence of HI in prisoners and of persisting disabling consequences is largely unknown yet an important issue when planning rehabilitation services.

Aims: To consider the relationship between the prevalence of HI in prisoners through self-report and hospital records. Secondly, to consider the prevalence of persisting effects of HI which include neuropsychological impairment, emotional difficulties, behavioural difficulties and disability.

Methods: Approximately 100-160 males and females across at least two prisons will be recruited. A cross-sectional study using a McNemar's test will describe proportions of prisoners with and without self-reported HI and hospital recorded HI. A between groups design will compare emotional, neuropsychological and disability outcomes of prisoners with and without HI using a CHI squared and an Analysis of Co-Variance (ANCOVA). Incident reports will be compared between HI and non-HI prisoners to understand behavioural outcomes.

Applications: Establishing the prevalence of disability in prisoners with HI may increase insight into appropriate interventions and service design.

Introduction

Current Context

Due to growing interest in the prevalence of HI in offender settings, the Justice Committee of the Scottish Government asked the National Prisoner Healthcare Network (NHPN - to be published later in 2016) to produce a report which recommended further research for this population. One recommendation relates to

determining the prevalence of disability in prisoners with HI and understanding the needs of this population.

Head Injury and Offending Behaviour

Head Injury (HI) often involves trauma to the brain and may result in widespread damage to brain structures (McAllister, 2008). Behavioural (Engberg & Teasdale, 2004), neuropsychological deficits, emotional difficulties (McAllister, 2008) and disability (Whitnall et al, 2006) may persist over time. Meta analyses have shown that the prevalence of HI in prisoners averaged 60% and ranged between 25% and 87% (Slaughter et al 2003; Shiroma et al 2010; Farrer et al 2013).

There are several associations between HI and offending. Impulsivity, aggression and disinhibited behaviour suggest it would be more difficult for a person with HI to regulate their behaviour and learn from mistakes (Shiroma et al, 2010). People with HI in offender populations are convicted of more violent crimes (Hawley & Maden, 2003) and have higher recidivism compared to offenders with no HI (Shiroma et al, 2010). Finally, offenders with HI are more difficult to manage in prison and to re-integrate into the community (Merbitz et al, 1995; Shiroma et al, 2010). This suggests a relationship between HI, offending behaviour and poor rehabilitation outcome which may indicate that the needs of this population differ from a typical offender population.

Prevalence and Impact of Head Injury in Prisons

A systematic review investigating prevalence of Head Injury (HI) in prisoners (Moynan & McMillan in preparation) found few studies consider the impact of HI especially in relation to disability. Disability is defined as the limitation on everyday function resulting from disease or injury (Gentleman, 2008). Studies investigating

disability, neuropsychological and physical impairments found some evidence to suggest poorer outcomes for prisoners with HI compared to prisoners without HI. However defining HI and severity was inconsistent across studies. Self-reported duration of loss of consciousness (LOC) was often referenced however arbitrary cut off scores were used and duration of LOC was not corroborated with hospital records. This reduces the reliability of the data and highlights the difficulty in determining HI severity. Additionally, determining disability in prisoners with HI lacks research. The Glasgow Outcome at Discharge Scale has been developed to determine disability after head injury in an inpatient setting (McMillan et al, 2013) and may be appropriate for incarcerated offenders.

In summary, the literature on prisoners with HI and associated disability is limited (Moynan & McMillan in preparation), relying on self-report, lack of appropriate controls groups and arbitrary models of defining HI and severity. Research to establish whether the needs of the prisoner population differ from typical offender populations, is necessary.

Aims: This project aims to establish the relationships between the prevalence of HI in hospital records compared to self-report and the prevalence of disability in prisoners with HI compared to prisoners without HI.

Hypotheses

H1: There is a greater prevalence of HI in prisoners assessed by self-report than by hospital records.

H2: Disability is more common in prisoners who self-report HI than prisoners who do not self-report HI.

Plan of Investigation

Participants

Males and females aged 18 and over will be recruited from the Scottish Prison Service (SPS). Prison officers in the role of 'key worker' will also be recruited to answer proxy measures.

Recruitment Sites – Her Majesty's Prison Service (HMPS)

HMPS Shotts and Cornton Vale have expressed interest in supporting the study. Other prisons may be approached and it is noted that since initial discussion it has been announced that Cornton Vale prison is to close. Recruitment support is being sought from the NHPN.

HMPS Shotts is a maximum security prison accommodating over 500 adult males which includes a National Integration Centre (NIC) accommodating 60 prisoners at the start of lengthy sentences (minimum 8 years).

1. HMPS Cornton Vale is the main female prison in Scotland accommodating over 300 females aged 18 and over.
2. HMPS Barlinnie is a local prison accommodating males serving sentences < 4 years.
3. HMYOI Polmont is Scotland's national holding facility for young offenders accommodating males aged 16-21 years.

Inclusion/Exclusion criteria

Participants must be fluent in English. Participants who would have difficulty because

of current severe mental health difficulties, severe communication difficulties, current substance use, a deteriorating neurological condition and individuals who pose imminent risk of violence to researchers will be excluded from the study.

Recruitment Procedures

An outline of the study will be sent to recruitment sites detailing the aims and procedures. Prison officers will invite prisoners to participate with an information form. Prisoners involved in work related duties and in receipt of monetary funds can participate with no impact on weekly funds.

Primary Measures: Disability and Mood

The Glasgow Outcome at Discharge Scale (GODS), McMillan et al, 2013

This is specifically designed to detect disability following HI encompassing eight categories of disability established through a structured interview. The GODS has good predictive validity and have been found to have high inter-rater reliability (98%). This takes approximately 10 minutes.

The Hospital Anxiety and Depression Scale (HADS), Snaith & Zigmond, 1994 – in Lezak 2012

The HADS is specifically sensitive in detecting depression and anxiety in people with HI (Whelan-Goodson et al, 2009). The scale consists of 14 items each rated on a 4-point Likert scale with a cut off score of 11 for anxiety or depression indicating clinical levels. This takes 5-15 minutes.

Neuropsychological Measures

Cognitive functioning

List Learning from The Adult Memory Information Processing Battery (AMIPB) -

(Coughlan & Hollows 1984, in Lezak 2012)

15 unrelated words are read and the participant is asked to recall these over 5 learning trials to test learning and memory. A second list is used as interference followed by recall of the first list. Test re-test reliability was high (Lezak, 2012) and people with an acquired brain injury were found to perform below tests norms, with large effect sizes, suggesting adequate sensitivity (Lezak, 2012). This takes 10 minutes.

The Symbol Digit Modalities Test (Smith, 1982, in Lezak 2012)

This is an assessment of information processing including attention, visual scanning, and motor speed. Firstly, it requires testees to identify nine different symbols which correspond with numbers 1-9. They are given ninety seconds to write the correct number under the symbol. Secondly, the testee is given a blank copy of the test and ninety seconds to orally state the number which corresponds with each symbol. This is scored using the total number of correct answers. It has been shown to have high test-retest reliability (Lezak, 2012), and is sensitive to the effects of TBI (Strauss et al, 2006). This takes 10 minutes.

Executive Functions (EF)

Research suggest some tests of EF correlate with dysexecutive symptoms, impacting on daily tasks (Burgess et al, 1998). Two EF tests which are quick to administer and sensitive to inhibition have been selected.

Trail Making Test (TMT), Armitage (1946) in Lezak (2012)

This test measures divided attention and mental flexibility by assessing a person's

ability to switch attention between sequences. The test has two parts. The testee is asked to connect circled numbers then later, circled numbers and letters by drawing a continuous line. This is scored by recording the total time taken to complete each part, and for mistakes to be corrected (Reitan from Lezak, 2012). Good sensitivity for neurological disorders has been found (Burgess et al 1998). This takes 10 minutes.

Hayling Sentence Completion Test (Burgess & Shallice, 1997)

This aims to detect difficulty suppressing the automatic, dominant response. This can be considered a test of verbal response inhibition. Firstly the testee is asked to complete a sentence with the dominant response (meaningful in context). Secondly the testee is asked to complete the sentence with a word which is meaningless, suppressing the dominant response. Adequate test-retest reliability ($r=0.72-0.93$) and internal consistency ($\alpha=0.62-0.76$) have been demonstrated (*Burgess & Shallice, 1997*). This takes 5 minutes.

Test of Symptom Validity

Valid neuropsychological assessment should always include some test of effort. It may be argued that those in an offender sample are a group who may be likely to feign symptoms for secondary gain, therefore there is increased rationale to use a symptom validity test.

Word Memory Test (WMT), Green et al, (2002, in Lezak (2012))

This tests effort and verbal memory and is considered the gold standard effort test. This involves being asked to learn 20 word-pairs followed by an immediate recall task then a 30 minute delayed recognition task. This is followed by a consistency paired associates task. Failure on any part of the test is considered evidence of poor

effort. Sensitivity in detecting simulators was found to be 96-100% and validated in forensic samples (Green et al, 2002). Only the first sections of this test will be used. This takes 20 minutes.

Retrospective Data Collection

Information will be extracted from incident reports as a marker of behaviour.

Scottish Morbidity Records (SMR-01)

SMR-01 is a national database of hospital recorded admissions, discharges and transfers from inpatient and outpatient hospitals. An application will be submitted to the Information Services Division (ISD) requesting access to participants' data. Data will be collected using participants Community Health Index (CHI) number, extracting ICD-10 HI codes (which give information about whether someone has had a HI and perhaps information of the nature of the HI) and information of duration of hospital stay.

Additional Measures

- The Brain Injury Screening Index (BISI)
- The Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID).

These are the focus of another project and will take 5 minutes each.

Design

Another project will be carried out in parallel by another DClin Psych trainee; it will focus on the practicality and validity of screening tools for identifying HI in prisoners.

The same dataset will be collected for both studies and shared between projects.

Participants will be randomly assigned to screening tools following simple

randomisation e.g. participant 1= BISI, 2= OSU-TBI-ID, 3=BISI, and so on.

This is a quantitative cross-sectional study adopting a between subjects design comparing two main groups (prisoners with HI x prisoners without HI). To address H1, participants will be grouped based on information obtained from self-reported HI and hospital recorded HI. Severity of HI will be derived from screening tools and descriptive information from SMR-01. This will identify differences between self-report of HI and recorded hospital admissions with HI. To address H2, participants' scores on outcome measures will be compared across three groups: no HI, mild HI, moderate-severe HI (see table 1 for details of how groups will be determined). If it unlikely SMR-01 data will offer detailed information to allow grouping of participants into severity categories H2 will group participants based on self-report. Hospital record may be used to corroborate information. A question will be added to the BISI, in relation to loss of consciousness (LOC) to help determine group category.

Table 1: Participant groups for analysis

| BISI categories | OSU (research categories) | Definition when merging categories for analysis | Groups for analysis |
|--|---|--|----------------------------|
| No HI | No HI | No HI | No HI |
| Mild (reports a blow to the head resulting in feeling dizzy/dazed) | Mild (no LOC) | At least 1 HI, < 30 minutes LOC | Mild HI |
| | Mild (LOC <30 minutes) | | |
| Moderate-Severe (includes multiple)- Reports no memory after incident and told LOC | Moderate (includes multiple) – most severe injury LOC between 30 minutes and 24 hours | At least 1 HI, > 30 minutes LOC | Moderate-Severe HI |
| | Severe includes multiple most severe | | |

| | | | |
|----------|-----------------------|--|---|
| | injury LOC > 24 hours | | |
| Acquired | | | This will either be excluded from analysis or depending on information provided grouped into mild or moderate- severe |

Research Procedure

Informed consent will be obtained prior to data collection. There will be a short pilot (n=4-6) where both researchers will be present and alternately administer screening tools and measures. Afterwards two researchers will score these independently (n=4-6) and check for inter-rater reliability. This data will be used in the final dataset. An interview will be completed with all participants and information recorded on a 'Data Capture Form'. Self-reported HI will be elicited using one of two screening tools, the BISI and the OSU TBI-ID. Outcomes measures will be administered taking 45-60 minutes. Incident reports held by the SPS will be accessed to compare behaviour between groups. Following interviews participants' hospital records will be checked for HI codes and length of stay. A follow up meeting or phone call will take place with prisoners' key workers in order to complete proxy ratings for the GODs.

Data Analysis

During interview demographic information will be gathered in relation to: age, gender, race, socioeconomic background (Scottish Index of Multiple Deprivation (SIMD 2012), education (in years), previous occupations, types and quantities of alcohol and substance use, number and natures of offenses, age of first offense, duration of time spent in custody. In the HI group data will be gathered in relation to treatment/rehabilitation offered/received for HI.

- H1: *There is a greater prevalence of HI in prisoners assessed by self-report than by hospital records.* A McNemar chi squared (Fisher et al, 2011) will be computed to provide proportions and confidence intervals.
- H2: *Disability is more common in prisoners with HI than prisoners without HI.* Firstly a chi squared will be computed using the primary outcome measure (GODs). This will compare groups based on two disability categories (poor v good recovery). To understand the level of disability across groups an Analysis of Covariance (ANCOVA) will be computed comparing means of all groups (table 1) across outcomes. This controls for variables which may confound results such as substance use. If data is normally distributed, a Pearson correlation will be computed between composite z scores (transformed to a percentile score of overall cognitive function score) and number of incident reports. If this assumption is not met, a spearman correlation will be computed.

Justification of sample size

H1: If self-reported HI prevalence is accurate (60%), we would require a sample size of n=100 in order to detect 60 people with self-reported HI.

H2: There are no studies that compare HI and non-HI on the primary measures. One study detected a difference between good and poor outcome following HI in relation to disability using the Glasgow Outcome Scale Extended (GOSE), with an n=40-45 (Whitnall et al, 2006). Pitman and colleagues (2014) found moderate to large effect sizes (n=189) comparing prisoners with and without HI on neuropsychological measures. In relation to H2, a G*power calculation indicated n= 158 would be required to detect medium effects ($d=0.25$), with power of 80% using ANCOVA alpha, 0.05. To detect large effects ($d=0.4$), with the same analysis and power, n=64,

would be required. Given the power analysis, I will aim to have a sample size of n= 100-160.

Setting & Equipment

The study will take place in the SPS. Equipment will include outcome measures, questionnaires and neuropsychological tests. SMR-01 will be accessed to check for episodes of HI and information from discharge reports.

Health and Safety Issues

This study will be conducted within a prison setting with potentially high risk individuals. Extra care will be taken to ensure that in accordance with SPS policies and procedures risk assessments and safety procedures are in place for researchers (see appendix 2).

Researcher Safety

The researchers will use personal alarms and follow prison procedures. The researchers will receive SPS training in relation to Boundaries, Key training and Breakaway techniques (see appendix 2) prior to data collection.

Participant Safety

This study is not likely to cause harm to participants however the content of interviews may generate distressing memories. Participants will be offered space to ask questions following the study. The researchers will seek to understand whether they have found any aspects difficult and if they are likely to require on-going emotional support. Information will be passed onto the SPS if this is identified.

Ethical Issues

This project will be submitted to the NHS Research Ethics Committee (REC)

because prisoners will be recruited via the NHS service to prisons, NHS Research & Development (R&D), Privacy Advisory Service regarding provision of SMR-01 data and the SPS Ethics committee. The population of interest represents a vulnerable group therefore it will be important to gain informed consent. Confidentiality limits and procedures will be discussed with participants. Information collected will be anonymised and stored in accordance with NHS and university guidelines. Capacity to consent will be determined by researchers who will ask questions to check understanding of consent form.

Financial Issues

Costs include printing/photocopying materials, neuropsychological test materials and travel expenses, approximately £630 for each trainee project (see appendix 3). There will be a cost for using ISD and funds will be requested from NPHN for this.

Timetable

1st June applications to SPS and ISD

1st July application to NHS ethics

1st September 2016 to 30 April 2017 – Data collection and scoring

May- July 2017 Data analysis and write up

July 2017 – Final project submitted

Practical Applications

Establishing prevalence of disability associated with HI, as recorded by hospital records is a necessary step to aid understanding of the needs of this population and whether/how they might be met in a prison setting. This study may provide details on appropriate service provisions and inform future researchers and policy makers.

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Appendices

Appendix 1: Plain English Summary

Title: Rates of Head Injury (HI) and related disability in Scottish Prisons.

Background: HI is linked to lifelong disability and on-going cognitive problems. The Scottish Government is keen to consider the needs of prisoners with undiagnosed HI's and understand rates of disability in this population. Studies have found between 25% - 87% of prisoners said they have a HI which can be linked with more violent convictions and higher rates of re-offending. These factors may be linked with poorer rehabilitation outcomes.

Impact of HI in Prisoners

Many studies report high numbers of prisoners with HI; however few studies have investigated the lasting impact in terms of cognitive difficulties and disability. Some evidence suggests prisoners with HI have worse outcomes compared to prisoners without HI. In summary, research into the rates and impact of HI on prisoners is incomplete and low in quality. Further research is necessary to determine whether the needs of this population differ from typical offender populations.

Aims and Questions

Establish the rates of HI in prisoners, in particular the rates of disability related to HI.

Hypotheses

H1: Prisoners self-reporting HI is higher than prisoners with a hospital recorded HI.

H2: Disability is more common in prisoners with HI than prisoners without HI.

Methods

Males and females aged 18 years and over from two or more Scottish prisons will be recruited. People will not be able to take part if they:

- are not fluent in English
- have current severe mental health difficulties
- have severe communication difficulties
- have current substance use
- have a deteriorating neurological condition
- pose immediate risk to researchers.

Information about the study will be sent to the prison and if prisoners want to take part, they will be asked to sign a consent form.

Measurements

The Glasgow Outcome at Discharge Scale (GODS) will be used to determine whether a person is disabled and to what extent they are disabled in relation to having a HI. Other measurements relate to: mood states, screening for HI's, incidents reports, cognitive skills and hospital records.

To address the first hypothesis, differences between self-reported HI and hospital record of HI will be described (table 1).

| Table 1: | | Hospital recorded | |
|-----------------|-----|-------------------|----|
| | | Yes | No |
| Self-reported | Yes | | |

| | | | |
|--|----|--|--|
| | No | | |
| | | | |

To address the second hypothesis participants will be split into groups for comparison across disability and cognitive measurements:

1. Mild HI
2. Moderate-Severe HI
4. No HI

Ethical Issues

Approval will be sought from NHS Research Ethics Committee (REC), NHS Research & Development (R&D) and the Scottish Prison Service. Confidentiality limits and procedures will be discussed with participants. Information collected will be anonymised and stored in line with NHS guidelines.

Applications

Understanding the rates of disability associated with HI is important to determine which prisoners with HI are likely to require on-going support. Using hospital records is a necessary step to understand the impact HI is likely to have in the long term. It is hoped this study will be published in journals for researchers and distributed to the SPS and justice committee to inform policy makers.

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Appendix 2: Health & Safety Form

| | |
|---|--|
| 1. Title of Project | The Prevalence of Head Injury and Associated Disability in Scottish Prisons |
| 2. Trainee | |
| 3. University Supervisor | Professor Tom McMillan and Dr Caroline Bruce |
| 4. Other Supervisor(s) | N/A |
| 5. Local Lead Clinician | Not established yet |
| 6. Participants: (age, group or sub-group, pre- or post-treatment, etc) | Males and females aged over 18 years. Participants will be in prison at time of study. Participants will be interviewed and complete several measures relating to head injury. This will take approximately 60minutes. For analysis purposes participants will be separated into groups (no head injury x mild head injury x moderate head injury x severe head injury). |
| 7. Procedures to be applied (eg, questionnaire, interview, etc) | An interview will involve gathering demographic details and administering measures listed below: |

| | |
|--|---|
| | <p>Two screening tools:</p> <ul style="list-style-type: none"> • The Brain Injury Screening Index (BISI) • The Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID). <p>Six outcome measures:</p> <ul style="list-style-type: none"> • The Glasgow Outcome at Discharge Scale (GODS) • The Hospital Anxiety and Depression Scale (HADS) • The Adult Memory and Information Processing Battery (AMIPB) - List Learning Sub-Test • The Symbol Digit Modalities Test (SDMT) • The Trail Making Test (TMT) • The Hayling Sentence Completion Test <p>A Symptom Validity Test:</p> <ul style="list-style-type: none"> • Word Memory Test Following interview, information will be obtained regarding hospital recorded head injury and duration of time spent in hospital in relation to this. • The Scottish Morbidity Records (SMR-01). |
| 8. Setting (where will procedures be carried out?) i) Details of all settings | <p>Research will be conducted within the Scottish Prison Service (HMP Shotts and HMP Cornton Vale have agreed to take part). Research may also be conducted within HMP Polmont and HMP Barlinnie, subject to their agreement to partake as recruitment sites.</p> <p>Within HMP Shotts, research will take place within the National Integration Centre (NIC). It is likely that a room outside of the main prison area will be arranged for testing. Researchers will discuss security options with prison staff to ensure optimal risk management. It is likely that prison officers will bring and retrieve</p> |

| | |
|------------------------------|---|
| | participants for interview and testing. Researchers may have access to keys in some settings |
| ii) Are home visits involved | No. |

| | |
|---|---|
| <p>9. Potential Risk Factors Considered (for researcher and participant safety):</p> <ul style="list-style-type: none"> i) Participants ii) Procedures iii) Settings | <p>Participants: There are no major risks to participants. Talking about head injury may bring about distressing memories however this is unlikely and debriefing will be available if this occurs. As participants have a history of criminal activity this suggests potential risk to researchers. Additionally it is likely some participants will have head injury often associated with impulsive, irritable and aggressive behaviour.</p> <p>Procedures: The interview and testing period will be approximately 60 minutes. It is hoped that this will not differ much from Clinical Psychology interviews and is unlikely to raise risk issues. Participants may become frustrated if struggling to complete tests. Clinical skills will be used to support effort and encouragement in completion of tests.</p> <p>Settings: The setting will be highly secure due to the nature of the participant group.</p> |
| <p>10. 10. Actions to minimise risk (refer to 9)</p> <ul style="list-style-type: none"> i) Participants ii) Procedures iii) Settings | <p>Participants: If participants experience distress relating to the testing process, researchers have some degree of clinical training, and will use their clinical skills to address this within the interview. Prison officers will also be informed if this occurs. Researchers will be careful to monitor all participants throughout interview. Participants will be free to leave the interview at any stage, but if any signs of distress are noted, researchers will ensure that</p> |

| | |
|--|--|
| | <p>participants are reminded that they may leave at any stage, and if necessary the interview will be ended. Participants posing increased risk of harm to themselves or the researcher will be excluded from the study. Guidance on this will be sought from prison officers. Whilst in the prison, prison officers will be aware of researchers whereabouts at all times, and will be on hand to manage any risks that are presented to researchers. Researchers will have training from the prison service to manage disclosure, maintain boundaries and to maximise breakaway skills.</p> <p>Procedures: Testing will take place in a safe area separate from the main prison to reduce risks. Researchers will ensure that they give on-going reminders to participants that they are free to withdraw from the study at any time.</p> <p>Settings: Prison officer support will reduce the likelihood of risk and increase the safety of researchers. Researchers will have a personal; alarm, and will ensure they adhere to relevant risk management strategies (such as having unblocked access out of the interview room) in order to navigate to safety if risk of harm arises. Researchers will have training from the prison service to manage disclosure, maintain boundaries and to maximise breakaway skills.</p> |
|--|--|

Trainee signature: Date:..... 18.04.16

University supervisor signature: Date:.....

Appendix 3: Equipment Form

Trainee :

Year of Course: 2016 **Intake Year:** 2014.

| Item | Details and Amount Required | Cost or Specify if to Request to Borrow from Department |
|---------------------------------|---|--|
| Stationary | 1 ream white paper | Subtotal: £2.18 |
| Postage | N/A | Subtotal: 0 |
| Photocopying and Laser Printing | 100 sheets | Subtotal: £20.00 |
| Equipment and Software | N/A | Subtotal: 0 |
| Measures | All measures available through university or free except Word Memory test, 100 test sheets. <ul style="list-style-type: none"> •The Brain Injury Screening Index (BISI) •The Ohio State University Traumatic Brain Injury Identification Method – Short Form (OSU TBI-ID). | Subtotal: \$525 = £368.81 |

| | | |
|---------------|---|---|
| | <ul style="list-style-type: none"> •The Glasgow Outcome at Discharge Scale (GODS) •The Hospital Anxiety and Depression Scale (HADS) •The Adult Memory and Information Processing Battery (AMIPB) - List Learning Sub-Test •The Symbol Digit Modalities Test (SDMT) •Trail Making Test (TMT) •Hayling Sentence Completion Test | |
| Miscellaneous | <p>The Scottish Morbidity Records (SMR-01) will be accessed to obtain records of head injuries which required hospital attendance/admission.</p> <p>This involves an application to the ISD, (costing approx. £2000) Professor Tom McMillan anticipates this will be funded via the NPHN.</p> <p>Travel costs: Shotts Prison: (from home 23.5 miles, from Gartnaval 20.6 miles).</p> <p>Cornton Vale Prison: (from home 36 miles,</p> | <p>Subtotal: £240 (15 journeys to and from Shotts or Cornton Vale/Polmont), @ 30pence per mile.</p> <p>It is likely data collection will take between 20-40 days (approximately 5 participants per day based on 100-200 participants). This will be split between two data collectors</p> |

| | | |
|--------------|---|-----------------|
| | <p>from Gartnaval 32.6 miles).</p> <p>Barlinnie Prison: (from home 8.9 miles, from Gartnaval 6.1 miles)</p> <p>Polmont YOI and prison: (from home 35.1 miles, from Gartnaval 29.9 miles).</p> | |
| Total | | £630.99. |

For any request over £200 please provide further justification for all items that contribute to a high total cost estimate. Please also provide justification if costing for an honorarium:

Given that this project requires a prison sample, frequent travel to HMP Shotts, HMP Cornton Vale, and possibly HMYOI Polmont and Barlinnie will be required. Given three of these locations are significant distances and will recruitment will be necessary from at least two of these, travel will be extensive and thus costs are estimated as above. The NHS GGC health board have stated no funds can be allocated to travel for research.

Trainee Signature: Date 18.04.16

Supervisor's Signature Date