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Head Injury and Associated Disability in Offenders on Release from Custody and Clinical Research Portfolio

Lauren Mapp, M.A (Hons), MSc

Thesis submitted in partial fulfilment of the requirements for the
degree of Doctorate in Clinical Psychology

Mental Health and Wellbeing
Institute of Health and Wellbeing
College of Medicine, Veterinary and Life Sciences

September, 2019

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Declaration of originality form



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Word count for submission of DClinPsy thesis for examination

Trainee name:	Lauren Mapp
Matriculation number:	0503366m
Title of thesis	Head Injury and Associated Disability in Offenders on Release from Custody
Date of submission of soft bound thesis	26.07.19
Systematic review chapter word count (6,000 limit, including tables, figures & references)	6,584
Major research project chapter word count (6,000 limit, including tables, figures & references)	6,754
Thesis word count (maximum 30,000 including appendices)	22,789
Justification for exceeding chapter word count (e.g. qualitative MRP chapter, with word count under 6,000 if excluding quotes)	Both Systematic Review and MRP are within the 20% allowance as stated in the Handbook. Reducing the word count would have removed essential information.
Trainee Signature	

Acknowledgement

Firstly, I would like to thank the men who participated in this study. They were generous in sharing their experiences with me and made this research possible.

I would like to thank the staff at HMP Low Moss, particularly the Links centre team and the PSP team for their help and support with the project.

I owe many thanks to my supervisor Professor Tom McMillan, for his guidance and patience. I am thankful to have had the opportunity to learn from him. A big thank you to my fellow researcher, Hira, for sharing her wisdom and being so generous with her time.

Thank you to my DClinPsy friends, I cannot imagine sharing this training experience with anyone else! Thank you to my wonderful friends outside of training, who gave me endless support. I am so grateful to have their friendship.

I dedicate this thesis to my parents Eric and Jaci. I am so thankful for their love, encouragement and zest for life. Finally to Terry, my constant throughout, providing love positivity and fun. Thank you.

Chapter 1 Systematic review

Is Head Injury a Risk Factor for Reoffending? A PRISMA Systematic Review

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Declaration of Conflict of Interest: None

Prepared in accordance with the guidelines for submission to the Journal of Offender Rehabilitation (See Appendix 1.1)

Word count (including abstract and references): 6,583

Abstract

Background: There is a higher prevalence Head Injury (HI) in offending populations compared to the general population. A recent review has suggested that HI may increase the risk of becoming involved in the Criminal Justice System (CJS); however, there has been little research on the role of HI as a risk factor for reoffending.

Aim: To systematically review empirical evidence for relationships between HI and reoffending to understand if HI is a risk factor for reoffending, if this relationship remains when controlling other factors, if specific effects of HI are associated with risk of reoffending and if HI is associated with characteristics of criminal reoffending.

Methods: Electronic databases were searched for research on HI and reoffending. Studies on the topic were hand-searched to identify further relevant research. All studies were assessed for risk of bias.

Results: Ten studies were included. The relationship between HI and reoffending was not proven. Only one low bias study reported a predictive relationship between HI and re-offending in adult offenders. No study explored relationships between neuropsychological deficits and reoffending. There was inconclusive evidence that HI is associated with more serious reconvictions.

Conclusion: The high risk of bias across studies meant that a causal link between HI and reoffending could not be made. Further research using consistent methodology is needed to establish the role of HI in risk of reoffending.

Keywords: Head injury, traumatic brain injury, prisoners, offenders, reoffending, recidivism

Word count: 224

Introduction

There is a growing body of research on Head Injury (HI) in offending populations. Meta-analyses report prevalence rates of self-reported HI in offending populations ranging from 51% to 60% (Farrer & Hedges, 2011; Shiroma, Ferguson & Pickelsimer, 2010). In Scotland, prisoners have a higher lifetime prevalence of hospitalised HI (25%) than the general population (18%) and are more likely to have had repeated HI or intracranial injuries (McMillan, Graham, Pell, McConnachie & Mackay, 2019).

Severe HI, is associated with cognitive impairment and neurobehavioural effects arising from impulsiveness, impatience, intolerance, impaired insight, lack of concern for others, impaired concentration and memory, poor planning and problem solving, aggression and social disinhibition (Worthington, Wood & McMillan, 2017). The effects of repeated mild HI can be cumulative and also lead to persisting impairment (Schofield, Butler, Hollis et. al., 2006; Karr, Corson, Arenshenkoff et. al, 2014). Persisting impairments are often generic, not associated with physical disability and may not attributed to HI. Therefore HI has been referred to as the ‘silent epidemic’ (Langlois, Rutland-Brown & Wald, 2006), whereby individuals and those around them are often unaware of the role of HI in perpetuating various difficulties.

HI could lead to increased risk taking, the breaking of societal rules and lead to involvement in the criminal justice system (CJS) (McMillan & Williams, 2017). Data-linkage and population studies indicate that HI increases criminality, however pre-injury characteristics such as socioeconomic status, psychiatric disorder and substance use remain important predictors of crime (Fazel, Lichtenstein, Grann et. al, 2011; Schofield, Malacova, Preen et. al, 2015; Kennedy, Heron & Munafo, 2017). Those with HI are approximately 2.5 times more likely to be imprisoned than those who do not have a history of HI (McIsaac, Moser, Moineddin et. al, 2016). A recent review

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(Williams, Chitsabsean, Fazel, McMillan et. al, 2018) concluded that HI is associated with earlier age of imprisonment, increased risk of violence, more convictions, infractions in prison, poorer treatment gains and reconviction.

Reoffending, has been defined by the US Bureau of Justice Statistics as “criminal acts that result in re-arrest, reconviction, or return to prison with or without a new sentence during a three-year period following the prisoner’s release” (Langan & Levin, 2002, p1.). The Scottish Government defines recidivism as, “where someone who has committed an offence and received some form of criminal justice sanction, goes onto commit another offence.” (p.8, Scottish Government, 2019). A defined time period is not included in this definition, however government data is presented on offenders who are followed up for one-two years post release. In 2016-17, the reconviction rate was 27% (Scottish Government, 2019). At present, there is no internationally accepted measure of reoffending as individual countries vary greatly in terms of outcomes used to define reoffending and whether this includes a follow-up period (Fazel & Wolf, 2015).

Recidivism rates (or rates of repeat offending) are often used as a measure of effectiveness of prison systems and post release offender management programmes (Ministry of Justice, 2017). It is necessary to establish the rate of recidivism in those released from custody, as this sample constitute a high-risk group that commit the majority of violent crimes (Andersen & Skardhamar, 2017). Approximately one fifth of all crime, in any year, is committed by those released from custody (Petersilia, 2011), with huge associated financial costs and a large contribution to overall societal criminality. Across countries it is consistently found that reconviction rates are higher for those leaving prison than those serving community sentences (Scottish Centre for Crime and Justice Research, 2012). In Scotland, 46% of people who left prison in

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2009/10 reoffended within a year compared to 34% of those who received a community sentence (Scottish Government, 2012).

It is recognised that not all crimes lead to imprisonment, however with diverse reporting practices for recording offence data it is necessary to focus on an imprisoned sample to gain the most accurate offending information to examine links between reoffending and HI. Although evidence for an association between HI and offending has been reviewed (Farrer & Hedges, 2011; Farrer, Frost & Hedges 2013; Shiroma, Ferguson & Pickelsimer, 2010), the case for an association between HI and recidivism has attracted less attention. There are significant implications for society, public health and criminal justice services if there is a causal connection between HI and reoffending and hence a need for the present systematic review.

Aim

To systematically review the evidence for relationships between HI and reoffending and its quality.

Systematic Review Questions:

1. Is HI a risk factor for reoffending?
2. Is there unique variance associated with HI when considering other key factors?
3. Are specific effects of HI associated with risk of reoffending?
4. Is HI associated with characteristics of criminal reoffending?

Method

Inclusion Criteria

- Quantitative design
- Participants are prisoners
- Participants are assessed for HI
- Consideration of relationships between HI and reoffending

Exclusion Criteria

- Single case studies.
- Qualitative studies
- Book chapters
- Conference abstracts
- Studies on sub-groups that are not representative of the prison population such as those in in-patient psychiatric hospitals, on death row or sexual offenders.

Search Strategy

The following databases were searched on 13th June 2019: EMBASE, CINAHL, Medline, ProQuest Dissertations & theses, PsychINFO & Open Grey (grey literature). No limits were placed on the publication year of studies. MEDLINE includes research dating from 1946, EMBASE from 1947, PsycINFO includes historical journal records from the 17th century, CINAHL from 1981 and ProQuest Dissertations & theses from 1743. The reference lists of relevant systematic reviews were reviewed to identify any further articles not captured in the database search and no further articles were identified.

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The main strategy used across databases was as follows, in consultation with a librarian to identify relevant papers (see appendix 1.2 for specific database searches):

1. Subject term mapping for the key words below to identify synonyms used across databases.
 - Head OR brain* NEAR/2 (injur*) OR traumatic brain injur* OR head trauma OR brain trauma OR HI OR TBI
 - Recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration)
2. Complete text-word search in title and abstract fields for each key area.
3. The 'OR' function was used to combine each subject term with the title and abstract search for each key area.
4. Separate searches were combined with the 'AND' function to combine key areas.

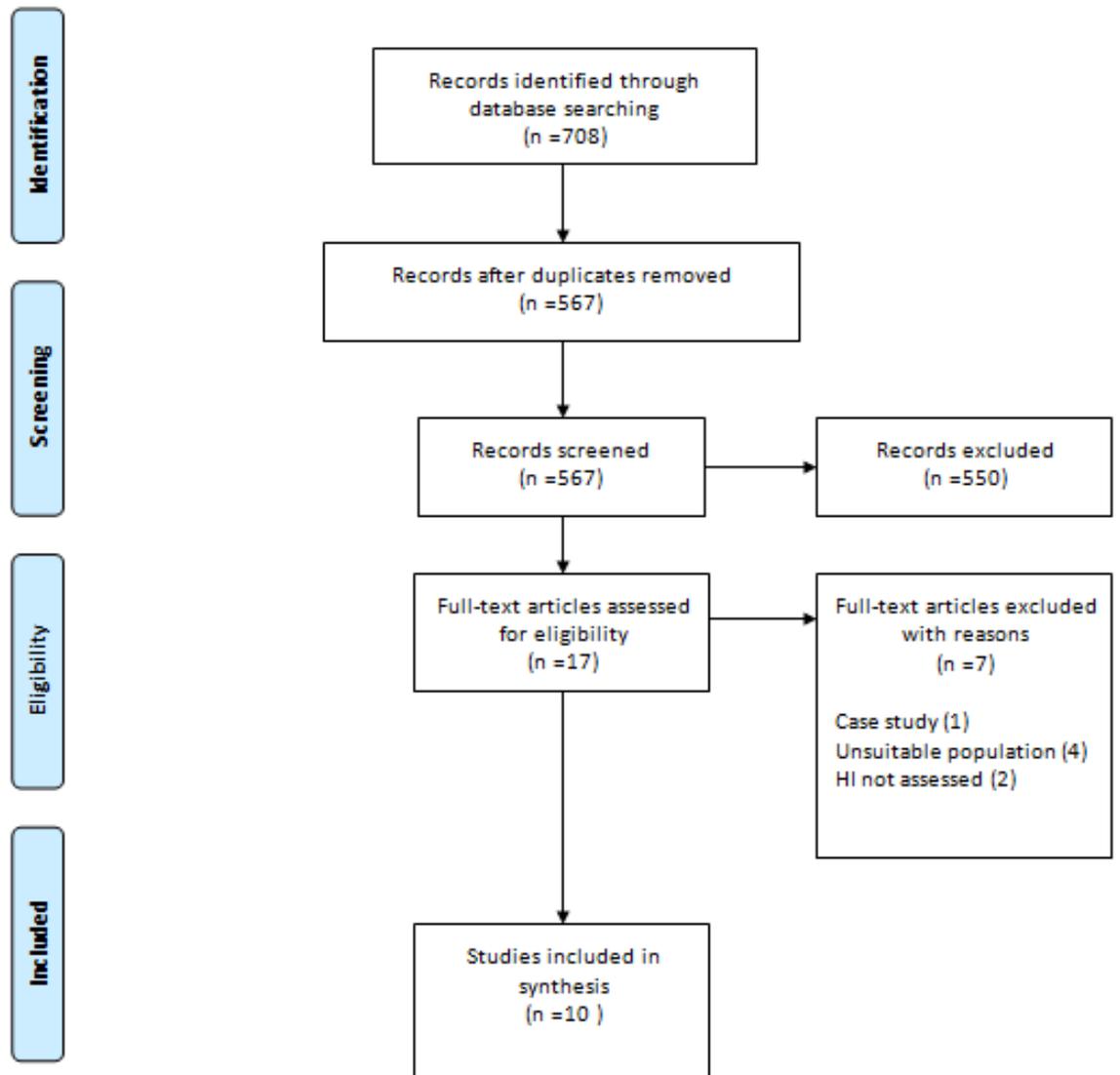


Figure 1: PRISMA Flow Diagram

The search yielded 708 results, of which 141 were duplicates (Figure 1). The author screened the titles and abstracts of 567 results for relevance and 550 were not relevant. The abstracts of full texts of 17 studies were reviewed, 7 were excluded, leaving 10 studies for inclusion.

Quality-Rating

Risk of bias was assessed using a quality-rating tool derived from criteria developed for use in observational epidemiological studies (Sanderson, Tatt & Higgins, 2007) and modified for use in HI (Moynan & McMillan, 2018). This tool was further adapted in line with the research questions in the current study. The tool comprised seven domains (see table 1). Domains were rated as ‘high’ or ‘low’ in risk of bias depending on whether they met criteria in the risk of bias tool (table 1). If domains were not relevant to the study they were rated as ‘not applicable’ (N/A) and if studies did not report data, that was likely to have been collected, this was rated as ‘not reported’ (N/R). Both NA and NR indicate high bias. A second-rater reviewed 50% of the papers. There was inter-rater concordance for 97% (34/35 ratings). A difference in rating domain three for the Ramdath (2015) study was resolved through discussion.

Table 1: Domains and criteria for assessing risk of bias

Domain	Criteria
1. Method for selecting study participants	<ul style="list-style-type: none"> I. Inclusion/exclusion criteria are clear II. Sample are representative of the larger prison population
2. Method for defining & measuring HI	<ul style="list-style-type: none"> I. Use of internationally recognised categories and definitions of HI (Carroll et. al, 2004; Malec et. al, 2007) II. Use of a validated HI assessment tool III. Assessment of effect of HI: Using an outcome relevant to HI using validated tools (e.g. disability, neuropsychological impairment)
3. Method for measuring reoffending outcome	<p>Reoffending: assessed by number of convictions/ number of times imprisoned</p> <p>Recidivism as a relapse into criminal behaviour post release including the following:</p> <ul style="list-style-type: none"> I. Re-arrest, re-conviction, re-imprisonment II. Defined follow up period: in line with specific country guidelines or guidance from recidivism research (Fazel and Wolf, 2015)
4. Measure of relevant Offending outcomes	<p>Characteristics of offending behaviour to include (but not limited to):</p> <ul style="list-style-type: none"> I. Age at first offence II. Type of offending III. Type of reoffending IV. Number of previous convictions V. Sentence length
5. Comparison of outcomes	<p>Comparison of outcomes with</p> <ul style="list-style-type: none"> I. Offenders without HI.
6. Methods to control confounding	<p>The control of confounding factors and examination of causality. Such factors may include (but not limited to):</p> <ul style="list-style-type: none"> I. Demographic variables II. Substance misuse / alcohol misuse III. Mental Health IV. Post-release supervision <p>Control confounders via:</p> <ul style="list-style-type: none"> I. Design II. Statistical methods <p>Cross-referencing self-report of HI/offending with hospital records for HI and prison/police records for recidivism</p>
7. Conflicts of interest	<p>Declarations of conflict of interest or identification of funding sources.</p>

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Data Extraction

For each paper, data relevant to each table heading was extracted (tables 2 and 3).

Strategy for combining the results of the study

Given the clinical and methodological heterogeneity of included papers, study results studies were analysed using narrative synthesis.

Results

Risk of Bias Assessment (see table 2)

In relation to the research questions, 44/70 ratings were high in risk of bias across the seven domains assessed (table 2). Low risk of bias was not found consistently for any domain or any study. Bias was mixed in three domains: ‘selection of participants’; ‘measures relevant to offending outcomes’ and ‘comparison of outcomes.’ There was high risk of bias in the remaining domains (Methods of defining and measuring HI, Methods of measuring reoffending and Methods to control confounding). In relation to the ten individual studies, two were low in risk of bias (4&6), six were high in risk in the majority of domains (1,2,5,8,9,10) and two were mixed (3&7).

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Table 2. *Risk of Bias Ratings*

	Selection of participants	Method of HI assessment	Method of reoffending measurement	Measures relevant to outcomes in offending	Comparison of outcomes	Methods to control confounding	Conflicts of interest
1. Williams et. al, 2010	High	High	High	High	Low	High	Low
2. Mancusi, 2013	High	High	High	High	High	High	N/A
3. Piccolino & Solberg, 2014	Low	High	High	Low	Low	High	Low
4. Ramdath, 2015	Low	High	Low	Low	Low	Low	N/A
5. Cebulla, 2016	Low	High	High	Low	High	High	N/A
6. Ray & Richardson, 2017	Low	Low	Low	Low	Low	Low	N/R
7. Durand et. al 2017	Low	High	High	Low	Low	High	Low
8. Nagele, et. al, 2018	High	High	High	High	High	High	N/R
9. Ahlers, 2018	High	High	High	High	High	High	N/A
10. Nielssen et. al, 2019	High	High	Low	Low	High	High	Low

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Study characteristics (see table 3)

The studies present data on 3,525 offenders (786 young offenders and 2078 adults). One study (n=661) did not report age and gender. Seven studies took place in the USA, one in the UK, one in France and one in New Zealand. Five used a cross-sectional design, four were prospective and one retrospective. Six studies were published in peer reviewed journals and four were theses. All participants were recruited from prisons, with recruitment varying across a number of factors such as type of prison (adult/juvenile) level of security (low-maximum), and number of prisons recruited from (single or multiple).

Table 3: Study characteristics

Study authors, year (country)	Design	Sample	Measure and definition of HI	Measure of reoffending	Additional Outcomes	Relationship between HI and reoffending
1. Williams, et al., 2010, (England)	Cross-sectional 1	Male prisoners (n=196) Age 18-54 years 65% (n=119) HI	Measure: Self-report Non-validated questionnaire. Definition: Any HI with or without LOC categorised by severity based on LOC:	First time in prison (yes/no response)	Age at first conviction Length of time imprisoned in past 5 years (months) Offence type	Univariate analysis: Significant association between HI and imprisonment: $X^2(1,195)=11.98$, $p=0.001$ OR/Cramer's V not reported. Counts not reported to calculate OR
2. Mancusi, 2013 (USA)	Cross-sectional 1	Male (n=87) prisoners Mean age: 37.8 years (SD=11.2) 99% (n=86) HI Black 37% Hispanic 6% White 54% Other 35%	Measure: Self-report TBIQ Definition from TBIQ	LSI-R score	Age at first arrest Number of convictions	Univariate analysis: No significant difference between HI severity and LSI-R scores No effect size reported Multiple regression: No predictive relationship between number of HI, severity of HI and number of convictions. No co-variates

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						Number of convictions correlated with LSI-R scores <i>r</i> = - 0.447
3. Piccolino & Solberg, 2014 (USA)	Cross-sectional	Male (n=998) prisoners, Mean age 32.7 years (SD=9.8years) 82.9% (n=827) HI	Measure: Self-report TBIQ Definition from TBIQ	Re-imprisonment Follow up period not stated	Number of convictions Offence type In-prison infractions Use of prison health services. Crisis intervention	Univariate analysis: Significant association between HI and re-imprisonment. % re-imprisoned: NoHI:33% Mild-moderate HI:43% Severe HI: 51% $X^2=8.93$, $p=0.011$, $\Phi=0.12$
4. Ramdath, 2015 (USA)	Prospective	Male (n=262) juvenile offenders in prison Age not reported 50% HI Black 70% Hispanic 29% White 9% Other 21%	Measure: Self-report TBIQ Definition from TBIQ	Re-imprisonment within 1 year	Number of times imprisoned Length of time in custody In-prison infractions Time in segregation Education	Multivariate binary logistic regression: Pseudo $R^2=0.01$ HI was not a significant predictor of recidivism in regression analysis Significant variables in model: Education: OR=0.22, $p<0.05$

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					<p>Family financial income</p> <p>MH service use</p> <p>Substance use</p>	<p>MH services utilisation: OR=2.8, p<0.01 Cannabis use: OR=0.46,p<0.01)</p> <p>Cox survival analysis: HI did not predict time to re-imprisonment HR=1.16 Significant variables in model: Education: HR=0.46,p<0.05 MH services utilisation: HR=1.91,p<0.01 Cannabis use: HR=0.69,p<0.05</p> <p>95% CI not reported for HRs</p>
5. Cebulla 2016 (USA)	Cross-sectional 1	<p>Juvenile offenders in prison 29% (n=56) female 71% (n=136) male</p> <p>Male mean age 15.8 (SD=1.3) Female mean age 15.6 (SD=1.1)</p> <p>83% HI males</p>	<p>Measure: self-report non-validated measure</p> <p>Definition: HI with LOC and post-concussion symptoms.</p>	Number of times imprisoned	<p>Age at first offense</p> <p>Offence type</p> <p>Mental Health diagnosis</p> <p>Neurocognitive tests: LANSE-A BRIEF-SR D-KEFS – trail</p>	<p>ANCOVA: No significant association between impairment (LANSE-A scores binary category) and number of times imprisoned</p> <p>Age at first offence only co-variate</p>

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		30% HI females Male/female (%) Ethnicity: Asian 0/2 Black 3/7 Hispanic 72/67 Multi-ethnic 7/9 White 18/14			making and colour-word interference tests. Youth Self-Report measure	
6. Ray & Richardson, 2017 (USA)	Prospective	Male (n=151) prisoners Mean age 31.2 years (SD= 10) 35% (n=54) HI Black 61% Hispanic 3% White 36%	Measure: Self-report OSU-TBI-ID Definition: from OSU-TBI-ID	Re-imprisonment within 12-30 months	Offence type Number of arrests Number of times imprisoned Psychiatric diagnosis	Cox survival analysis: HI predicted time to re-imprisonment: HI:48% re-offended No HI:37% re-offended HR=1.85 (95% CI 1.08-3.15) Significant variables: Ethnicity: HR=0.58 (95% CI 0.36 – 0.94) Prior Arrests: HR=1.05 (95% CI 1.02 – 1.08)
7. Durand, et al., 2017 (France)	Cross-sectional	Young offenders in Prison (n=332) Male=302 Female=30 Mean age: Males: 18.9years (SD=1.7) Females: 17.8years (SD=2.3)	Measure: Self-report Non-validated questionnaire. Definition: Definition: Any HI with or without LOC	Number of times imprisoned	Age at first imprisonment Total prison time in past 5 years Number of times imprisoned Education Occupation	Univariate analysis: No significant difference between those with HI and without HI and number of times imprisoned No effect sizes reported

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		24% (n=80) HI 78=male 2=female			Cause of HI	
8.Nagele, et al., 2018 (USA)	Prospective	Male (n=163) prisoners Age: not reported 76% (n=120) HI	Measure: Self-report TBIQ Definition: Any HI + any acquired brain injury from sickness/disease	Re-imprisonment – No follow up period reported	Neurocognitive tests: RBANS Trail making Booklet category test Brown-Peterson consonant trigrams Tower of London	Descriptive results only 17% (n=44) re-imprisoned. No comparison group
9. Ahlers, 2018 (USA)	Prospective	Prisoners across 43 counties (n=483) Male=333 Female=150 Mean age=35.5years (SD=11.9) 36.4%(n=176) HI	Measure: Self report HELPS Screen or OSU-TBI-ID No definition	Any self-reported crime within 6 months	Mental health diagnosis History of trauma Community treatment post-release	Cox survival analysis: HI was not a significant predictor of time to re-offend: HR: 1.69 (95%CI 0.95-3.01, p=0.08) No co-variates

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<p>10. Nielsse, et al., 2019 (New Zealand)</p>	<p>Retrospective</p>	<p>Prisoners (n=661) Age and gender not reported 11% (n=73) 'Cognitive disorder' (including HI)</p>	<p>Measure: Clinical judgement - reviewing court report No definition</p>	<p>Re-imprisonment within 8–10 years</p>	<p>Imprisonment for first offence Time in prison following re-imprisonment Diagnosis of psychosis</p>	<p>Univariate analysis: No significant association between re-imprisonment and psychosis, cognitive disorder or neither condition. Kaplan-Meier survival analysis: Cognitive disorder was not a significant predictor of overall re-imprisonment. HR: 1.15 (95%CI 0.79-1.65, p=0.46) Cox survival analysis: Imprisonment for first offence only significant predictor of time to re-imprisonment HR: 3.55 (95%CI 2.62-4.81) Only controlled for gender, presence of court report and initial custodial sentence</p>
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Bias in Measurement of HI and Re-offending

Risk of bias was high for methods used to assess and measure HI, methods used to measure reoffending and measures to control for confounding. This significantly reduced the quality of most studies, with only two rated as low in bias overall (4,6), providing a limited evidence base for the review questions.

There was a high risk of bias in assessment of HI in all but one study (6). Studies did not use an international definition of HI, or did not report the definition used (5, 9,10). Non-validated self-report tools were used to assess the presence of HI (1,5,7,9,10) and the definition of HI severity varied (1,2,3,4,7,8) out with internationally recognised criteria (LOC <30minutes indicating mild HI and LOC>30minutes indicating moderate-severe HI) (Malec, Brown, Leibson et al, 2007).

There was a high risk of bias in methods used to assess reoffending in seven studies. Three were low in risk of bias, reporting reoffending as re-imprisonment within a minimum 1-2 year follow up period (4,6,10). Three studies used shorter follow-up periods (4) or did not report the length of follow up (3,8). The criteria for reoffending varied widely in all other studies (1,2,5,7,9).

The prevalence of HI in adult offenders ranged from 11- 99% and reoffending (i.e. re-imprisonment) occurred in 11-51% of those with HI and 9-37% of those with no HI. HI was reported in 24% to 83% of juvenile prisoners. It was not possible to synthesize data on reoffending here because studies used different criteria for reoffending. Only one used reported re-imprisonment data, which occurred in 67% of those with HI and 58% of those without (4).

1. Is there an association between HI and reoffending?

There is limited evidence of an association between HI and reoffending. One high risk of bias study (1) found a significant association between the occurrence of a HI and previous imprisonment in adult offenders. The magnitude of the association is not clear and only univariate analysis was employed, with no consideration of covariates. Another low quality study (3) reported a significant association between HI and re-imprisonment in adult offenders (33% no HI group, 43%, 'Mild-Moderate' HI group, 51% 'Severe' HI group re-imprisoned). The necessary data to calculate effect sizes was not reported.

Three low quality cross-sectional studies reported no significant association between HI and reoffending (2,5,7). One (2) measured re-offending in adult offenders using the Level of Service Inventory- Revised (LSI-R, Andrews & Bonta, 2001). The LSI-R assesses the likelihood of future offending and as such, the study did not utilise actual reoffending data. A study on young offenders, found no significant association between impairment (binary categorisation using the Leiby-Asbell Neurocognitive Screening Examination for Adolescents; Leiby & Asbell, 2007) scores to identify those likely to have impairment linked to HI and number of times imprisoned. Another juvenile study (7) used a non-validated measure of HI and self-reported previous imprisonment, finding non-significant differences in those with or without HI.

Nielsen and colleagues (10) retrospectively explored factors associated with re-imprisonment in adult offenders convicted of serious non-lethal violence (attempted murder; assault with grievous bodily harm; malicious wounding), using re-imprisonment 8-10 years post-release as a measure of recidivism. While the quality of re-offending and other relevant offending outcomes was acceptable, the overall quality was reduced by potential bias in selection of participants, HI measurement, comparison of outcomes and

methods to control confounding. Diagnostic information was obtained from reviewing court reports (n=336) by one clinician using clinical judgement to categorise those who had a recorded 'psychotic disorder' (10%), those recorded with 'cognitive disorder', (including both HI and intellectual disability, 11%) and those with neither psychotic nor cognitive disorder (80%, n=533). This design does not account for reconviction in the absence of a court report. Overall return to prison occurred in 45% with none of these conditions, 51% with 'cognitive disorder' and 54% with psychosis. No significant association was found between disorder and re-imprisonment. These findings should be interpreted with caution given the high risk of bias in the study.

2. Is there unique variance associated with HI when considering other key factors (covariates and factors linked with offending)?

Overall, there was a high risk of bias in methods to control confounding, including study design and statistical analysis used. Four studies analysed a possible predictive role of HI in reoffending when considering other key factors. One low bias study (4) explored relationships between HI and recidivism in young offenders (using logistic regression) and the role of HI in predicting time from release to reoffending (using Cox survival analysis). A low bias study (4) found that 67% of young offenders with HI and 58% of those without HI were reconvicted within 1 year. After controlling for covariates (age, ethnicity, education) HI did not predict re-imprisonment. Significant variables predicting recidivism in the model were low education ($B=-1.53, OR=0.22, p<0.05$) mental health service utilisation ($B=1.13, OR=2.8, p<0.01$) and cannabis use ($B=-0.78, OR=0.46, p<0.01$). HI did not significantly predict time to re-imprisonment in survival analysis, (HR=1.16); education (HR=0.46), mental health service use (HR=1.91) and cannabis use (HR=0.69) were significant (95%CI not reported for hazard ratios).

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Three other studies only explored specific relationships between HI and time between release and re-imprisonment as a measure of reoffending in adult offenders (6,9,10). A low bias study (6) explored reoffending in adult offenders with (36%) and without HI (64%) at 12-30 months follow-up. Of 151 released, 48% with HI and 37% without had returned to prison within 12 months. When controlling for co-variables (age, education, type of offence, presence of a mental health diagnosis), HI status predicted time to re-imprisonment (HR=1.85, 95% CI 1.08-3.15), meaning those with HI were re-imprisoned more quickly.

Two high bias studies did not find that HI predicted re-offending in adults. One of these (9) explored reoffending in offenders who had been engaged in prison-based behavioural programmes that covered a wide range of needs, and compared those with HI (36%) and those without (64%). After six months 12% of those with HI and 9% of those without had been re-imprisoned. The Cox regression model was not significant. This study had no control group not engaged in behavioural programmes, and it is not clear whether the intervention influenced the relationships with reoffending. The third study (10) found that 'cognitive disorder' (including HI) did not predict time to re-imprisonment. This finding should be interpreted with caution given the high bias in selection of participants, assessment of HI and comparison group (described above in Q1).

3. Are there specific effects of HI associated with risk of reoffending?

No study explored relationships between neuropsychological deficits and reoffending.

4. Is HI associated with characteristics of criminal reoffending?

One low bias study (4) reported an average of 125 days imprisonment for young offenders with HI and 87 days for those without. After controlling for age, ethnicity, education, household income, mental-health service use, cannabis use and criminal history this was no

longer significant. Williams and colleagues (2010) reported that prisoners with HI had longer sentences (average 20-months) than those without (12.7-months). No effect size or post-hoc analyses were reported and age was the only covariate that was considered.

Three studies reported that prisoners with HI are convicted more often for serious offences. One study on young offenders (5) reported a significant but small effect in bivariate analysis ($r=0.1$) with a higher number of violent offences in those with HI. In adult prisoners (3) those with HI had a higher number of 'felonies' (a crime regarded in the USA as being more serious than a misdemeanour), however effect size is not reported. Imprisonment with 'person offences' was more likely in those with HI in, however effect size is not reported and Cox regression, did not show that offence type predicted reoffending when controlling for age, education, type of offence, presence of a mental health diagnosis (6).

Discussion

This review considered the evidence for a relationship between HI and reoffending. Research is sparse and uses a variety of definitions and measures assessing variables of interest across heterogeneous groups of offenders making risk of bias high.

Most studies do not demonstrate that their samples are representative of the prison population, with the exception of three US-based studies (3,4,6), that present data for entire cohorts, and key variables of research interest captured in routine prison assessment using validated measures. Overall the ten included studies suggest that there is not sufficient evidence to conclude that HI is a risk factor for reoffending.

There was wide variability in the tools used and the categorisation HI severity (or only binary classification as the presence or absence of HI). One study (6) utilised an internationally recognised definition of HI severity, with mild HI as 0-30minutes LOC and any HI with LOC over this being moderate to severe (Malec et. al, 2007). Other studies that used validated HI assessment tools, reported severity of HI based on categorisation set out in the Traumatic Brain Injury Questionnaire (Diamond et al., 2007). A key issue being that this states a LOC range of 5minutes-60minutes to identify mild HI (which then includes the more commonly recognised 30minute categorisation). These studies may not have been sensitive in accurately identifying those likely to have ongoing problems linked to HI. This variability in HI definition reflects similar findings reported in systematic reviews on the prevalence of HI in offending populations (Allely, 2016; Hughes, Williams, Chitsabesan et. al, 2015; Moynan & McMillan, 2018). It highlights a persisting limitation in the quality of the literature, which limits cross-study comparison and hinders the development of an evidence base on HI in offending populations.

There was wide variation in outcomes used to represent measures of reoffending in all but two studies. There is no internationally accepted measure of reoffending and individual countries measurement of this varies greatly (Fazel & Wolf, 2015). Once more, this lack of consistency limits cross-study comparison. Most studies focused on re-imprisonment, however it is recognised that not all offences committed or recorded by the police result in conviction and reimprisonment (Scottish Government, 2019, p.8).

Quality of the Evidence

The review did not find sufficient high-quality evidence; thus, the conclusions that can be drawn are limited. The review questions can only be partially answered and the relationship between HI and reoffending was not proven.

Association between HI and reoffending, and unique variance of HI

The low bias studies in this review (4,6), provide some evidence to suggest a unique relationship between HI and re-offending. One reported a predictive relationship between HI and re-offending in adult prisoners and the other no predictive relationship in young offenders. Overall there was incomplete reporting on the potential relationship between HI and reoffending variables. Hence there is insufficient evidence to conclude that HI is associated with reoffending.

It may be that a distinction needs to be made between young and adult offenders, when considering life trajectory following HI and the risk of reoffending. At present, the literature is limited in assessment and analysis of the potential complex causal links that may influence this trajectory, such as deprivation, substance misuse, neurodevelopmental disorder, developmental trauma, brain pathology, as well as protective factors, that may confound any possible association between HI and reoffending (McMillan and Williams, 2017). The current evidence-based does not consider potentially important variables that might influence the relationship between HI and re-offending linked to life trajectory. For

example no studies reported on age at first HI and subsequent offending. Previous research (Williams, 2012) suggests that childhood HI is associated with earlier criminal activity and more serious frequent crime, with young people representing approximately 25% of the prison population. A recent systematic review (Walker, 2017) concluded that more research is required to determine the prevalence of childhood HI in offenders, the reasons for this and the associated risk of offending. As yet, studies do not consistently collect, report or analyse this data.

Specific effects of HI associated with risk of reoffending

Two studies (5,8) assessed cognition but neither analysed this data in relation to HI and reoffending. The broader literature suggests that neuropsychological dysfunction following HI affects the development of the 'social brain', that is required for prosocial behaviour (Williams, et.al., 2018). It is necessary to assess neuropsychological and neurobehavioural impairment and its cause in repeat offenders to explore the possibility that HI early in life plays a key role in perpetuating offending.

Limitations and strengths

The scope of the review was broad, with no limit on demographic factors (age, country) which presents a heterogeneous group. HI and reoffending may interact differently across ages, and may differ depending on the unique challenges of living in different countries. Varying health care and criminal justice systems limit the generalisability of findings and could lead to confounding when drawing on papers from multiple countries with vastly different systems (e.g. differences in disposals and sentences, access to prison-based rehabilitation programmes) and differences in those individuals who are likely to be served custodial sentences (ethnicity, socio-economic deprivation, gender). Therefore an awareness of the system within which the data has come from is necessary to contextualise

conclusions that could be made. The current review excluded subsamples of specific offenders, for example those who commit sexual offences. Such offenders present with distinct differences in pathways to re-offending, with follow-up studies typically finding sexual offence recidivism rates of 5-15% after five years (Harris & Hanson, 2004; Helmus, Hanson, Thornton, Babchishin & Harris, 2012) compared with rates of around 40% for general recidivism (Fazel & Wolf, 2015). When convicted of a sexual offence, there is understandably considerable public concern regarding further risk of re-offending, therefore there is compulsory supervision upon release from custody, unlike the majority of general short term offenders (Management of Offenders (Scotland) Act, 2005). Therefore, specific subsamples are not representative of the general offending population, however it might be useful to consider the role of HI in specific types of offending in future studies.

Theses were included in the review, and have different standards for publication than peer-reviewed articles. Two of these were rated as high in risk of bias (5,9), and added little to the evidence base. However, one thesis was overall low in bias (4) and presented high quality evidence regarding the relationship between HI and reoffending in young offenders. A possible strength of studies included is the reporting of statistically non-significant results, which reduces the risk of publication bias in this field. Other sources of grey literature were not included within the scope of the review.

This study did not include articles not written in English. However, none were cited in the articles included in this review. The search screening and data extraction procedures for this review were not checked by a second reviewer, which increases the overall risk of bias in this review. Study authors were not contacted as part of the review. It may be that relevant data was collected by authors but not reported.

Future research

A key challenge is to determine not only if HI is associated with involvement with the criminal justice system but also if it is associated with subsequent reoffending. Future prospective studies would allow the examination of reoffending post release and the potential causal role that HI plays, while controlling for confounding variables. Future research may benefit from the use of corroborating self-report with official records for both HI and offending data.

Reoffending is delineated by the starting and stopping of criminal justice events. This should be a key element in measuring reoffending in future research. It is necessary to determine clear starting points to record from and be clear in the type of stopping events, using a combination of these (re-arrested, charged, convicted, re-imprisoned). When only part of this data is reported, it does not provide a clear understanding of the potential predictive relationship between variables of interest, such as HI and overall reoffending behaviour.

Conclusion

This is the first systematic review to assess the evidence base and quality of studies on HI and reoffending. At present there is not sufficient evidence to suggest that HI is a risk factor for reoffending. While recent reviews (Williams et. al, 2018) suggest that there is very likely to be a link, this is based on a diverse evidence base that demonstrates the complexity of predicting re-offending. Development of research that continues to explore the relationship, while controlling for confounding variables known to be associated with reoffending is required. This would help understand the need for and shape specific service provision in supporting prisoners with HI prepare for release into the community, while measuring the impact this has on outcomes.

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Chapter 2 Major Research Project

Head Injury and Associated Disability in Offenders on Release from Custody

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Declaration of Conflict of Interest: None

Prepared in accordance with the guidelines for submission to the Journal of Offender
Rehabilitation (See Appendix 1.1)

Word count (including abstract and references): 6,754

Plain English Summary

Background: In Scotland, prisoners have higher rates of self-reported and hospitalised records of head Injury (HI) than the general population. HI can result in cognitive, behavioural and emotional problems and persisting disability in day-to-day life. The Scottish Government emphasise that those leaving prison must be prepared for release. Prisoners serving short sentences are offered voluntary support from Through-Care services, to identify what they need help with and services available to help them in prison and post-release. It is necessary to investigate the occurrence of HI and associated disability in those with HI leaving prison, how this is currently assessed by Through-Care services and what provision is in place for those who require additional support.

Aim: To inform the Scottish Prison Service (SPS) Through-Care by investigating the impact of HI on prisoners in terms of disability, functioning and offending.

Methods: Sixty-six male prisoners from HMP Low Moss Through-Care service took part in the study. Prisoners who posed a risk of violence to researchers or who had a learning disability were not able to take part. Participants were asked to complete questionnaires on whether they had a head injury, mental health problems (anxiety and depression), alcohol and drug use and difficulties they experience day-to-day. They were also asked to complete tests of their memory, attention and learning.

Findings: Overall prisoners had high levels of self-reported HI, cognitive difficulties and disability. Prisoners who had a history of moderate-to-severe HI or multiple head injuries (e.g. from gang fighting) had higher levels of self-reported behavioural and organizational difficulties and were more likely to be disabled. There was a high number of convictions per person and this did not differ significantly between those who had mild HI and those who had moderate-to-severe or multiple HI.

Conclusions and implications: The SPS should be aware of the high rate of HI and disability in prisoners within Through-Care. HI and associated disability could potentially impact prisoners' ability to remain in the community, if difficulties are not recognised and understood by Criminal Justice Services. Educating Through-Care services on HI and difficulties and developing education and intervention programmes may be helpful to increase post release prospects for service users.

Abstract

Introduction: Scottish prisoners are significantly more likely to have head injury (HI) than the general population. The Scottish government recommend exploring HI and consequent disability in offenders in the criminal justice system. Little research exists on persisting effects of HI in short-term prisoners preparing for release.

Aim: To investigate HI-related disability in prisoners within Through-Care services and differences in number of convictions.

Methods: 66 participants were recruited from HMP Low Moss. A cross-sectional design was employed. History of HI was screened and individuals were categorised as having mild or moderate/severe HI. Disability, cognitive and mental health outcomes were assessed.

Results: Self-reported multiple and moderate-severe HI (MMHI) was associated with disability, with a greater proportion of those with MMHI (72%) rated as 'disabled' compared to those with mild HI (37%); $\chi^2(1)=7.246$, $p=0.007$, $\phi=0.266$, $OR=4.5$, 95%CI: 1.45–13.8). A history MMHI was associated with significantly greater reported dysexecutive difficulties ($r=0.26$, 95%CI = -13.01--0.37). When controlling for covariates (age, education), HI was a significant predictor of disability ($OR=5.03$; 95%CI = 1.56 - 16.22, $p=0.007$), however the association between HI and dysexecutive difficulties did not remain significant. There was no significant difference in the number of convictions between HI groups.

Conclusion: Prisoners in Through-Care preparing to leave prison have a high level of self-reported HI. HI is predictive of disability, which may act as a major constraint on short-term prisoners' prospects, having limited opportunity to access appropriate services for support. Educating Through-Care services on HI, disability and executive difficulties, with

the development of prison based interventions, might improve post-release prospects for service users.

Keywords: Head Injury, Prisoners, Through-Care, disability, impairment, offending

Introduction

Head Injury (HI) is significantly more prevalent in prison populations than in the general population (Moynan & McMillan, 2018). Meta-analyses estimate prevalence rates of HI in 50-60% of adult offenders (Farrer & Hedges, 2011; Shiroma, Ferguson & Pickelsimer, 2010) compared with 12% of the general population (Frost, Farrer, Primosch & Hedges, 2013). In Scotland, the relative risk of having a HI is four and a half times higher in individuals in prison than demographically matched controls (McMillan, Graham, Pell et al., 2019). The National Prisoner Healthcare Network (2016) recommend that screening, triage and assessment of HI should be considered throughout the Criminal Justice System.

There are several potential reasons for associations between HI and offending. Impulsivity, aggression and disinhibition may make it difficult for a person with HI to regulate their behaviour and learn from mistakes (Shiroma et al., 2010). With increasing severity, HI can be associated with long-term impairments in attention, memory, word finding and executive function (Cicerone et al., 2011). Given that these impairments are often not visible, HI has been referred to as the 'silent epidemic' (Langlois et al, 2006), whereby the individual and those around them may not make allowances for the injury and its consequences. A modest causal link has been found between HI and subsequent offending (Schofield, Malacova, Preen et al., 2015), rate of reoffending (Ray & Richardson, 2017) and difficulties re-integrating into the community (Merbitz et al., 1995; Shiroma et al., 2010). This suggests a possible relationship between HI, offending and poor outcome.

The Scottish Government's Justice Strategy (Scottish Government, 2012) states prisoners must be prepared for release, with effective support and supervision to enable the process

of desistance; “the long-term abstinence from criminal behaviour among those for whom offending had become a pattern of behaviour” (McNeill, Farrall, Lightowler et al., 2012, p.3). Under the Prisoners and Criminal Proceedings (Scotland) Act 1993, prisoners serving long-term sentences (\geq four years) are released with statutory supervision, whereas those serving short-term (ST) sentences (<4 years) are only subject to supervision under specific orders. In 2017, 55% of the Scottish Prison population were serving ST sentences (Carnie, Broderick, Downie, et al., 2017). Research has shown that people who have served ST sentences are more likely to reoffend than those on either community sentences or longer prison sentences (Scottish Centre for Crime and Justice Research, 2012).

There is a wealth of research into the backgrounds, characteristics and needs of prisoners which demonstrates the serious and chronic disadvantage, social exclusion and problems commonly experienced by ST prisoners and its association with reconviction (Social Exclusion Unit, 2002; Macguire et al., 1997; Loucks, 2007). ST prisoners appear to have multiple problems linked to release and resettlement in the community (Lewis et al., 2003) and in Scotland two-thirds are found to report health problems immediately after release, half report accommodation problems and two-fifths report problems with unemployment (MacRae et al., 2006).

Due to the timeframe of their sentences, these prisoners have limited opportunity to participate in prison-based programmes and are not generally subject to statutory post-release supervision, which allows for support and planning both pre and post release. As a result they are often dependent upon voluntary Throughcare services.

The Scottish Prison Service (SPS) developed a Through-Care service, offering voluntary engagement from the point of imprisonment to community transition to support ST prisoners to access necessary services to address a wide range of needs (housing, finances, substance misuse, mental health difficulties) and potentially reduce the risk of reoffending post-release (Reid-Howie Associates, 2017).

An understanding of the impact of HI on prisoners, serving short-term sentences, preparing for release is pivotal in terms of informing service need. The current study aimed to provide an exploration of the impact of HI on a sample drawn from ST prisoner population to inform understanding of HI and association with impairment and offending. This may increase knowledge on additional factors that could influence a prisoner's ability to remain in the community once released from custody.

Aims

To estimate the occurrence of HI and associated disability in offenders within Through-Care services, determine the extent to which these services were aware of HI in service users and processes in place if this is identified. A secondary aim is to establish the association between HI and the number of previous convictions.

Hypotheses

H1. Multiple and moderate-severe HI is associated with persisting disability, neuropsychological impairment and mental health difficulties.

H2. Those with multiple or moderate-severe HI have a higher number of previous convictions.

Method

Participants

Participants were recruited from the Prison Support Pathway (PSP) Through-Care service at HMP Low Moss. Information sheets (See appendix 2.1) were distributed by PSP staff to prisoners. The research was advertised as a general ‘well-being study’, HI was not specifically mentioned in the information sheet. Prisoners who were interested in taking part were asked to give their name to PSP staff and give consent that their details (name and location in the prison) could be passed to the research team.

PSP Service

In 2013 HMP Low Moss developed the (PSP) service in partnership with a range of third sector partners in response to evidence that those serving ST sentences often faced complex issues with restricted access to coordinated support in prison and the community (Carnie, Broderick & McCoard, 2013) (See appendix 2.2 for further PSP service information).

PSP assesses those referred using a standard proforma. This includes one question on HI as follows: “Have you sustained a head injury in the past 12 months?” No further questions are included in the assessment to ascertain more historical HI or severity. If the prisoner answers yes, the assessor can ask more questions, however PSP staff are not trained in HI or its assessment. There is no standard protocol for onwards referral to prison-based NHS health services or third sector HI specific organisations (e.g. Headway). Of the current caseload (n=80) PSP stated that 35% (n=28) responded ‘yes’ to the HI question. Specific data on the number of prisoners serving short term sentences within HMP Low Moss was not available (this is presented by the SPS for the whole prison population). HMP Low Moss has a total population of 775 and annual reports state 40% of prisoners serve ST sentences across the SPS. This would suggest approximately 310 prisoners may have been

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servicing ST sentences within HMP Low Moss, if there is equal distribution between establishments housing prisoners serving short or long term sentences. If this is accurate, it would suggest that the PSP service support approximately one quarter of ST prisoners, however caution should be made in this interpretation.

Inclusion Criteria

- At least aged 18 years
- Fluent in English
- Able to give informed consent

Exclusion Criteria

- Severe communication difficulties, a learning disability or severe neurological or mental health conditions.
- Deemed by SPS staff to pose a risk of violence to researchers

Procedure

Data were collected by two researchers; both attended SPS induction and safety training. Participants were given full details on what the study involved and provided informed consent to participate. They then completed self-report measures with the support of the researcher (for those with literacy issues) and completed cognitive tests. Assessment took approximately ninety minutes in total. Breaks were given where necessary. Prison officers were asked to complete measures on their view of participant difficulties.

A pilot of three participants was conducted. Researchers observed each other administering all measures and double marked measures to ensure inter-rater reliability. Inconsistencies were resolved through discussion. Pilot data was included in the final dataset.

Measures

Demographics and offence history

Participants completed questions on age, socioeconomic background and offence history (Appendix 2.3).

Head Injury

HI was assessed using the Ohio State University Traumatic Brain Injury Identification Method Short Version (OSU TBI-ID; Corrigan & Bogner, 2007). It is a self-report measure which defines HI as an injury to the head or neck that resulted in a change in consciousness (being dazed, memory gap or loss of consciousness [LOC]). It identifies an individual as 'likely' or 'not likely' to have ongoing problems based on the worst HI received. Those identified as 'unlikely' to have ongoing problems are categorised as having single event Mild HI (dazed or ≤ 30 minutes LOC). Those 'likely' to have ongoing problems are those with multiple HI (see definition below), moderate HI (30 minutes–24 hours LOC) and/or severe HI (>24 hours LOC), HI with LOC before the age of age of fifteen or a recent HI (a mild HI in the last weeks or a more severe HI in the last months).

The OSU-TBI defines multiple HI as two or more HIs close together, including a period of time when an individual experienced repeated blows to the head, even without LOC. Individuals are thought to generally recover well from mild HI provided there is recovery time and they do not receive another HI in close succession (e.g. in weeks or months). Repeated HI is likely to cause damage when another HI occurs when an individual is still recovering from a previous HI (Guskiewicz et al., 2005).

The OSU-TBI has been validated on the prison population and there were large effect sizes when comparing OSU TBI-ID scores with several cognitive, psychiatric and behavioural outcomes ($R^2 > 0.36$) (Bogner & Corrigan, 2009).

Disability and Impairment – primary outcome

The Glasgow Outcome at Discharge Scale (GODS; McMillan, Weir, Ireland & Stewart, 2013) is a structured assessment of HI-related disability in several domains including activities of daily living, relationships and independence (e.g. employability). The GODS was adapted to make it relevant to life in prison (e.g. language used was adapted from hospital based terms such as ‘ward’ or ‘hospital staff’ to ‘prison’ or ‘prison staff’). The GODS categorises disability into eight domains (1= dead through to 8= good recovery) and allows for consideration towards disability being linked to HI only, other illness only or a mix of these. The prisoner and a prison staff member, who knew the prisoner, were asked to complete the GODS. Where there were discrepancies between prisoner and staff ratings, the more severe disability was used. This was to ensure consistency of decision making across researchers in terms of rating discrepancies.

The Dysexecutive Questionnaire (DEX; Wilson, Evans, Alderman, et al., 1997) is a twenty-item self-report and twenty-item informant-report measuring occurrence of changes in everyday life from impairments of executive functioning post HI. Higher total scores indicate greater dysexecutive difficulties (range from 0-80). It has good internal consistency ($\alpha=0.89$) (Azouvi et al, 2015).

Mental Health

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) is a self-report measure. Clinical levels of anxiety or depression are indicated by scores ≥ 11 . It has good reliability and validity in assessing depression and anxiety in people with HI (Whelan-Goodinson, Ponsford & Schonberger, 2009).

Alcohol and substance use

Alcohol and substance use in the community was assessed. The Alcohol Use Disorders Identification Test (Saunders et al, 1993) is a ten-item screening tool to assess alcohol consumption, drinking behaviour and dependence. Scores of ≥ 8 indicate harmful alcohol use as well as possible dependence. The Drug Abuse Screening Test -10 (DAST-10, Skinner, 1982) assesses the substance use and scores of ≥ 3 indicate at least moderate use, 9-10 indicate severe misuse. It has high internal consistency ($\alpha > 0.85$) and acceptable test-retest reliability ($r > 0.70$) (Yudko, Lozhina & Fouts, 2007).

Neuropsychological Tests

The following domains of cognitive functioning were tested as they have been found to be sensitive to HI (including mild HI; Belanger, Curtis, Demery, Lebowitz & Vanderploeg, 2005). A test of effort was administered in analysis of test performance.

Verbal memory and learning

The Adult Memory and Information Processing Battery, List Learning sub-test (Coughlan & Hollows, 1985). The score is the total number of words (heard from a list) recalled over five trials. Test re-test reliability was high and those with an acquired brain injury perform below test norms with large effect sizes suggesting adequate sensitivity (Lezak, 2012, pp531).

Processing speed, attention, visual scanning and motor speed

The Symbol Digit Modalities Test (SMDT; Smith 1982). The score is the total number of correctly matched pairs of symbols and digits after 90 seconds. It has high test-retest reliability and is sensitive to the effects of HI (Strauss et al., 2006).

Executive functioning-related domains (mental flexibility & divided attention)

The Trail Making Test (Armitage, 1946). The test has two parts and requires participants to join numbers, then numbers and letters in ascending order. The score is the total time taken to complete each part. Good sensitivity for neurological disorders has been found (Burgess et al, 1998).

Test of Effort

The Word Memory Test (Green et al, 2003). Participants hear twenty-word pairs and then complete an immediate then delayed recognition trials. The person receives a score out of 40 for correctly identifying recognizable words. If scores fall below 82.5% (score of 33) on the delayed task, this is considered a fail and evidence of poor effort while scores under 90% (score of 36) should be interpreted with caution and indicative of insufficient effort. It is valid in forensic and HI samples (Green et al, 2003 Green et al, 1999).

Justification for sample size

Walker (2017) reported a correlation of 0.291 (n=81) for correlations of severity of HI and Disability (GODs) in a prison population. Using this data, G*power (Faul et al, 2009) indicates n=90 is required to detect a medium effect with 80% power, and $\alpha=0.05$. When using multiple linear regression, Walker (2017) reported a large effect size between HI disability (GODS) and HI severity (LoC) ($f^2=0.278$, $p=0.011$, $CI= -0.595,-0.080$). Using this data, G*Power indicates n=31 is required to detect a large effect ($f^2=0.278$) with 80% power and $\alpha=0.05$. To detect a medium effect size ($f^2=0.15$), n=55 is required with 2 predictor variables specified. Based on this, a sample size of 100 would be sufficient and allow at least 31 individuals per HI group.

Data Analysis

OSU-TBI-ID categories were used to group the sample as 'Mild HI', 'moderate-severe HI' or multiple HI. Comparisons were planned between no/mild HI, multiple HI and single moderate-severe HI only (no repeated injury). After data collection all participants reported HI; few reported single moderate-severe HI (n=7). The OSU-TBI-ID indicates that those with moderate-severe HI and multiple HI are likely to have ongoing problems. For this reason those with multiple HI and moderate-severe HI were combined into a 'multiple/moderate-severe HI' (MMHI) group. This is consistent with the overall research aim of determining disability and impairment in individuals with HI in the PSP service. Secondary analysis, re-examined the data excluding those with single event moderate-severe HI to determine if significant findings remained for those with multiple HI.

Univariate analyses investigated between-group differences in outcome measures. Regression models investigated significant differences in univariate tests and controlled for age and years of education to understand the relationships between HI impairment and offending.

Ethics

Ethics approval was granted from the West of SCOTLAND NHS Research Ethics Committee (WoSREC; 18/WS/0183, Appendix 2.4) and the Scottish Prison Service Ethics committee (Appendix 2.5).

Results

Sixty-six prisoners participated. It is not clear how representative this was regarding those who had reported HI during PSP assessment, because PSP could not make specific information available regarding individual service users. The age range was 21 to 64 years (median 32 years; Table 1). Most participants were Caucasian (99%). On average participants had 9.8 years of formal education. Overall 64% of the sample reported attending mainstream school, and 55% of those in MMHI group required 1:1 support or specialist schooling. Scottish Index of Multiple Deprivation quintiles represent national social deprivation levels from 1 (most deprived) to 5 (least deprived) (Scottish Government, 2016). Most of the sample (86%) were from the highest deprivation quintiles 1 and 2. There were no statistically significant differences between mild and MMHI groups on demographic variables.

Table 1. *Demographics*

	Mild HI (n=19)	MMHI (n=47)
Age (median, range)	33 (21-55)	32 (23-64)
Years Education (median, range)	9 (7-12)	10 (6-13)
Type of Schooling (N, %)		
Mainstream	11 (58)	21 (45)
Mainstream with 1:1 support	3 (16)	7(15)
Specialist School	5 (26)	19 (40)
SIMD Quintile (N, %)*		
1	11 (61)	21 (53)
2	5 (27)	13(32)
3	1 (6)	4 (10)
4	1 (6)	2 (5)

* n=8 could not remember their postcode

The average age at first arrest was 15 years (SD, 5.4; median, 15; IQR, 13-17.5) (Table 2). Almost all reported multiple convictions (99%), with 53% reporting more than 20. Eighty percent had served multiple sentences. There were no statistically significant associations when comparing HI groups and offending characteristics.

Table 2. *Offending characteristic*

	Mild HI (n=19)	MM HI (n=47)
Age at first offence (median, range)	15 (9-46)	15 (8-26)
Number of convictions (median, range)	15 (2-60)	21 (1-80)
Number of custodial sentences	3.5 (1-20)	6.5 (1-60)
Total length of time (months) in prison (median, range)	27 (1-300)	53 (3-288)
History of Young offenders Institute* (N %)	8 (42)	25 (53)

* missing data n=1

Head Injury

All participants reported having a HI (Table 3). Forty (61%) reported multiple HI as defined by the OSU-TBI-ID: Twenty-three (35%) reported a history of multiple mild HI, 17 (26%) reported multiple HI including moderate to severe HI. Nineteen (29%) reported single-event mild HI and 7 reported single-event moderate-severe HI (10%).

Table 3. *Head Injury History; n (%)*

	Multiple Event	Single Event	Total
No HI	0	0	0 (0)
Mild HI(Dazed, no LOC)	12	8	22 (34)
Mild HI (LOC<30mins)	11	11	19 (28)
Moderate-severe HI (LOC>30mins)	17	7	24 (36)
Total	40 (60)	26 (39)	66 (100)

The average age at first HI was 14 and for HI with LOC was 16 years. Twenty-six (39%) reported having their first HI with LOC before the age of fifteen and twenty-one (32%) reported their first HI with LOC after age fifteen. Sixty (91%) reported no recent HI (mild HI in past weeks or moderate-severe HI in past months). Those with MMHI were younger

at age of HI with LOC (aged 13 years) compared to those with mild HI (18 years) ($U=103$, $z=-2.31$, $p=0.02$, $r=-0.3$).

For those who reported single event mild HI ($n=19$), 62% reported the cause of HI was ‘assault’ with a one-off hit to the head. For those who reported multiple HI ($n=40$), 63% reported cause as ‘assault’, 45% of which were categorised as ‘gang-fighting’. Participants described this as frequent (often weekly) fighting between rival gangs, with an expectation of physical violence; a further 18% reported repeated HI in incidents such as one-off fights and familial violence. For those who reported single-event moderate-severe injury ($n=7$), 85% reported the cause of HI as road traffic accidents, with only one report of assault.

Disability

Forty-one participants (62%) were disabled on the GODS, with thirty-two (48%) moderately and 9 (14%) severely disabled. Twenty-three (35%) attributed disability to HI, 22 (33%) to a combination of HI and another illness/injury and 21 (32%) to another illness or injury. Disability was analysed as ‘any-cause’ because there was some uncertainty about HI as a cause given the high proportion of participants with multiple HI (Table 4).

Table 4. *Disability Ratings by Cause; n (%)*

GODS Category	Cause: HI	Cause: Mix	Cause: Other	Total
Upper Good Recovery	15	1	2	18 (27)
Lower Good Recovery	2	1	4	7 (10)
Upper Moderate Disability	6	9	8	23 (35)
Lower Moderate Disability	0	3	6	9 (14)
Upper Severe Disability	0	4	1	5 (8)
Lower Severe Disability	0	4	0	4 (6)
Total	23 (35)	22 (33)	21 (32)	66 (100)

Association between Mild HI, Multiple/Moderate-Severe HI and Disability

Univariate Analysis

More individuals with MMHI (n=34, 72%) than with mild HI (n=7, 37%) were disabled (Table 5): $\chi^2(1)=7.246$, $p=0.007$, $\phi=0.266$, OR= 4.5, 95%CI: 1.45 – 13.8) (Table 5). This association remained after excluding single event moderate-severe HI from analysis, (72% MMHI, n=29 disabled): $\chi^2(1)=6.88$, $p=0.009$, $\phi=0.266$, OR= 4.5, 95%CI: 1.41, 14.44. (See appendix 2.6).

Table 5. *Proportion of disability and recovery by Mild HI and Multiple/Mod-Severe HI: n (%)*

Head Injury	Disabled or Recovered (GODS)		
	Disabled	Recovered	Total
Mild HI	7	12	19 (29)
MMHI	34	13	47 (71)
Total	41 (62)	25 (38)	66 (100)

Association between Mild HI, Multiple/Moderate-Severe HI and Impairment

The sample scored below population norms on all cognitive measures (see Appendix 2.7). Composite cognitive impairment scores did not differ significantly between mild HI and MMHI groups ($p=0.64$), nor did individual, cognitive test scores (see Appendix 2.X for table of outcome measure means). Average HADS depression scores were below the cut off score (<11) for clinical caseness in both groups. The MMHI group had an average HADS anxiety score indicative of clinical caseness (median=11). AUDIT and DAST scores were indicative of moderate-high risk of alcohol and drug misuse in both groups. HADS Depression and Anxiety, AUDIT and DAST scores did not significantly differ between groups. On the delayed word memory test, sufficient effort was demonstrated in 63% of mild and 58% of MMHI.

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DEX self-report scores differed significantly by group; the average score (mean=32) being higher for MMHI, representing greater dysexecutive difficulties than the mild HI group (mean=25) ($t(63)=-2.115, p=0.038, r=0.26$). Sixty-six percent ($n=31$) of MMHI and 42% ($n=8$) of mild HI scored above the cut-off of 28 for 'considerable dysexecutive difficulties' (Chan, 2001; Pedrero et al., 2011).

There were 23 missing independent-report DEX results (7 for mild HI, 16 for MMHI), when prisoners thought that staff could not accurately comment on their functioning. The average independent-reported DEX score (was lower than for self-report). Scores on the DEX-independent, differed by group ($U=291.5, z=2.859, p=0.01, r=0.44$) suggesting greater dysexecutive difficulties after MMHI (median=20) than mild HI (median=10). This finding should be interpreted with caution given the small sample size ($n=12$) for mild HI and ($n=31$) and MMHI, therefore it may not be representative of the overall sample. While significant, DEX-independent scores were not used in further multivariate analysis, as substantial missing data on one variable would result in losing overall sample size, therefore losing power in regression models.

Univariate analyses were repeated, excluding those with single-event moderate-severe HI. DEX-independent scores remained significantly different. No other scores differed significantly. (See Appendix 2.8).

Multivariate Analysis

Multivariate regression modelled outcomes that differed in univariate analysis. A logistic regression was completed, with disability as a dichotomous outcome (disabled or recovered) and HI as a binomial explanatory variable (with mild HI as the reference category). A forced-entry approach was used, with explanatory variables (HI, age, years of education) entered simultaneously into the model.

Assumptions were checked and met as follows: All continuous independent variables were linearly related to the logit of the dependent variable and there was no multi-collinearity or

significant outliers. The model was significant ($X^2(3)=8.282, p=0.041$) and explained 16.1% of the variance in disability (Table 6). Those with MMHI had 5.04 times the odds of exhibiting disability. Analysis was re-run excluding those with single event moderate-severe HI. The model was significant ($X^2(3)=7.855, p=0.049$) and explained 16.9% of the variance in disability. Those with multiple HI had 4.9 odds of exhibiting disability (see Appendix 2.9).

Table 6. *Logistic regression of association between Multiple/Mod-Severe HI and disability*

Outcome: GODS disability	OR	95% CI	p	Pseudo R²
				0.161
MMHI	5.036	1.563 – 16.225	p=0.007	
Age	1.005	0.948 – 1.065	p=0.874	
Years Education	0.837	0.599 – 1.169	p=0.296	

Multiple regression modelled DEX-Self outcome. Assumptions were checked as follows: Independence of residuals, as assessed by a Durbin-Watson statistic of 2.22, linearity and homoscedasticity was established, no multicollinearity was found and normality of residuals was found. MMHI was not significantly associated with DEX self-scores: $F(3,61) = 1.884, p=0.149$ and (Table 7).

Table 7. *Multiple Regression of Association between Multiple/ Mod-Severe HI and Self-Reported Dysexecutive Difficulties*

Outcome: DEX-self	B	SE	p	Adj R²
				0.038
MMHI	6.248	3.214	0.056	
Age	-0.058	0.159	0.716	
Years Education	0.889	0.886	0.320	

HI and offending

Univariate analysis examining differences in offending characteristics (number of convictions, number of custodial sentences and total time in custody) between mild HI and MM HI groups revealed no significant differences (Table 8). Both groups had many convictions, with a median of over 10 and wide ranges. Similar analyses excluding those with single event moderate-severe HI also revealed no significant differences in offending characteristics (Appendix 2.10).

Table 8. *Offending characteristics of those with Mild HI and Multiple/Mod-Severe HI (median, range)*

	Mild HI (n=19)	MMHI (n=47)
Number of previous convictions	15 (2-60)	21 (1-80)
Number of custodial sentences	4 (1-20)	6.5 (1-60)
Total time in custody – months	30 (1-300)	53 (3-288)

Discussion

HI, disability impairment and offending

There was a high occurrence of HI in the sample (all prisoners reported HI). MMHI was found in 71% of the sample and of these 62% were disabled, including executive difficulties (66%). The level of disability suggests that those in Throughcare have significant needs which may not currently be understood within the context of HI. Less than half (35%) were identified by PSP assessment, with support likely to be sub-optimal given little awareness of brain injury services. The sample performed below reported population norms on cognitive tests (no significant differences between HI groups). Impairments in attention, executive functioning, memory and learning might lead to difficulties in adjusting to life post-release, regulating behaviour and learning from mistakes (Shiroma et al., 2010), potentially increasing the risk of reoffending in the community.

In addition to needs arising from disability, the MMHI group also have a history of repeat offending and, although this was not statistically different from the mild HI group, it points to a need to develop supports and intervention to reduce the risk of this on release. Pitman et al (2015) found more convictions among prisoners with HI (mean=5.59) than non-HI controls (m=4.78). These averages are lower than in the present study, raising the possibility that HI, independent of severity, may contribute to re-offending (this study had no 'non-HI' comparison group).

There is very little literature regarding the prevalence of disability linked with HI in prison populations (Moynan & McMillan, 2018), despite there being increasing evidence of persisting neurobehavioural problems in offenders with HI, which could have disabling consequences (McMillan & Williams, 2017). Previous research demonstrates that prisoners with HI have poorer cognitive function (Barnfield & Leatham, 1998; Pitman et

al., 2015) compared to controls without HI. Given the prevalence of self-reported dysexecutive difficulties in the sample, (despite no significant differences between HI groups) it is relevant to consider possible implications for antisocial behaviour (Ogilvie, Stewart, Chan & Shum, 2011).

Cause of HI

Assault was the most common cause of HI in this sample, with the high prevalence of multiple HI associated with gang violence. This is similar to previous studies, which report that multiple HI is more common in prisoners than non-offenders (42% vs 15%) (Perkes, Schofield, Butler & Hollis, 2011), Offenders with multiple HI from almost daily gang fighting are unlikely to attend hospital, making the impact of repeated HI more difficult to determine, particularly where substance misuse and deprivation are common (McMillan & Williams, 2017; Kerr, Mihalik, Guskiewicz et al., 2005). For example, McMillan and colleagues (2019) found 25% of the population of Scottish prisoners had been hospitalised with HI, which is lower than self-reported rates (Shiroma et al., 2010), and concluded that future work is required to clarify the correspondence between self-reported HI and hospital records to better inform assessment and service provision.

Limitations

The high prevalence of co-morbidity, makes controlling for all potentially confounding factors difficult in studies on HI in prisoners, a problem in statistical modelling which is common to real-world phenomena. This makes analysis of the role of HI in outcome difficult. Recruitment from the PSP service, took place at a time when staff were pressured because there was uncertainty over its future and resulted in limited information sharing with potential participants reducing the opportunity for recruitment within the finite timescale.

It was not possible to provide a robust account of how Throughcare prisoners differ from the general population of ST prisoners as no published was data available which provided

this. This limited the studies ability to understand how those within Throughcare may differ across key variables of interest compared to the general ST prison population.

The study relied on self-report measures for key outcomes. While the OSU-TBI-ID (Bogner & Corrigan, 2009) is a reliable instrument for measuring single, moderate-severe and recent HI in prisoners, there may be potential for recall bias and inaccuracies for multiple HI especially given its high occurrence in gang violence. Nevertheless, research shows that offenders self-report of HI is generally accurate when corroborated with available medical records (Schofield et al., 2011).

For conviction data, potential bias and inaccuracy could have been reduced by cross-checking self-reports with official charge and conviction records. This information is held by prisoner's solicitors and on the Scottish Police Authority Criminal History System, which the current study did not have time to access.

Prison officers completed measures on participants (DEX). However, officers may not have a full understanding of a prisoners functioning. This might explain why DEX independent scores were lower than self-reported scores.

Implications for Through-Care services

Since completion of data collection, the SPS suspended Through-Care Services due to operational pressures across the prison estate and staff were re-deployed to mainstream prison duties. Therefore, short-term prisoners no longer have access to a service, which acts as a link between prison and community, setting up necessary links with public and third sector agencies to meet a high level of need.

This study is the first to explore HI in prisoners within Through-Care. There was a high occurrence of HI within the PSP service. Hence it seems necessary (should Through-Care services resume functioning) that there is screening and triage, with staff trained in administering the OSU-TBI-ID. This would allow resources to be tiered appropriately; from those who might benefit from psycho-education regarding the effects of HI to those

who may require neurorehabilitation (NPHN, 2016). With staff training on HI and increased awareness of the disability associated with this, links could begin to be made with third-sector HI brain injury organisations to support the preparation and transition from prison to community.

Future directions

Future research is necessary to shape service provision for those leaving custody with identified HI and associated disability. A prospective design, would allow greater understanding of the potential causal relationship between HI, outcomes and re-offending post-release. Evidence suggests that HI is not a single treatment issue (O'Rourke et al., 2016). For example, factors such as trauma and distress may act as a self-perpetuating cycle among prisoners with co-occurring HI and mental illness (Schofield et al., 2006). Development of effective assessment is necessary, to understand the contributions of multiple factors in perpetuating contact with criminal justice systems, providing further evidence of the possible unmet needs of prisoners.

Conclusion

Preparing for release requires significant input from services for prisoners who have a high level of need. This study shows that the prevalence of HI and associated disability is high, and potential needs are currently unmet, because prisoners are not linked to services for support in prison or in the community. These prisoners have a history of reoffending with multiple convictions and numerous custodial sentences. HI may be a factor in perpetuating re-offending with significant economic and societal implications if unaddressed by CJS via appropriate training and intervention.

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Appendix 1.1. Author Guidelines for Journal of Offender Rehabilitation

About the Journal

Journal of Offender Rehabilitation is an international, peer-reviewed journal publishing high-quality, original research. Please see the journal's [Aims & Scope](#) for information about its focus and peer-review policy.

Please note that this journal only publishes manuscripts in English.

Journal of Offender Rehabilitation accepts the following types of article: original articles.

The Journal of Offender Rehabilitation is a multidisciplinary, peer-reviewed journal presenting empirical research and critical analyses of criminal justice program policies, practices, and services. The journal serves as a professional resource for practitioners, educators and researchers who work with individuals involved in the criminal justice system and study the dynamics of rehabilitation and individual and system change. Original research using qualitative or quantitative methodology, theoretical discussions, evaluations of program outcomes, and state of the science reviews will be considered. A primary journal focus is the use of research to inform and improve correctional policies and practice, with articles clearly defining the theoretical and empirical basis for program models and establishing connections between research findings and needed interventions and services. Programs and services for correctional populations residing in prison, as well as in the community, are examined. The range of topics included in the journal is broad and encompasses alternatives to incarceration; community reentry and reintegration; alcohol, substance abuse and mental health treatment interventions; services for correctional populations with special needs; recidivism prevention strategies; educational and vocational programs; families and incarceration; culturally appropriate practice and probation and parole services. Please note that Journal of Offender Rehabilitation uses CrossCheck™ software to screen papers for unoriginal material. By submitting your paper to Journal of Offender Rehabilitation you are agreeing to any necessary originality checks your paper may have to undergo during the peer review and production processes.

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Structure

Your paper should be compiled in the following order: title page; abstract; keywords; main text introduction, materials and methods, results, discussion; acknowledgments; declaration of interest statement; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figures; figure captions (as a list).

Word Limits

Please include a word count for your paper.

A typical paper for this journal should be no more than 25 pages.

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7. **Funding details.** Please supply all details required by your funding and grant-awarding bodies as follows:

For single agency grants

This work was supported by the [Funding Agency] under Grant [number xxxx].

For multiple agency grants

This work was supported by the [Funding Agency #1] under Grant [number xxxx]; [Funding Agency #2] under Grant [number xxxx]; and [Funding Agency #3] under Grant [number xxxx].

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Appendix 1.2. Systematic Review Search Terms

Title, abstract and keyword search terms	
Medline – OVID	<ol style="list-style-type: none"> 1. head injur/ 2. Craniocerebral Trauma/ 3. (Head injur* or brain Injur* or traumatic brain injur* or head trauma or brain trauma or TBI or HI).tw. 4. 1 or 2 or 3 5. Recidivism/ 6. (recidivis* or reoffend* or re-offend* or reconvict* or re-convict* or rearrest* or re-arrest*).tw 7. 5 or 6 8. 4 and 7
EMBASE – OVID	<ol style="list-style-type: none"> 1. head injur/ 2. (Head injur* or brain Injur* or traumatic brain injur* or head trauma or brain trauma or TBI or HI).tw. 3. 1 or 2 4. Recidivism/ 5. (recidivis* or reoffend* or re-offend* or reconvict* or re-convict* or rearrest* or re-arrest*).tw 6. 3 or 6
PsychINFO – EBSCOhost	<ol style="list-style-type: none"> 1. DE “Recidivism” 2. TI (recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration) OR AB (recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration) 3. (((DE "Brain Concussion") OR (DE "Head Injuries"))) OR (DE "Traumatic Brain Injury")) OR (DE "Brain Injuries") 4. TI (Head injur* OR Brain injur* OR Traumatic Brain injur* OR head trauma OR brain Trauma OR TBI OR HI) OR AB (Head injur* OR Brain injur* OR Traumatic Brain injur* OR head trauma OR brain Trauma OR TBI OR HI) 5. S1 OR S2 6. S1 OR S4 7. S5 AND S6
CINHAL – EBSCOhost	<ol style="list-style-type: none"> 1. (MH “Recidivism”) 2. TI (recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration) OR AB (recidivis* OR reoffend*

	<p>OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration)</p> <p>3. (MH "Head Injuries") OR (MH "Brain Injuries")</p> <p>4. TI (Head injur* OR Brain injur* OR Traumatic Brain injur* OR head trauma OR brain Trauma OR TBI OR HI) OR AB (Head injur* OR Brain injur* OR Traumatic Brain injur* OR head trauma OR brain Trauma OR TBI OR HI)</p> <p>5. S8 OR S9</p> <p>6. S10 OR S11</p> <p>7. S12 AND S13</p>
<p>Proquest Dissertations & theses</p>	<p>(head OR brain*) NEAR/2 (injur*) OR (traumatic brain injur*) OR (head trauma) OR brain trauma) OR (HI OR TBI) AND (recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration) abstract: (head OR brain*) NEAR/2 (injur*) OR (traumatic brain injur*) OR (head trauma) OR brain trauma) OR (HI OR TBI) AND (recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration)</p>
<p>Open Grey</p>	<p>ab (((head OR brain*) NEAR/2 (injur*) OR (traumatic brain injur*) OR (head trauma) OR brain trauma) OR (HI OR TBI) AND (recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration))) OR ti(((head OR brain*) NEAR/2 (injur*) OR (traumatic brain injur*) OR (head trauma) OR brain trauma) OR (HI OR TBI) AND (recidivis* OR reoffend* OR re-offend* OR rearrest* OR re-arrest* OR reconvict* OR re-convict* OR reintegration OR re-integration))))</p>

Appendix 2.1 Participant Information Sheet



PARTICIPANT INFORMATION SHEET

Understanding health and lifestyle factors linked with persisting psychological and day-to-day difficulties

We would like to invite you to take part in a research study.

Before you decide if you would like to participate 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 ask a staff member who will notify us.

What is the purpose of the study?

- To find out more about the health and lifestyle of those who have served a custodial sentence.
- To understand what factors are linked with a range of possible difficulties and how persistent the difficulties are.
- To understand any differences between those with difficulties compared to those with no identified difficulties.
- This study will contribute towards the researchers' qualifications and will fulfil a component of their Doctorate in Clinical Psychology.

We hope this information will help us understand the needs of those who have served a custodial sentence. This could inform considerations of what might help to better understand and manage any specific difficulties, particularly when leaving custody and re-entering the community.

Why have I been invited?

You have been invited because you have served a custodial sentence in Scotland.

Who is suitable to take part in this study?

Those of all abilities are welcome, not just those with apparent difficulties, as we would like to be able to understand different levels of difficulties.

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

version 2:11.10.18

To be **included** you must:

- Be at least 18 years of age
- Be preparing for release, having served the majority of your sentence
- Have the capacity to consent to participate
- Be fluent in English

There are certain criteria that would mean you **cannot** participate. If you are currently experiencing acute mental health difficulties that might impact your ability to engage:

- If you have significant difficulties in communicating
- If you have a deteriorating neurodegenerative condition, e.g. dementia, Parkinson's disease
- If you have significant sensory impairment (e.g. sight or hearing impairment that cannot be corrected with glasses or hearing aids)

If you would like to discuss your suitability, please let your key worker know so that they can get in contact with the researcher to discuss.

Do I have to take part?

No, it is up to you to decide if you want to take part in the study. There are no consequences for not taking part. You will be approached by a key worker who will give you this information sheet. Please keep this as you will have up to 2 weeks to consider if you would like to participate. After 2 weeks the key worker will check with you once if you would like to participate. You can say no and nothing further will happen. If you would like to take part, notify them and they can arrange an appointment for you to meet with the researcher. You are free to withdraw from the study at any time without giving a reason.

What will happen to me if I take part?

You will be invited to attend for a single assessment lasting between 60 and 90 minutes. This involves a brief interview about your health, questionnaires about psychological wellbeing, lifestyle and completing some tasks and puzzles that look into different cognitive skills such as memory and concentration.

During the assessment appointment, you will be asked for your consent for the researcher to approach a staff member to answer questions about your day-to-day functioning based on their observations. You can say no to this. If you say no, they will **not** be approached.

Where will the assessment take place?

The assessment will take place within the prison. If you need to be excused from work to attend, 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 90 minutes.

What are the possible disadvantages and risks of taking part?

There are no particular disadvantages to taking part, other than the time taken to attend the assessment, and your participation will have no impact on your 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 factors that might be linked to persisting difficulties and may allow us to make recommendations for service improvements in prisons and the community.

Will I be personally identifiable in the study?

You will only be identified by an identity number and any information about you will have your name removed so that you cannot be recognised from it. To safeguard your rights, we will use the minimum personally-identifiable information possible. You can find out more about how we use your information from Principal investigator, Lauren Mapp.

What will happen to the data I provide?

Data collected in paper form will be kept within the University of Glasgow department in a locked cabinet for 10 years and all data in electronic format will be stored on secure password-protected computers 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 about you during the research will be kept strictly confidential, accessible only to the study researchers, the study's chief investigator and representatives of the study sponsors at the University of Glasgow who will make sure that the study is being conducted, regulatory authorities or by the NHS Board where it is relevant to my taking part in this research. No one outside of the research team or appropriate governance staff will be able to find out your name, or any other information which could identify you.

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 concerns regarding your health are identified through the study, we will inform the health service you are linked to so that it can inform your future care. For example, if you disclose significant mental health issues (e.g. suicidal ideation), we would be obligated to feedback to the NHS health staff based in the prison.

The data gathered will be analysed at the group level, not the individual level

Your rights to access, change or move the information we store may be limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. You can find out more about how we use your information from Principal investigator, Lauren Mapp.

Researchers from the University of Glasgow collect, store and process all personal information in accordance with the General Data Protection Regulation (2018).

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 fulfil the requirements of the Doctorate in Clinical Psychology.

If you want to receive a summary report of the findings of this study, you will be requested for details of where a plain English summary of the findings should be sent during the participation appointment.



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.

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 information

You can contact Lauren Mapp (researcher) or Professor Tom McMillan (supervisor), who are involved in the research project on the following phone number: 0141 211 0354.

Thank you for considering to take part in the study.

Appendix 2.2. Prison Support Pathway Through-Care Service Information

PSP is staffed by approximately fourteen prison officers, seconded from operational duties, with additional training to assess the needs of ST prisoners and advise on available services suited to their needs in preparation for pre-release, with continued support in the community.

PSP reported mainly receiving self-referrals, however the service also accepted those made by prison staff on behalf of prisoners. Once a referral has been made, there is a duty system (staff members rotate weekly and have 2 days per week allocated to triaging referrals) whereby the individual will be seen for initial assessment by two duty staff. There was no official criteria for referrals being accepted onto caseload. The service manager described the following: those referred with 'relatively minor needs' (such as issues with housing on release) would be re-directed by duty clinicians to the relevant support service, with no full assessment of need. Those who present with a range of complex needs (e.g. mental health, substance misuse, homelessness, high levels of repeat offending) are fully assessed within 72 hours of referral using the assessment proforma which was designed in 2013 by Turning Point Scotland. The prisoner is assigned a PSP worker, who will have weekly contact with them in preparation for release. Once in the community the same PSP worker will continue to meet with the individual in the community to ensure that they have the necessary links with services.

Appendix 2.3. Demographic Questionnaire

Participant ID number				
Age				
PSP case				
Gender				
Fluent English speaker				
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?	Frequency ➡	< 20 times throughout school	At least once month (from – until)	At least once a week (from – until)
	Reason ⬇			
	Truancy			
	Illness			
	Suspension/ Exclusion			
Most recent occupation	Managers, directors and senior officials			
	Professional Occupations			
	Associate Professional and technical occupations			
	Administrative and Secretarial occupations			
	Skilled trades			
	Care and support			
	Leisure and service occupations			
	Sales and customer Service			
	Process, Plant and Machine Operatives			
	Elementary occupations			
	None			
Offence history	Current sentence			
	Age at first offence (arrest)			
	Number of arrests			
	Number of charges			
	Number of convictions			

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	Type and number of disposals	Financial penalty		
		Fiscal fine		
			Community Order	
			Compensation Order	
			Custodial sentence	
	Secure unit/Young Offenders Institute			
	Number of short term custodial sentences			
	Number of long term custodial sentences			
	Longest sentence served			
	Total length of custodial sentences served			
	Offence types and number		Violent	
			Sexual	
			Drug	
			Property	
			Theft	
			Fire raising	
			Motor	
		Breach of Peace		
		Financial		
	Other state (e.g. drunk and disorderly)			
			

Appendix 2.4. NHS Research Ethics Committee Approval Letter

WoSRES
West of Scotland Research Ethics Service

Professor Tom McMillan
Professor of Clinical Neuropsychology
University of Glasgow
R213 Level 2 Admin Building
Mental Health and Wellbeing, Gartnavel Royal
Hospital
1055 Great Western Road
G12 0XH



West of Scotland REC 3
Research Ethics
Clinical Research and Development
West Glasgow Ambulatory Care Hospital
Dalnair Street
Glasgow
G3 8SJ
(Formerly Yorkhill Childrens Hospital)

Date 24 October 2018
Direct line 0141 232 1807
E-mail WoSREC3@ggc.scot.nhs.uk

Dear Professor McMillan

Study title: The prevalence of head injury and associated disability
in offenders on release from custody.
REC reference: 18/WS/0183
IRAS project ID: 248963

Thank you for your letter of 11 October 2018, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information was considered in correspondence by a Sub-Committee of the REC. A list of the Sub-Committee members is attached.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact hra.studyregistration@nhs.net outlining the reasons for your request.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission must be obtained from each host organisation prior to the start of the study at the site concerned.

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Appendix 2.5. Scottish Prison Service Research Ethics Committee Approval

From: Carnie James <James.Carnie@sps.pnn.gov.uk>
Sent: 06 November 2018 10:14
To: Tom McMillan <Thomas.McMillan@glasgow.ac.uk>
Cc: McDowall Lesley <Lesley.McDowall@sps.pnn.gov.uk>
Subject: RE: SPS ethics

Tom

The Research Access and Ethics Committee met in October and was content to approve access in principle. In the interim, I have been waiting for final confirmation from colleagues in our Health and Justice Division that they are supportive of this phase of the TBI research.

That confirmation has now been forthcoming, so RAEC can approve the necessary clearances.

As this is a new phase, it probably makes sense for you to sign another form of standard regulations.

RAEC wished you well with the study.

Regards
Jim

Appendix 2.6 Proportion of disability and recovery by Mild HI and Multiple HI

Significantly more individuals with multiple HI (n=29, 72%) were disabled on the GODS than those with mild HI (n=7, 37%): $\chi^2(1)=6.88$, $p=0.009$, $\phi=0.266$, OR= 4.5, 95%CI: 1.41, 14.44.

Proportion of disability and recovery by Mild HI and Multiple HI

Head Injury	Disabled or Recovered (GODS)		
	Disabled (%)	Recovered (%)	Total (%)
Mild HI	7 (37)	12 (63)	19 (32)
Multiple HI	29 (72)	11 (28)	40 (68)
Total	36 (61)	23 (39)	59 (100)

Appendix 2.7. Mild-Multiple/Moderate-Severe Head Injury Univariate Analysis

Outcome measure means, tests of differences between Mild HI and Multiple/Moderate-Severe HI and normed mean/median

Variable	Mild HI (N=19)	MM HI (N=47)	r	95% CI	t/U ^a	p	Normed Mean
SDMT* (median, range)	45 (32-52)	42 (26-61)	-0.06	†	393.5	0.83	49.9 (10.8) ^b
List Learning	36 (9.6)	36 (8.6)	0.08	-4.67 – 5.03	0.074	0.94	52 (9.6) ^c
Trails A (median, range)	41 (25-66)	40 (19-76)	0.01	†	457.5	0.88	24.4 (8.7) ^d
Trails B (median, range)	85.5 (46-179)	106 (44-251)	0.2	†	510.5	0.11	50.7 (12.4) ^d
Word Memory Delayed (median, range)	38 (27-40)	36 (26-40)	-0.14	†	368.5	0.266	39.4 (2.4) ^e
Composite Cognitive Impairment (Z scores)	-0.0378 (0.57)	0.0215 (0.42)	0.05	-0.31 – 0.19	-0.47	0.64	N/A
DEX Self*	25 (11.6)	32 (11.6)	0.26	-13.01 – 0.37	-2.15	0.038	22.1 (8.9) ^f
DEX Independent* (median, range)	10 (0-44)	20 (3-49)	0.44	†	291.5	0.01	20.6 ^f
HADS Anxiety	9 (3.7)	11 (4.7)	0.2	-4.53 – 0.459	-1.63	0.108	6 ^g
HADS Depression*	6 (2.9)	7 (3.8)	0.14	-3.08 – 0.82	-1.16	0.25	3 ^g
AUDIT (median, range)	13 (0-40)	20 (0-40)	0.17	†	541.5	0.178	9.23 ^h (7.1)
DAST (median, range)	6 (3.4)	7 (3.1)	0.16	†	535.5	0.202	N/A

^a = Independent t-test. Or Mann-Whitney, † 95%CI not available for Mann-Whitney

* Missing data: SDMT=2 for MMHI group, Trails A= 1 in MMHI group, Trails B=1 in Mild HI group, 2 in MMHI group, DEX-self= 1 in MMHI group, DEX-Independent= 7 in mild HI, 16 in MMHI, HADS Depression/Anxiety=1 in mild HI group 2 in MMHI group.

^bKiely, Butterworth, Watson & Wooden (2014), ^cCoughlan & Hollows (1985), ^dTombaugh(2004), ^eGreen (2003), ^fChan (2001), ^g50th percentile of normed sample (Crawford, Henry & Taylor, 2001), ^h Young & Mayson, (2010)

Appendix 2.8. Mild/Multiple Head Injury Univariate Analysis

Outcome measure means and tests of differences between Mild HI and Multiple HI and normed mean/median

Variable	Mild HI (N=19)	Multiple HI (N=40)	<i>r</i>	95% CI	<i>t/U</i> ^a	<i>p</i>	Normed Mean/ Median
SDMT (median, range)	45 (32-52)	43 (26-61)	-0.03	†	346	0.79	49.6 (10.8) ^b
List Learning	37 (9.7)	37 (7.6)	2.9	-4.83 – 4.79	-0.007	0.99	52 (9.6) ^c
Trails A (median, range)	40 (12.7)	39 (11.9)	-0.03	†	355.5	0.80	24.4 (8.7) ^d
Trails B (median, range)	86 (46-179)	102 (44-251)	0.17	†	415.5	0.19	50.7 (12.4) ^d
Word Memory Delayed Recall (median, range)	38 (27-40)	37 (28-40)	-0.11	†	324	0.36	39.4 (2.4) ^e
Composite Cognitive Impairment (Z scores)	-0.0204 (0.6)	0.005 (0.4)	0.06	-0.33 – 0.19	-0.52	0.61	N/A
DEX Self	24 (11.4)	33 (11.1)	0.24	-12.58 – 0.36	-1.89	0.06	22.1 (8.9) ^f
DEX Independent (median, range)	10 (0-44)	20 (3-47)	0.4	†	247	0.003	20.6 ^f
HADS Anxiety	9 (4.2)	11 (4.8)	0.2	-4.74 – 0.43	-2.03	0.10	6 ^g
HADS Depression	6 (2.9)	7 (7)	0.11	-2.62 - 1.10	-0.82	0.41	3 ^g
AUDIT (median, range)	13 (0-39)	14 (0-37)	0.03	†	200.5	0.23	9.23 ^h (7.1)
DAST (median, range)	7 (0-10)	8 (2-10)	0.15	†	234.5	0.27	N/A

^a = Independent *t*-test. Or Mann-Whitney, † 95%CI not available for Mann-Whitney

* Missing data: SDMT=2 for multiple HI group, Trails A= 1 in multiple HI group, Trails B=1 in Mild HI group, 2 in multiple HI group, DEX-self= 1 in multiple HI group, DEX-Independent= 7 in mild HI, 16 in multiple HI, HADS Depression/Anxiety=1 in mild HI group 2 in multiple HI group.

^bKiely, Butterworth, Watson & Wooden (2014), ^cCoughlan & Hollows (1985), ^dTombaugh(2004), ^eGreen (2003), ^fChan (2001), ^g50th percentile of normed sample (Crawford, Henry & Taylor, 2001), ^h Young & Mayson, (2010)

Appendix 2.9. Logistic regression excluding single-event moderate-severe HI

The model was significant ($X^2(3)=7.855, p=0.049$) and explained 16.9% of the variance in disability. Those with multiple HI had 4.9 odds of exhibiting disability.

Table: *Logistic regression of association between mild HI and multiple HI categories and disability*

Outcome: GODS disability	OR	95% CI	p	Pseudo R ²
				0.169
Multiple HI	4.983	1.502 – 16.528	0.009	
Age	0.998	0.939 – 1.062	0.998	
Years Education	0.840	0.597 – 1.184	0.320	

Appendix 2.10. Offending characteristics excluding single event moderate-severe HI

	Mild HI	Multiple HI
Number of previous convictions (median, range)	15 (2-60)	20 (1-80)
Number of custodial sentences	4 (1-20)	8 (1-60)
Total time in custody – months (median, range)	30 (1-300)	72 (3-288)

Appendix 3. Research Proposal

Abstract

Introduction: The Scottish government recommend exploring the prevalence of head injury (HI) and consequent disability in offenders in the criminal justice system. Research suggests that for those entering prison with moderate-severe HI, long lasting disability, cognitive impairment and anxiety are common. The prevalence and needs of people with HI who are re-entering the community has not yet been established.

Aims: To estimate the prevalence of HI and its persisting effects including disability, neuropsychological impairment, emotional and behavioural difficulties and make recommendations with regards to assessment and likely needs.

Methods: Approximately 90-100 participants will be recruited from those preparing to leave custody. A cross-sectional design will be employed. History of HI will be screened for and individuals categorised as having significant HI or not. Cognitive, emotional and disability outcomes will be assessed. Where appropriate, regression analysis will be used to establish the predictive relationship of severity of HI on outcomes.

Applications: Establishing the prevalence of HI will inform the need for assessment of HI and contribute to the routine consideration of clients needs with HI. Establishing persisting disability and difficulties associated with HI may facilitate potential service development. The work will contribute to implementation of the National Prisoner Healthcare Network report on Brain Injury and Offending.

Title

Head injury and associated disability in offenders on release from custody.

Introduction

The World Health Organisation (2006) reported that Head Injury (HI) is the leading cause of death and disability in children and young adults around the world and is involved in nearly half of all trauma deaths. HIs vary greatly in severity, indices of which are duration of loss of consciousness (LoC) and post-traumatic amnesia. Around 10% of HI's are classified as moderate-severe (Carroll et al, 2004).

With increasing severity, HI can be associated with long term impairments in attention, memory, word finding and executive function (Cicerone et. al, 2011). Given that these impairments are often not visible, HI has been referred to as the 'silent epidemic' (Langlois et al 2006), as difficulties may not be attributed to the HI, therefore the individual and those around them may not make allowances for the injury and its consequences.

In the context of the Criminal Justice System (CJS), HI is the most common cause of brain damage and it is also more frequently associated with anti-social behavior (National Prisoner Healthcare Network, NPHN, 2016). There are several potential reasons for 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). It has been suggested that there is an association between HI and a higher risk of violent crime (Fazel et al, 2011).

Preliminary findings from a population study in Scotland (McMillan et al, in preparation, cited in NPHN, 2016) suggested that 26% of the prison population had been admitted to hospital with HI, with the relative risk of having a HI being four and a half times higher in individuals in prison than demographically matched controls. Therefore, overall the prevalence of HI in offending populations appears to be significantly higher than the

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general population (7%). With the development of research on prevalence rates of HI and associated disability in prison populations, the NPHN suggested that screening, triage and assessment of HI should be considered at various points throughout the CJS. Offenders with HI have higher recidivism rates and have difficulties re-integrating into the community (Merbitz et al., 1995; Shiroma et al., 2010). This suggests a possible relationship between HI, offending and poor outcome which may indicate the needs of this population differ from a typical offender population.

O'Rourke and colleagues (2017) researched the understanding of HI in the Probation Board for Northern Ireland, finding potential barriers to identification and rehabilitation of HI for offenders. Misconceptions were held about HI, such as an over-reliance on the offender's insight into injury in being able to identify, understand and communicate the extent and severity of their injuries. Such misconceptions could lead to inappropriate recommendations being made at various points in the CJ process (sentencing, post-custodial supervision, community management). Screening of HI, using a standardized protocol, is necessary given that the impairments associated with HI may not necessarily be picked up and triaged by professionals within the CJ system. The needs of individuals with HI might not be met in terms of understanding the level of impairment from HI, the possible role HI has in offending/re-offending and the consequent level of rehabilitation, if any, that is necessary. This may help to reduce re-offending rates by providing more appropriate support to engage with CJSW.

Aims

To establish the prevalence of significant HI and associated disability and difficulties in offenders who are at the point of release from custody into the community.

Hypotheses

H1. 'Significant' HI is associated with persisting disability, neuropsychological impairment and mental health difficulties.

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H2. Those with significant HI have a higher number of previous offences.

Plan of Investigation

This study is being carried out in parallel with another DCLinPsy trainee project which aims to examine the prevalence of HI and associated disability, neuropsychological, emotional and behavioural outcomes offenders entering the court phase of the CJS. A research assistant funded by the Scottish Government will also support the work. Therefore there will be three data collectors in total.

Participants

Males and females aged ≥ 18 preparing for release from the Scottish Prison Service (SPS) into the community. If available, a relative, carer or prison officer will be recruited to complete proxy measures.

Recruitment sites

HMP Low Moss have provisionally agreed to support the project. Every quarter the Duty System see's approximately 439 offenders through triage. A further 35-40 are taken on to full caseload and allocated a practitioner through the Prisoner Support Pathway (PSP). At present practitioners are working with 75 in custody and 57 in the community. HMP Shotts have also expressed interest in the project.

Inclusion and Exclusion Criteria

Participants must have the capacity to consent to participate, be fluent in English and able to read and write. Individuals will be excluded if they are experiencing acute mental health difficulties, significant communication difficulties, deteriorating neurodegenerative conditions, significant sensory impairment or pose imminent risk of violence to researchers.

Recruitment Procedures

Staff associated with the Prison Support Pathway, preparing prisoners for the transition from custody to the community will give participants an information sheet about the study.

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The information sheet will state that the study is about health and associated disability. It will not mention HI so that this does not influence recruitment, particularly those with no HI. If interested, the participant will meet with the researcher and informed consent to participate will be obtained.

Measures

Demographic information and forensic history

The following will be collected: Age, gender, ethnicity, native English speaker or second language, level of education, school type, any possible learning difficulties, most recent occupation and social deprivation - using Scottish Index of Multiple Deprivation 2012 quintiles. A forensic history will include the number and nature of offences, age at first offence, duration of time spent in custody and longest sentence.

Screening tool

The Ohio State University Traumatic Brain Injury Identification Method Short Version (OSU TBI-ID) is a structured interview. It identifies if an individual is 'likely' or 'not likely' to have ongoing problems as a result of HI. The OSU TBI-ID identifies significant HI when loss of consciousness is ≥ 30 minutes. Bogner & Corrigan, (2009) (n=210) found large effect sizes when comparing OSU TBI-ID scores with several cognitive, psychiatric and behavioural outcomes ($R^2 > 0.36$).

Disability (primary outcome)

The Glasgow Outcome Scale-Extended (GOS-E, Wilson, Pettigrew and Teasdale, 1998) is a structured interview assessing disability after HI, used in community settings. It was found to have significant associations with various measures of health and disability effect sizes ranged from small ($r=0.22$) to large ($r=0.72$). The Glasgow Outcome at Discharge Scale (McMillan et al, 2013) is based on the GOS-E and is used in inpatient settings at the point of discharge. Some questions will be adapted for use in a prison context (e.g. 'prison area' will replace 'ward').

Mental Health

The Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983). Clinical levels of anxiety or depression are indicated by scores ≥ 11 . It has good reliability and validity in assessing depression and anxiety in people with HI (Whelan-Goodinson, Ponsford & Schonberger, 2009).

Cognitive Functioning

The Adult Memory and Information Processing Battery, List Learning Sub-Test (Coughlan & Hollows 1985) measures learning and working memory. Test re-test reliability was high and those with an acquired brain injury were found to perform below test norms with large effect sizes suggesting adequate sensitivity (Lezak, 2012, pp531).

The Symbol Digit Modalities Test (Smith 1982) assesses information processing, attention, visual scanning and motor speed by assessing participants ability to correspond symbols with numbers. It has been shown to have high test-retest reliability and is sensitive to the effects of HI (Strauss et al, 2006).

Executive Function

The Trail Making Test (Armitage, 1946) measures divided attention and mental flexibility by assessing participants ability to switch attention between sequences. Good sensitivity for neurological disorders has been found (Burgess et al, 1998).

The Dysexecutive Questionnaire (part of the Behavioural Assessment of Dysexecutive Syndrome, Wilson, et al, 1996) is a twenty-item questionnaire measuring occurrence of changes in everyday life resulting from impairments of executive functioning post HI. Reliability is better when completed by someone who knows the person well, rather than by the patient (Burgess et al, 1998). It has good internal consistency ($\alpha=0.89$) (Azouvi et al, 2015).

Test of Symptom Validity

The Word Memory Test (Green et al, 2003) tests effort and verbal memory. Failure on any part of the test is considered evidence of poor effort. Sensitivity in detecting simulators was found to be 96-100%. It has been validated in forensic and HI samples (Green et al, 2003 Green et al, 1999).

Alcohol and substance use

The Alcohol Use Disorders Identification Test (Saunders et al, 1993)) is a ten-item screening tool to assess alcohol related problems. The Drug Abuse Screening Test -10 (DAST-10, Skinner, 1982) assesses the severity of substance use. It has high internal consistency ($\alpha > 0.85$) and acceptable test-retest reliabilities ($r > 0.70$).

Design

A cross-sectional design will be employed to establish if there is an association between significance of HI and outcome variables. Participants will be categorised into two groups, those with significant HI and those without significant HI (See table 1).

Table 1: Participant groups for analysis

OSU (research categories)	Groups for analysis (merging categories)
No HI	No significant HI
Mild HI (no LOC)	
Mild (LOC < 30 minutes)	
Moderate HI (includes multiple) – most severe injury: LOC between 30 minutes and 24 hours	Significant HI
Severe (includes multiple) most severe injury: LOC > 24 hours	

Procedure

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A pilot (n=4-6) will address potential procedural issues and increase inter-rater reliability between researchers when scoring the screening tool and outcome measures.

A semi-structured interview will be undertaken to collect outcome information detailed above and recorded on an anonymised form, which will be developed by the researchers. It is anticipated that this will take 60 minutes. During the participation appointment all participants will be asked if they want to receive a plain English summary report of the findings of this study. If participants do wish to receive a copy of this report they will be requested for details of where the report should be sent.

Data Analysis

Descriptive statistics will describe the data using measures of central tendency by group. Statistical significance will be tested with independent sample t-tests or Mann-Whitney tests, comparing groups on outcome variables.

H1. Significant HI will be associated with persisting disability, neuropsychological impairment and mental health difficulties.

If univariate tests are significant, regression models will be used enabling the adjustment of covariates to understand if significance of HI predicts outcomes. Covariates are age, years of education. To investigate the relationship between significant HI and persisting disability, ordinal logistic regression will be used. Scores used to measure cognitive impairment will be converted to z scores, based on normative data used in clinical practice, and transformed to a percentile score of overall cognitive function score and multiple regression will be used.

H2. Those with significant HI have a higher number of previous offences.

T-tests or Mann-Whitney will be used to compare number of offences (convictions) between those with significant HI and those with no significant HI. As number of previous offences is a count variable, Poisson regression model will be employed to explore the predictive relationship between HI and offending.

Justification of sample size

Pitman and colleagues (2015) found moderate-large effect sizes ($n=189$) comparing prisoners with HI and without HI on neuropsychological measures. A meta-analysis (Belanger, et al., 2005) on differences in cognitive functioning between individuals with and without HI in the general population computed effect sizes for the cognitive domains of interest in the present study: attention, delayed memory and verbal/semantic fluency, incorporating tests used in this study. The effect sizes found (Cohen's d) were 0.47, 0.69 and 0.77 respectively. Using these effect sizes it was estimated that between 22-57 participants per group would be required to detect significant differences with power of 0.80 $\alpha=0.05$, (one-tailed). A one tailed estimate was used as all hypotheses were specific in terms of the direction of difference (HI predictors would be associated with worst outcomes on each measure). When the average of these effect sizes was used ($d = .64$), power calculations estimated that 31 participants per group would be required.

Walker (2017) reported a correlation of 0.291 ($n=81$) for correlations of severity of HI and Disability (GODs) in a prison population. Using this data, G*power (Faul et al, 2009) indicates $n=90$ is required to detect a medium effect ($r=0.291$) with 80% power, and $\alpha=0.05$. The same study reported a correlation of 0.33 between LoC and Cognitive impairment. With the same parameters as above, $n=69$ would be required. When using multiple linear regression, Walker (2017) reported a large effect size between HI disability (GODS) and HI severity (LoC) ($f^2=-0.278$, $p=0.011$, $CI= -0.595,-0.080$). Using this data, G*Power indicates $n=31$ is required to detect a large effect ($f^2=-0.278$) with 80% power and $\alpha=0.05$. To detect a medium effect size ($f^2=0.15$), $n=55$ is required with 2 predictor variables specified. Based on this, a sample size of 100 would be sufficient and allow at least 31 individuals per HI group

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Settings and equipment

There are interview rooms available in SPS settings. (see appendix 3 for equipment).

Health and Safety Issues

Researcher safety

Researchers will adhere to SPS policy to ensure safety when collecting data. Personal safety alarms will be provided. Necessary training to ensure personal safety, will be completed. (See appendix 2 for Health and safety form).

Participant safety

Within the settings above, the safety of participants can be clearly monitored.

Ethics

The interview will be as non-intrusive as possible, and data anonymised at the point of collection. To ensure data security, it will be stored in a locked filing cabinet, and kept for 10 years in accordance with University of Glasgow policy. Data will be entered onto an electronic database. This will be stored securely on a password protected University of Glasgow computer. Informed consent will be taken from participants using a study information sheet and written consent form. This consent form will include seeking consent to inform staff of any significant HI to inform care and management. Participants will be informed that their participation is voluntary and will not impact their healthcare or custodial sentence.

Apply for approval from:

- NHS Research Ethics Committee.
- SPS Ethics Committee.
- NHS Research and Development departments for NHS Highland (researcher's employer NHS GG&C (covers HMP Low Moss) and NHS Lanarkshire (covers HMP Shotts). The University of Glasgow will sponsor the research.

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Timetable

February-May – Finalise proposal

May- September 2018 – Obtain ethical approval from WOSREC and SPS.

September 2018 - May 2019 - Data collection & scoring.

May- July 2019 - Data analysis and write up.

July 2019 – Final project submitted.

Practical Applications

Establishing the prevalence of HI and associated disability and offending in this population is necessary to aid understanding needs of and how these might be met under the supervision of CJSW service. Results may inform service provision at the point of release from custody.

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