Persisting Disability After Head Injury in Juvenile Prisoners

and Clinical Research Portfolio

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Chapter One: Systematic Review

The Relationship between Adverse Childhood Experiences (ACEs) and Offending in Young Offenders: A PRISMA Systematic Review

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Abstract

Background

Young offenders often have trauma backgrounds. Adverse Childhood Experiences (ACEs) capture the cumulative stress early in life and can be related to poor health and social outcomes. ACEs and Traumatic Brain Injury (TBI) are prevalent in young offenders and may have a relationship with offending.

Aim

To systematically review whether there is unique variance associated with ACEs and offending.

Methods

CINAHL, EMBASE, MEDLINE, PsycINFO and PTSDPubs databases were searched for research published on the relationship between ACEs and offending using key words and subject headings.

Results

Eleven papers were combined into six studies; two were low risk of bias. With bias in mind, the relationship between ACEs and offending was evaluated with the roles of child welfare, relationships and psychological constructs explored. No study explored TBI and two papers explored sexual offending.

Conclusion

Given the high risk of bias in four included studies, overlapping populations and research groups, limited conclusions can be made. However, low bias studies did find evidence of

an ACE-offending relationship in young offenders. There was not unique variance, as child welfare and other factors also contribute towards the relationship. Further large-scale research should determine the role of TBI and sexual offending and professionals should have awareness of the potential impact of ACEs on future youth offending risk.

Introduction

The early lives of offenders are shaped by traumatic histories, including interruption of care, abuse and domestic violence (Grimshaw et al., 2011) and psychological trauma is more prevalent in offending than in general populations (Liddle et al., 2016). Most offenders originate from deprived backgrounds where there is a high incidence of life experiences that are associated with psychological trauma, such as maltreatment, abuse, care system involvement or having family members involved in crime (Day et al., 2008; Boswell, 1996; Blades et al., 2011; Williams, Papadopoulou & Booth, 2012).

Adverse Childhood Experiences (ACEs) are ten events involving abuse, neglect or household dysfunction. Felitti et al. (1998) developed a questionnaire to capture the occurrence of these in the first eighteen years of life. Presence of multiple ACEs is a risk factor for health conditions such as problematic drug use and mental ill health and are associated with poor social outcomes in adult education, employment and income potential (Hughes et al., 2017; Metzler et al., 2017).

ACEs are common in offenders, with a Welsh study reporting that 80% were exposed to at least one ACE (Ford et al., 2019). Young offenders are four times more likely to report four or more ACEs when compared to non-offending controls (Baglivio et al., 2014). In a high-risk of offending youth sample in Scotland, 93% had been exposed to at least one ACE and 59% four or more (Vaswani, 2018).

Young offenders with more ACEs are more likely to be assessed as high risk of re-offending using a validated risk tool (Baglivio et al., 2014). Baglivio et al. (2015) identified that a higher number of ACEs was associated with an earlier age of arrest and that when controlling for risk factors it remained a significant predictor. The researchers interpret these results as supporting Moffitt's (1993) developmental taxonomy, which posits that life-course offenders more often have significant neuropsychological deficits

and these interact with persisting effects of their disadvantaged early life experiences, resulting in an ongoing anti-social lifestyle. Anda et al. (2010) suggest a neurodevelopmental explanation for the ACE-offending relationship whereby the cumulative stress that the developing brain is exposed to may cause deficits in the amygdala and prefrontal cortex which results in poor mental health and aggressive behaviour (Anda et al., 2006).

Traumatic Brain injury (TBI) is prevalent in young offenders, estimated as 30% in a meta-analysis (Farrer et al., 2013) and TBI highly associated with self-reported childhood trauma in young offenders (Schofield et al., 2019). Given the high prevalence of TBI and ACEs both could be relevant to offending.

The ACE framework provides a method of examining whether there is a relationship between cumulative stress early in life and offending in the vulnerable young offender population. This review examines the quality of evidence for this relationship and the extent to which there may be unique variance associated with ACEs and offending.

Research Questions

1. Do ACEs increase risk of offending?

2. Is there unique variance associated with ACEs and offending?

3. Does brain injury increase risk of offending in people with ACE history?

4. Are ACEs associated with particular types of offending?

Methods

<u>Search Strategy</u>

The Databases CINAHL, EMBASE, MEDLINE, PsycINFO and PTSDPubs were searched on the 3rd May 2019. Relevant subject headings and search terms were used in each database. The reference lists of key papers were hand searched to locate potentially relevant articles. The records extracted from CINAHL are from 1981 onwards, EMBASE from 1947 onwards, MEDLINE from 1946 onwards, PsycINFO from 17th century and PTSDPubs from 1871. Articles were limited to English only as translation was not viable. The following search strategy using search terms and subject headings was used in the PsycINFO database:

Line 1 Child

TI (child* or young or youth or juvenile) OR AB (child* or young or youth or juvenile)

Line 2 Offending

TI (arrest* or deliquen* or inmate* or incarcerat* or perp* or crim* or prison* or imprison* or offend* or remand* or correctional or proba* or penitentiar* or recidivism or re-offend* or reoffend* or homicid* or jail* or Gaol*) OR AB (arrest* or deliquen* or inmate* or incarcerat* or perp* or crim* or prison* or imprison* or offend* or remand* or correctional or proba* or penitentiar* or recidivism or re-offend* or reoffend* or homicid* or jail* or Gaol*)

DE "Criminal Offenders" OR DE "Male Criminal Offenders" OR DE "Female Criminal

Offenders" OR DE "Mentally Ill Offenders" OR DE "Probation" OR DE "Juvenile Delinquency" OR DE "Prisoners" OR DE "Parole

Line 3 ACE

TI (adverse childhood experience* or ACE or ACES) OR AB (adverse childhood experience* or ACE or ACES)

Inclusion Criteria

1. Juvenile offender sample
2. Uses original ten-item ACE questionnaire (Felitti et al., 1998)
3. Includes data on offending characteristics, such as number of convictions or type of offence
4. Explores relationships between ACE and offending
5. Published in a peer-reviewed journal

Exclusion Criteria

- Not printed in English
- Dissertations, theses, book chapters, conference presentations, abstracts, reviews or case studies.

Search Results

JMcV conducted the search and selected the articles. Of 1038 articles found, 557 duplicates were removed. The title and abstracts of the remaining 557 were screened for eligibility, leaving 44 articles. The full text of these articles were read; 33 were excluded. Of the 11 articles remaining, the same research group studied overlapping participant

samples from the same time period in several articles (Baglivio et al., 2015; Craig et al., 2019). These were grouped together as a single study for purposes of synthesis and resulted in 6 studies for review (see Figure 1). Data were then extracted using a tool developed for the review.
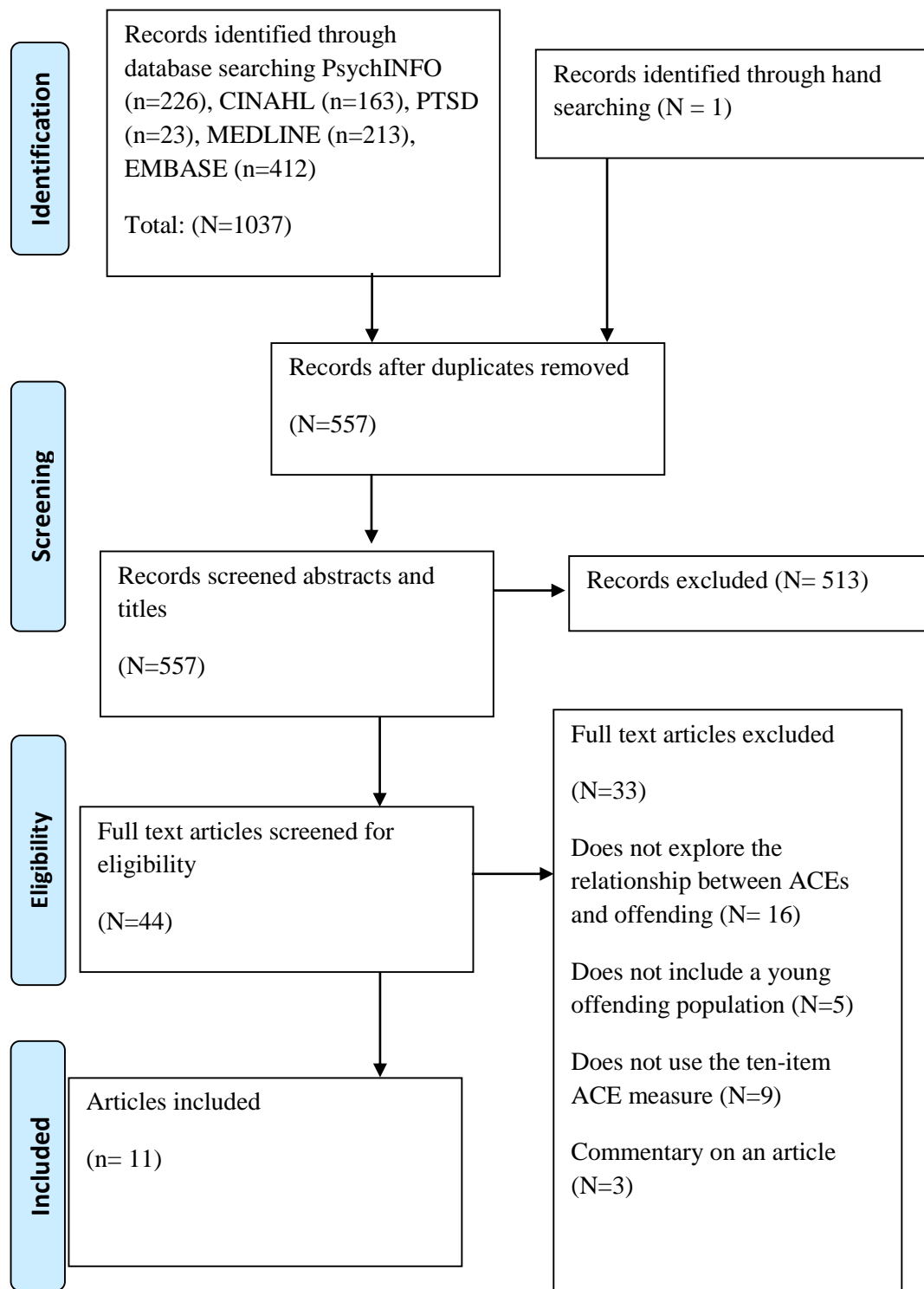
Figure 1. PRISMA Flow Diagram

The risk of bias assessment tool was based on Sanderson et al. (2007) and modified by Moynan and McMillan (2018) who reviewed prevalence of Head Injury (HI) and associated disability in offenders. Included articles were rated as 'low', 'high' or 'not reported' (NR) using the criteria for the seven domains in Table 1. The writer initially rated all studies and then 50% were rated by another Trainee Clinical Psychologist. The agreement was 95% (20/21). There was disagreement about the Design-specific bias domain for the Craig et al., (2019) study and this was resolved by discussion.

Table 1. Risk of Bias Domains and Criteria

Domain	Criteria
1. Methods for Selecting Participants	i. Inclusion and Exclusion criteria are clear ii. Sample should be representative of the larger young offender population
2. Design-specific bias	Methods used to manage issues such as interviewer bias or recall bias.
3. Methods for measuring ACE variable	i. Reports the ten ACE questions (Felitti et al., 1998) ii. Describes method of obtaining ACE result e.g interview, file search
4. Methods for measuring offending characteristics	Definition of offending behaviour clearly stated. Examples of characteristics of offending measured could include: i. Age of first offence ii. Type of offence iii. Number of convictions iv. Sentence length
5. Methods to control confounding	Description of any other variables being assessed that may impact on offending behaviour, such as: i. Social deprivation ii. Substance use iii. Mental health problems iv. Age v. Ethnicity vi. TBI

	Were records checked for accuracy, to manage under/over-reporting when self-report is used?
6. Design and Analysis plan	i. Statistics appropriate for analysing relationship between ACES and offending ii. Analysis is appropriate to the study design and accounts for confounding variables iii. Are effect sizes reported where appropriate
7. Conflicts of Interest	Declarations of conflicts of interest or identification of funding sources

Strategy for synthesising results of the study

The sample of studies used varying methodology to explore different aspects of the ACE-offending relationship. This contributed towards the variation in clinical conclusions that can be made from the studies. Given this heterogeneity, studies were analysed qualitatively.

Results

Study Characteristics

The six included studies all used a cross-sectional design and present data on a total of 106,696 participants. Five studies were conducted in the USA (three with samples from Florida) and one in Portugal. Hall, Stinson and Moser (2018) had a male only sample and the remaining five a mixed gender sample. Two articles comprised sexual offending samples only (Naramore et al., 2017; Hall et al., 2018). Table 3 summarises data from included studies and Appendix 1.2 describes variables included in statistical models.

Risk of bias was low for Design/Analysis Plan and for Conflict of Interest (Table 2). It was high for Methods of Assessing ACE and for Methods for Selecting Participants and mixed for the other domains.

Research Questions

1. Do ACEs increase risk of offending?

None of the six studies had low risk of bias ratings for all domains considered. Two studies were mostly low risk of bias, except for measurement of the ACE variable which was rated as high for both (Baglivio et al., 2016; Craig et al., 2019). Baglivio et al. (2016) found that ACEs increase recidivism risk through child welfare involvement only (no direct effect found). Craig et al. (2019) found more ACEs were associated with greater likelihood of recidivism and that variables of substance non-use, attachments to conventional others and negative emotionality can contribute towards this.

The remaining four studies were higher in risk of bias, having a mixture of high and low ratings for domains (Baglivio et al., 2015; Basto-Perreria et al., 2016; Brown & Shillington, 2017; Hall et al., 2018). Baglivio et al. (2015) and Basto-Perreria et al. (2016) found that those with more ACEs offended earlier in life, were more likely to be sex trafficking and specific ACEs of physical abuse, sexual abuse, parental separation/incarceration were predictors of delinquency; selection bias was high for both. ACE measurement was rated high bias for Baglivio et al. (2015) and offending measurement was high for Basto-Perreria et al. (2016) which are the two key variables in the ACE-offending relationship.

Brown and Shillington (2017) and Hall et al. (2018) were only low bias for design and analysis plan and conflict of interest, with more ACEs associated with more delinquent

acts and ACEs interacting with number of out-of-home placements to increase sexually abusive behaviour risk. ACEs appear to increase the risk of offending, but the high risk of bias present in four studies limits the ability of the review to answer the question.

2. Is there unique variance associated with ACEs and offending?

Evidence for an ACE-offending relationship was found across studies; they explored a range of potential contributory factors including welfare involvement, relationships and psychological constructs.

Welfare involvement and out-of-home placement were evaluated by Baglivio et al. (2016) and Hall et al. (2018) which could be considered as similar variables. Baglivio et al. (2016) found ACEs increased offending risk through child welfare and Hall et al. (2018) found a significant interaction between ACEs and number of out-of-home placements on offending. Baglivio et al. (2016) was a low bias study with only measurement of ACEs rated high, therefore greater confidence can be placed in these findings. Hall et al. (2016) was higher in bias with only design and analysis plan and conflict of interest rated low.

Two papers considered whether relationships were protective factors for those offending who had experienced ACEs (Brown & Shillington, 2017; Craig et al., 2017 of the Craig et al., 2019 study). Mixed evidence was found for this variable as Brown and Shillington (2017) found that protective adult relationships did not moderate the ACE-offending relationship, whereas Craig et al. (2017) found that attachments to conventional others were protective for risk of offending in those who had five ACEs or less. Brown & Shillington (2017) was high risk of bias with only design and analysis plan and conflict of interest rated low, which limits conclusions made whereas Craig et al. (2017) was low risk of bias overall.

Craig (2019) and Wolff and Baglivio (2017) evaluated the psychological constructs of future orientation and negative emotionality, both were papers from the Craig et al. (2019) study which was low in bias. Future orientation was not a mediator in the ACE-offending relationship whereas an indirect effect was found for negative emotionality. Craig et al. (2019) explored substance use and found this was a moderator between ACEs and offending in those with higher levels of substance use. Unique variance may not be present between ACEs and offending.

3. Does brain injury increase risk of offending in people with ACE history?

No included article collected data on TBI and none included this as a variable in analyses of the ACE-offending relationship.

4. Are ACEs associated with particular types of offending?

Two studies focused on sexual offending. Naramore et al (2017) used the data from a larger study (Baglivio, et al., 2015) to investigate sexual trafficking offences and Hall et al. (2018) had an exclusively sexual offending sample of male adolescents who had engaged in sexually abusive behaviour. Both studies found evidence of an ACE-offending relationship, although Hall et al. (2018) found that alongside ACEs, out-of-home placement and placement instability were associated with risk of sexually abusive behaviour therefore other factors could contribute towards this relationship. Both studies were rated as high in risk of bias for measurement of ACEs and offending which are key in evaluating evidence of this relationship. Hall et al. (2018) was also high in risk of bias for methods to control confounding which further limits confidence in the findings.

Table 2. Risk of Bias Ratings

	Selection bias	Design specific bias	Methods for assessing ACE	Methods for measuring offending characteristics	Methods to control confounding	Design and Analysis plan	Conflicts of Interest
1. Baglivio et al. (2016)	LOW	LOW	HIGH	LOW	LOW	LOW	LOW
2. A) Baglivio et al. (2015) B) Naramore at al. (2017)	HIGH	LOW	HIGH	HIGH	LOW	LOW	NR
3. Basto-Perreria et al. (2016)	HIGH	HIGH	LOW	LOW	HIGH	LOW	LOW
4. Brown & Shillington (2017)	HIGH	HIGH	HIGH	HIGH	HIGH	LOW	LOW
5. Craig et al. (2019) A - E*	HIGH	LOW	HIGH	LOW	LOW	LOW	LOW
6. Hall et al. (2018)	HIGH	HIGH	HIGH	HIGH	HIGH	LOW	LOW

*A) Craig et al. (2019) **B)** Craig et al. (2017) **C)** Craig (2019) **D)** Wolff & Baglivio (2017) **E)** Wolff, Baglivio & Piquerio (2017)

Table 3. Summary of Included Papers

Citation	Sample	Design	ACE Exposure Measure	Offending Characteristics Measure	ACE-Offending Relationship
1. Baglivio et al. (2016)	N = 12, 955 Ethnicity = 54% Black Gender = 85% Male Age at release = 17	Cross-Sectional between groups.	ACE 10 score from C-PACT assessment.	Recidivism measured as referral or arrest within one year of release from official records.	*Mediator*: child welfare involvement in the last 5 years. ACEs are found to have an indirect effect on recidivism through child welfare exposure in the last five years using structured equation modelling (SEM) (coefficient = 0.009, p<0.05). No direct effect was found.
2. A) Baglivio et al. (2015) **B) Naramore et al. (2017)**	N= 64,329 Ethnicity = 47% Black Gender = 79% Male Age at offence = 7 - 17 B) N= 102 sexually trafficked. Ethnicity= 53% Black Gender= 16% Male Age at offence = <18	Cross-sectional between groups.	ACE 10 score from C-PACT assessment.	A) Official records used to determine whether a juvenile was arrested at each age under 18. B) Identified whether youths had violated sexual trafficking violations.	A) Youths who began offending at an earlier age, had a greater number of ACES, when relevant risk factors are controlled for (p<0.01, OR =1.053) B) The odds of being adjudicated for sex trafficking were 3.27 times higher for youth with a high-risk (i.e., greater than 4) ACE score (p <0.05).

3. **Basto-Perreria et al. (2016)**	N= 69 Ethnicity= 64% White Gender= 91% Male Age at offence= 12-15 N=69 matched controls	Cross-sectional between groups	Portuguese version of ACE questionnaire using self-report.	Self-report of crime in the last 12 months and in lifetime assessed using the D-CRIM. Official records screened for number of convictions and type/date of crime.	Results of logistic regression indicated that physical abuse (OR = 4.17), sexual abuse (OR = 4.51), parental divorce/separation (OR = 2.74) and incarcerated household members (OR = 7.99) were significant predictors of juvenile delinquency. The model was statistically significant, $p < 0.001$.
4. **Brown & Shillington (2017)**	N= 1054 Ethnicity= 38% White Gender= 55% Female Age at assessment= 11-17	Cross-sectional	ACE 10 score data from multiple sources.	Denver Youth Survey (delinquency self-report tool).	*Moderator:* Positive adult relationships More ACEs associated with more delinquent acts, $p < 0.001$, IRR = 1.24. (Binomial Regression). Protective adult relationships did not moderate this association.
5. **A) Craig et al. (2019)** **B) Craig et al. (2017)** **C) Craig (2019)**	N= 28,169 Ethnicity= 46% Black Gender= 77% male Mean age at release= 17	Cross-sectional	ACE 10 score from C-PACT assessment.	Official Records Recidivism = re-arrest within one year of youth completing community-based placement. Reconviction = within one year of completing community-based placement.	A) *Moderator*: substance non-use. ACEs exerted a significant positive effect on both re-arrest and recidivism among youth who fell within the bottom 10% of the substance abuse buffer score (e,g highest level of substance use) ($p < 0.01$). OR re-arrest = 1.019; OR reconviction = 0.026. B) *Moderator*: attachments to conventional others Compared to those with weaker bonds, those with stronger bonds are protected from re-arrest when they have experienced 5

D) Wolff & Baglivio (2017) **E) Wolff, Baglivio & Piquerio (2017)**					or less ACES. Greater number of ACEs still increases odds of rearrest, regardless of social bonds. Strongly bonded OR= 1.10, Weakly bonded OR= 1.05. (p <0.001) C) *Mediator*: future orientation. Those with more ACEs were still more likely to be rearrested when future orientation was added to the model (OR = 1.03, p < .001.) Future orientation did not mediate the relationship between ACE and rearrest. D) *Mediator*: negative emotionality ACEs had a significant direct effect on recidivism (coefficient=0.14), as well as a significant indirect effect through negative emotionality (coefficient=0.14) with a total effect of coefficient 0.28 (p < 0.05). E) An additional ACE was associated with a shorter time to failure, when the commonly considered risk and demographic factors are considered (Hazard ratio =1.022, p < 0.01)
6. **Hall et al. (2018)**	N= 120 Ethnicity= 88 % Caucasian Gender= 100% male Mean age= 14	Cross-sectional	ACE 10 score generated from file.	Age at first reported sexually aggressive and/or sexually abusive behaviour documented in file.	*Mediator*: Number of out of home placements and age these occurred at. The interaction between ACEs and number of placements on risk of sexually abusive behaviour onset was significant (OR = .95, p < 0.05).

C-PACT=Positive Achievement Change Tool; ACE=Adverse Childhood Experience; OR=Odds Ratio; D-CRIM=Self-Report Delinquency and Crime Measure; IRR=Incident Rate Ratio

Discussion

There are relatively few published studies exploring the ACE-offending relationship. Furthermore, some studies in this area have originated from a small number of research groups. Studies were combined for analysis because of overlapping samples and three of the studies originate from the same research group. Of the six reviewed, only two studies were low risk of bias (Baglivio et al., 2016; Craig et al., 2019). This weakens the ability of this review to effectively answer research questions with confidence.

1. Do ACEs increase risk of offending?

Risk of bias was high across articles for measurement of the key ACEs variable with only one study (Basto-Perreria et al., 2016) collecting ACEs through self-report, which was the standardised method of capturing them in the original Felitti et al. (1998) study. One article used self-reported offending only (Brown and Shillington, 2014) and studies measured varying offending characteristics of recidivism, time to recidivism, age at arrest and delinquent behaviour which were difficult to synthesise. Three studies (Baglivio et al., 2015; Baglivio et al., 2016; Craig et al, 2019) extracted ACE scores from the C-PACT tool which is not its original purpose and may not provide a valid ACE score. However, most studies accounted for confounding variables in their analyses to rigorously evaluate the ACE-offending relationship, which provides greater confidence in the findings.

The two low bias studies (Baglivio et al., 2016; Craig et al., 2019) found evidence of an ACE-offending relationship, indicating child welfare involvement, substance use and negative emotionality also contribute towards it. Baglivio et al. (2016) did not find a direct effect of ACEs on offending; only indirectly through child welfare. Those with child

welfare involvement could be the offenders with the most difficult backgrounds; which may account for the relationship between ACEs and offending. Studies that were higher in bias also found evidence for the ACE-offending relationship, however they should be considered with their limitations in mind (Baglivio et al., 2015; Basto-Perreria et al., 2016; Brown & Shillington, 2017; Hall et al., 2018). ACEs were associated with offending earlier in life, sex trafficking, delinquent acts and to interact with out-of-home placements to increase risk of sexually abusive behaviour. Only one study analysed the effect of specific ACEs on offending and found the most significant effect for those with family members who were incarcerated (Basto-Perreria et al (2016). Juveniles who observe household members being incarcerated could themselves be at greater risk of offending. However, this study did have domains high in risk of bias as it was a small convenience sample and only had ACEs themselves in the statistical models.

The findings of this review could have been affected by differences in criminal justice systems. Five out of the six included studies were set in the USA therefore the implications of this may not be substantial. The remaining study was set in Portugal where the minimum age of criminal responsibility is 16 which differs from the USA where it ranges from age 7-14 depending on the state (Papadodimitraki, 2016; Child Rights International Network, 2011). In considering age of criminal responsibility in the UK where this review was conducted (although no reviewed study was UK based), this also varies from age 10 in England and Wales to age 12 in Scotland (GOV.UK, 2019; Age of Criminal Responsibility (Scotland) Act, 2019).

Overall, there is some evidence for ACEs increasing the risk of offending, but further research is required given the high risk of bias in published studies and the small number of research groups involved.

2. Is there unique variance associated with ACEs and offending?

The ability of this review to examine unique variance in the ACE-offending relationship is limited by high bias present in four of the included studies and overlapping samples from similar research groups in Florida. It was also difficult to synthesise information across studies to determine whether unique variance exists because they explored a range of different factors that could account for variance.

Child welfare involvement, out of home placement and substance use appear to account for variance when considering the impact of ACEs on offending, but high risk of bias existed in some of these studies (Baglivio, et al., 2016; Hall et al., 2018; Craig et al., 2019). Greater confidence in the effects of child welfare involvement and substance use on the ACE-offending relationship exists as they were low bias studies overall; only ACE measurement was the common high risk of bias domain between them. Craig et al. (2019) was also rated high for selection bias as they had excluded several offenders. Hall et al. (2018) found that out-of-home placement interacted with ACEs to increase offending. However, this was a high bias study, so conclusions about the role of this variable are limited.

Mixed evidence was found for the role of relationships and psychological constructs on ACEs and offending (Brown & Shillington, 2017; Craig et al., 2017, Craig, 2019 and Wolff & Baglivio, 2017 of the Craig et al., 2019 study). The Craig et al. (2019) study was low bias and allows greater confidence in findings of a role of attachment to conventional others and negative emotionality in an ACE-offending relationship. Future orientation was not found to mediate the ACE-offending relationship. Brown and Shillington (2017) found that positive adult relationships did not moderate the relationship and it was a high bias study.

Understanding what contributes towards youth offending is complex and multi-factorial (Williams et al., 2018). Offenders are a multi-morbid population, with many factors influencing offending risk, one of which may be ACEs.

3. Does brain injury increase risk of offending in people with ACE history?

No articles that considered TBI as a potential factor in an ACE-offending relationship were found. TBI and ACEs are prevalent in offending populations (Farrer et al., 2013; Baglivio et al., 2014). Recent research has found an association between ACEs and TBI in non-offending adults; those who had four or more ACEs had significantly greater odds of reporting TBI than respondents with no ACEs (Guinn et al., 2018). It is possible that TBI could explain the relationship between ACEs and offending, as risk of offending may increase after HI (Schwartz, 2019) and TBI could be a potential cause of violent crime (Williams et al., 2018).

4. Are ACEs associated with particular types of offending?

Two articles in this review investigated the relationship between ACEs and sexual offending (Naramore et al., 2017; Hall et al., 2018). Both were rated high risk of bias for measurement of ACEs and offending which limits the conclusions made. Hall et al., (2018) used a convenience sample and was rated high for risk of bias for methods to control confounding as potentially associated variables with offending were not included.

Although bias was present, both studies found evidence for an ACE-offending relationship. Naramore et al. (2017) found that the odds of being involved with sex trafficking were higher for youth with more ACEs. No mediator in this relationship was tested. Hall et al., (2018) investigated mediators in the ACE-offending relationship. These

were of out-of-home placement and age placement occurred at which yielded a significant interaction of ACEs and number of placements on the risk of sexually abusive behaviour. Such placements could be an important consideration when evaluating the ACE-offending relationship in sexual offenders. ACEs and sexual offending could be associated, but further low risk of bias research is required to strengthen confidence in its existence.

Limitations

A limitation of this review is that one researcher defined the inclusion/exclusion criteria, conducted the searches and selected the studies. Studies were limited to English language only as there was no access to a translator. One study used data from the second wave of the 'National Survey of Child and Adolescent Well-Being' (NSCAW II) sample, which is a child maltreatment population (Brown & Shillington, 2017). This population was included as the review focused on difficult childhood experiences which those participants have experienced and are common in offending populations and central to the research questions.

The concept of ACEs has been criticised; it can be viewed as simplistic in its approach to capturing early life events and can be prone to measurement error through retrospective self-report (Kelly-Irving & Delpierre, 2019). Several studies were excluded from this review as they did not report data on the original ten ACEs. This review aimed to examine the cumulative effect of those ACEs, rather than specific experiences.

Three studies were rated as high risk of bias for measurement of ACE and offending statistics. This does restrict the ability of the review to answer the research questions.

Effect sizes were not reported using the same methodology across the studies which made it difficult to quantitively analyse the results.

Recommendations for Future Research

Further large-scale research conducted with ACE data extracted from interview and offending characteristics using official records would allow more reliable conclusions to be made about the ACE-offending relationship. As there is not unique variance associated with the ACE-offending relationship, it is possible that other factors could explain this, which have not been examined; one of these is TBI. Further research exploring the ACE-offending relationship in sexual offenders would be useful in evaluating potential differences between offence types with non-offending control groups.

Conclusions

Low risk of bias studies suggest that ACEs are associated with increased offending and that child welfare involvement, substance non-use, attachments to others and negative emotionality can also contribute towards this relationship. Further research could explore the role of TBI and sexual offending in the ACE-offending relationship. Health and social care professionals working with this population should be aware of this relationship in managing future health and offending risk.

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Chapter Two: Major Research Project

Persisting Disability After Head Injury in Juvenile Prisoners

Chapter word count: 6,751

Prepared in accordance with manuscript guidelines for the Journal of Head Trauma

Rehabilitation (Appendix 2.1).

Plain English Summary

Title:

Persisting Disability After Head Injury in Juvenile Prisoners.

Background:

Head Injury (HI) is common in young offenders (Farrer & Hedges, 2011), but disability after HI in prisoners is not clear (Moynan & McMillan, 2018). Preliminary studies on adult male prisoners found that more severe HI is associated with greater disability, anxiety and cognitive difficulties (Walker, 2017). An investigation of persisting disability in juvenile prisoners with HI has not been conducted previously; this study will aim to provide this.

Aims and Questions:

1. To explore the relationships between prisoners with a HI history and disability in juvenile prisoners.

2. To explore whether HI is related to disability when other potentially related factors are accounted for.

3. To explore the relationships between HI and offending characteristics.

Methods:

Male offenders aged 16-25 in Polmont Young Offenders Institution were recruited using posters. Assessment of personal and offending history, HI, cognitive function, mental health, drug/alcohol use and disability were carried out. Prison officers were interviewed to gather information on the offender's disability. Offenders were categorised into No/mild HI, Multiple HI or Moderate-Severe HI for analysis.

Main Findings and Conclusions:

Juvenile prisoners with more severe HI history (categorised as Multiple HI) had greater disability, substance use, mental health problems, adverse life events and poorer executive functioning than those with no/mild HI. Number of convictions and prison incidents were also higher in those with more severe HI. When more severe HI was analysed with other variables to determine their effect on disability/executive functioning, only a PTSD screening tool cut-off score was significant. This result could be due to those with HI making self-report errors on PTSD questionnaires or could be because prisoners do not refer to PTSD symptoms alone when answering the questions.

Limitations of this research include reliance on self-report. Trauma is an important consideration for staff delivering care and managing offending risk in young offenders' institutions as a screening measure for PTSD was the best predictor of disability and dysexecutive functioning. In conclusion, HI is prevalent in this population and should be recognised as being related to poorer health outcomes.

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Abstract

Background

The prevalence of head injury (HI) in juvenile offenders is estimated to be 30%, however no studies report disability after HI in prisoners. Furthermore, a recent Doctoral thesis found that adult offenders with a history of moderate-severe HI were more likely to experience disability, cognitive impairment, and anxiety than those with a mild HI history.

Aims

To explore disability, health-related outcomes and offence characteristics associated with HI in juvenile prisoners in Scotland.

Methods

HI, mental health, trauma, substance use, cognitive function and offending history were assessed in 78 male juvenile prisoners in HMYOI Polmont.

Results

Compared with No/Mild HI, Multiple HI (as defined by the Ohio State University Traumatic Brain Injury Identification Method) was associated with greater substance use, poorer mental health, slower information processing, more violent convictions and prison incidents. Disability and self-report of dysexecutive functioning were associated with Multiple HI in univariate analysis. Regression indicated that a PTSD screening score and not HI group, ADHD, problematic alcohol/drug use, adverse childhood experiences, age or education predicted outcomes.

Conclusions

Multiple HI was highly prevalent in juvenile prisoners and had associations with disability, dysexecutive difficulties and offence characteristics. A PTSD screening score was the only significant predictor of disability and dysexecutive difficulties. Those who

score above the cut-off on the PTSD screening tool may not be referring to PTSD symptoms alone; clinical interview would be required for PTSD diagnosis. Staff working with juvenile prisoners should be aware of the impact of HI and trauma on their health and offending risk.

Introduction

Lifetime prevalence of head injury (HI) in prisoners is higher than in the general population (Farrer & Hedges, 2011). Furthermore, a meta-analysis reported that 30% of young offenders had a HI history (Farrer, Frost & Hedges, 2013). A Scottish Government report made several recommendations in relation to service development for prisoners with brain injury. These included estimating the occurrence of disability associated with HI (NPHN, 2016). A recent systematic review found that there are no studies on the prevalence of disability after HI in prisoners (Moynan & McMillian, 2018). Walker (2017) explored disability after HI in adult males in a Scottish prison and found greater HI severity was associated with greater disability, anxiety and cognitive difficulties. No similar work has been conducted in juveniles.

HI can have persisting effects on cognition, emotions and behaviour (Rabinowitz & Levin, 2014). Mental health problems and substance misuse are common (Ponsford et al., 2007; Whelan-Goodinson et al., 2009). Given the complex relationships between HI, cognitive deficits, mental health, substance use and disability, offenders with HI history can have a multi-morbid presentation (Walker, 2017). In addition, prisoners have higher prevalence rates of PTSD than the general population, indicating that significant trauma histories can be present (Goff et al., 2007). Traumatic events can often occur early in life in prisoners, with one study reporting that 39% of adults who had four or more Adverse Childhood Experiences (ACEs) before the age of 18 (categorised as abuse, neglect or household dysfunction) had spent time in prison compared to 4% who reported none (Public Health Wales, 2015).

Prisoners with HI have a higher risk of offending, younger age of entry into custodial systems and higher rates of repeat offending (Williams, et al., 2018). Offenders with HI are admitted to custody more times and spend longer in custody than offenders without HI (Durand et al., 2016). However, it is difficult to determine whether HI is a casual factor for offending or whether risk of HI is higher because of offending behaviour (Williams et al., 2018). Early life factors contribute towards an increased risk of HI and of offending. A birth cohort study identified that more adverse life events and a punitive parenting style were risk factors for childhood HI (McKinlay et al., 2010). Similarly, male offenders had four times more ACEs than a non-offending sample (Reavis et al., 2013) and a meta-analysis reported relationships between hostile and rejecting parenting styles and delinquency (Hoeve et al., 2009). Age at injury may be particularly important in determining relationships between offending and HI because global and severe deficits in executive functioning can be found after childhood HI (Anderson et al., 2010), with subsequent difficulties in inhibiting behaviour that can be associated with increased aggression (McMillan & Williams, 2017).

This study investigates associations between HI history, disability and associated difficulties in male juvenile prisoners.

Aims and hypotheses

Aims

1. To determine the occurrence of disability in juvenile prisoners with HI.

2. To ascertain whether there is unique variance associated with HI and disability after accounting for other potentially related factors.

3. To explore relationships between HI and offending characteristics.

Hypotheses

1. Juvenile prisoners with multiple HI or moderate-severe HI (i) are more disabled ii) have poorer cognitive function iii) have a history of greater alcohol and drug use iv) have mental health difficulties and traumatic backgrounds more often than male juvenile prisoners with no/mild HI.

2. There will be unique variance associated with HI and disability.

3. Juvenile prisoners with multiple HI or moderate-severe HI have more convictions overall, more convictions for violent offences and more prison incidents.

Methods

Ethics

NHS Research Ethics (18/WS/0210) and Scottish Prison Service (SPS) Ethics (Appendix 2.2) approved the project.

Design

A between-subject, quantitative, cross-sectional design, comparing juvenile prisoners
with no/mild HI against those with multiple HI or moderate-severe HI on the primary
outcome measure (disability) and other outcome measures.

Participants

The participants were male juvenile prisoners at Her Majesty's Young Offenders
Institution (HMYOI) Polmont.

Inclusion Criteria

- male juvenile prisoners (with/without HI)

- 16-25 years

- fluent in English

- had capacity to consent

- had no significant communication difficulties

- would not pose a significant risk to the researcher

Women were excluded because of potential differences in cause and comorbidity between
male and female prisoners and because it was anticipated that gender differences could
not be analysed because there are few juvenile women prisoners in Scotland (McGinley
and McMillan submitted).

Procedure

The research team (JMcV and a research worker experienced in assessing HI and
disability in offenders) attended mandatory SPS safety training prior to recruitment.

Participants were recruited using posters (advertising a well-being study to recruit a wide range of HI severity). Officers provided details of interested prisoners to the research team. The study was discussed with SPS staff to increase engagement with recruitment processes. This procedure was successful in a previous project at HMP Shotts (Walker, 2017). JMcV and the research worker conducted the interviews. The researchers observed the interview being conducted by each other (n=2) at the start of the study. Inconsistencies were resolved thorough discussion with the research worker and the chief investigator (Professor McMillan).

An information sheet was provided to juveniles (Appendix 2.3) before obtaining written informed consent. Each participant then completed the HI screen and measures described below. The interview lasted 60-120 minutes.

Each prisoner's personal officer provided written consent, and completed the Dysexecutive questionnaire (DEX), Glasgow Outcome Discharge Scale (GODS), and provided the number of prison incidents. Concerns about health or safety of participants were shared with NHS and SPS staff.

Measures

Head injury

The Ohio State University Traumatic Brain Injury-Identification Method (OSU TBI-ID, Bogner & Corrigan, 2009) assesses HI history. McGinley (2017) found it to be practical to use in prisons in Scotland. The OSU records information on the cause and severity of single-event and multiple HI.

Primary outcome measure: Disability. Duration: 10 minutes

The Glasgow Outcome at Discharge Scale (GODS) assesses disability outcome in people with HI nearing discharge from hospital (McMillan et al., 2013) and has been used with prisoners (McGinley, 2017). The GODS is based on the Glasgow Outcome Scale-Extended (GOS-E) which is for use with people with HI living in the community (Wilson, Pettigrew & Teasdale, 1998). The GODS has good predictive validity ($r= 0.51$) and high inter-rater reliability (98%; McMillan et al., 2013). GODS categories HI-related disability and disability from any cause.

Secondary outcome measures

These provide further information about specific difficulties arising after HI or other conditions.

Symbol Digit Modalities Test (Smith, 1982). Duration: 10 minutes

The test assesses information processing speed. Participants de-code symbols on a sheet which correspond to nine numbers. The number of correct answers in ninety seconds provides the score. It is sensitive to impairment after HI (Strauss et al., 2006).

Verbal Fluency Test (Benton, 1967). Duration: 4 minutes

This test assesses executive functioning and verbal ability. The participant has to name as many words as they can in 60 seconds beginning with the letters 'C', 'F' and 'L'. The participant then names as many animals as they can in 60 seconds. It is commonly used in HI samples (Zaninotto et al., 2014).

List learning (AMIPB sub-test, Coughlan & Hollows, 1985). Duration: 10 minutes

This test assesses verbal memory and learning. The participant immediately recalls 15 words read to them; the score is the total over 5 trials.

The Trail Making Test (Armitage, 1946). Duration: 10 minutes

This test assesses speed of processing and mental flexibility. There are two timed parts. The participant initially draws a line through escalating numbers. They then connect escalating numbers followed by an escalating letters.

The Word Memory Test (*WMT; Green, 2005*). *Duration: 20 minutes*

This test assesses effort and is recommended in forensic settings as there could be motivation to deceive (McMillan et al., 2009). It involves learning 20-word pairs, with 30-minute delayed recall.

The Hospital Anxiety and Depression Scale (HADS, Snaith & Zigmond, 1983). Duration: 5 minutes

Assesses symptoms of anxiety and depression. Whelan-Goodinson et al. (2009) found HADS to be reliable for detecting emotional distress in a HI sample.

Drug Abuse Screening Test (DAST-10, Skinner, 1982). Duration: 2 minutes

This 10-item questionnaire addresses drug use and has been used with HI samples (Ponsford et al., 2007).

The Alcohol Use Disorders Identification Test Consumption (AUDIT-C, Bush et al., 1998). Duration: 2 minutes

This three-item alcohol screen has been used with HI samples (Ponsford et al., 2007).

Dysexecutive Questionnaire (DEX, Wilson et al., 1996). Duration: 5 minutes

An assessment of everyday difficulties associated with executive problems (self and independent rated versions). It has high internal consistency, in excess of a=0.91 (Bennett, Ong & Ponsford, 2005).

Traumatic Life Events Questionnaire (TLEQ; Kubany et al., 2000). Duration: 10 minutes

This 21-item scale assesses exposure to traumatic events. It has been used successfully in a study on Scottish prisoners (Crowe, 2018).

The *PTSD Checklist of DSM-5 (Weathers et al., 2013; PCL-5). Duration: 5 minutes*

This self-report checklist assesses the 20 DSM-5 PTSD symptoms. It has been used successfully on Scottish prisoners (Crowe, 2018).

The Adverse Childhood Experiences (Felitti et al., 1998; ACEs) Questionnaire. Duration: 2 minutes

A ten-item questionnaire, where a 'point' is given for the occurrence of the ten experiences before age 18. It has been used with Welsh prisoners (Public Health Wales, 2015).

<u>*Demographic Background and Offending History*</u>

This was gathered using a proforma used in studies on HI and prisoners in Scotland (Walker, 2017; See Appendix 2.4). Postcodes were obtained from participants and social

deprivation was estimated using the Scottish Index of Multiple Deprivation (SIMD; Scottish Government, 2016).

Justification of Sample Size

The power calculation is based on the predictor variable of HI severity and primary outcome variable of disability. Walker (2017) recruited 83 participants using similar recruitment procedures to explore relationships between HI and disability in adult prisoners. Duration of LoC predicted anxiety, disability and cognitive impairment with medium effect sizes after controlling for factors that could be independently associated these outcomes. Data from Walker (2017) were used in power calculations.

For the first hypothesis, it was estimated that, n=88 are required to detect a medium effect (w=0.3) for disability with 80% power, α=0.05, with 1 degree of freedom, using chi-square (G*Power; Faul et al., 2009). For the second hypothesis, a medium effect (f^2=0.15) for disability (GODS) with alpha set as 0.05 and power at 0.8, n=85 was required, using multiple logistic regression with four variables. Given these estimates, a sample size of 90 was targeted.

Data Analysis

HI was categorised as 'No/mild HI', 'Multiple HI' or 'Moderate-severe HI' groups. Participants were considered to have Multiple HI if they had periods of "multiple repeated impacts to the head", as captured in Step 3 of the OSU-TBI (Bogner & Corrigan, 2009). A single HI with loss of consciousness (LoC) of over 30 minutes was considered moderate-severe HI (Blyth & Bazarian, 2010). As no participant had a single moderate-severe HI, analysis was carried out on No/Mild and Multiple HI groups only. Statistical

test assumptions were checked before each analysis with non-parametric tests used when appropriate. No test assumptions were violated for the regression analyses.

H1 and H2

Chi-Square was used to ascertain the relationship between HI group (No/mild vs Multiple HI) and disability.

Univariate statistics evaluated whether there were significant differences between HI groups for outcome measures. A composite mean z score was calculated for cognitive tests for each participant with effort evaluated separately. Significant results were analysed further using regression.

H3

Chi-Square investigated relationships between HI severity (No/mild HI and Multiple HI) and offending characteristics (violent or not violent offence history, number of convictions and number of prison incidents).

Results

Demographics

Of 78 participants, JMcV interviewed 54 and the research worker 24. Most were Caucasian (94%) and were convicted prisoners (53%). The median age was 19 and years of schooling 10. Specialist schooling or individual support had been provided for 55%

and truanting was common (72%). Unemployment or being recently employed in elementary occupations was reported by 36% of the sample and 55% previously lived in the most deprived areas in Scotland. Appendix 2.5 details demographic information for Multiple-mild and Moderate-severe HI groups.

Table 1. Demographics by HI Group

	No/Mild HI N=16	Multiple HI N=62
Age Median (Interquartile Range)	20 (19-21)	19 (18-20)
Years of Education Median (Interquartile Range)	11 (10-11)	10 (9-11)
Scottish Index of Multiple Deprivation (SIMD 2016) N (%) 1 High 2 3 4 5 Low*	8 (50) 4 (25) 1 (6) 1 (6) 2 (13)	35 (59) 11 (19) 5 (9) 5 (9) 3 (5)

*Missing N=3 with English postcodes

Forensic History

Overall, the median number of self-reported convictions was 4, with violent convictions being common (86%). Relatively few prisoners reported convictions for sexual offences (9%). The median age of first offence was 14. Most reported involvement in a prison incident during their current sentence (76%); the median number of prison incidents was 2, with 86 being the largest value.

Table 2. Forensic History by HI Group

	No/Mild HI N=16	**Multiple HI N=62**
Number of Convictions Median (Interquartile Range)	3 (1-4)	4 (2-10)
History of Conviction Type N (%)		
Violent	11 (69)	56 (84)
Sexual	2 (13)	5 (8)
Property	6 (38)	43 (69)
Other	9 (56)	34 (55)
Age at First Offence Mean (S.D)	15 (3)	13 (3)
Number of Prison Incidents Median (Interquartile Range)*	1 (0-4)	4 (1-16)

*Missing N=1

Attention Deficit Hyperactivity Disorder (ADHD), Mental Health, Alcohol/Drug Use and PTSD

ADHD diagnosed in childhood was reported in 13 (17%). Twenty-six reported clinical anxiety (HADS score >10; 33%) and 10 clinical depression (13%). Self-reported problematic drug use was common (71%) and 42% reported problematic alcohol use. Twenty-seven (35%) were above the PCL-5 PTSD screening cut-off score (score =>33).

Table 3. ADHD Substance Use, HADS and PTSD

	No/Mild HI N=16	**Multiple HI N=62**
Problematic Alcohol Use N (%)	3 (19)	30 (48)
AUDIT-C Median (interquartile range)	8 (5-10)	10 (7-11)

Problematic Drug Use N (%)	7 (44)	48 (77)
DAST-10 Mean (S.D)	3 (3)	5 (3)
HADS- Clinical Anxiety N (%)	1 (6)	25 (40)
HADS- Clinical Depression N (%)	0 (0)	10 (16)
PCL-5- PTSD N (%)*	0 (0)	27 (44)
ADHD diagnosed in Childhood (<16); N (%)	3 (19)	10 (16)

*Missing N=1

Seventy-two participants (92%) reported at least one ACE with 49% above the cut-off of four ACEs or more (Felitti et al., 1998).

On the TLEQ, the median number of traumatic events was 7; and the median 'severe' scores was 3. Severe score was captured by asking if they experienced fear helplessness or horror after each event. Interpersonal trauma was defined as presence of traumatic events involving others and was common (86%). Death of a friend/loved one (89%), witnessing assault (76%) and receiving threats of serious harm (74%) were prevalent. Appendix 2.6 details TLEQ event frequencies.

Table 4. ACE and Trauma History

	No/Mild HI N=16	Multiple HI N=62
ACE Mean (S.D)	2 (2)	4 (3)
TLEQ Median Number of Events (Interquartile Range)	4 (3-6)	7 (5-9)
Severe Scores Median (Interquartile Range)	1 (1-2)	3 (1-5)
Interpersonal Trauma N (%)	9 (56)	58 (94)

Cognitive Impairment

The mean composite z-score was -0.003. For individual tests, mean SDMT, list learning and letter fluency scores were > 1SD below the normed mean and category fluency equalled the normed mean (where possible matched for age; Table 5). The time taken in

TRAILS B was twice that of the population norm. This suggests abnormality in 39 participants overall (composite score) and in 41, 65 and 50 for SDMT, list learning and letter fluency respectively. The mean DEX-self score was overall above the cut-off of 28, indicating dysexecutive difficulties (Pedrero-Perez et al., 2011) and above this cut-off in 50 participants. The median for the WMT Delayed Recall was above 'clear fail' (score of 33) and below the normed mean of 39.4 (S.D=2.4) for 'healthy volunteers' (Green, 2005); the latter applied to fifty-nine (76%) participants. Nine participants (12%) scored at or below the 'clear fail' cut-off of 33. Appendix 2.7 details the sources of the norms.

Table 5. Cognitive Test, DEX Sample Means

Measure	N	Sample mean (S.D) or median (interquartile range)	Normed mean (S.D) or median (range)	N below cut-off
Symbol Digit Modality Test	78	43.3 (10.38)	54.9 (12.31)[a]	41~
AMIPB List Learning	78	40.8 (9.2)	57.3 (7.6)[b]	65~
TRAILS A in seconds (median, interquartile range for sample, range for norm)	78	33.5 (25-40)	21.70 (12-57)[c]	39†
TRAILS B in seconds (median, interquartile range for sample, range for norm)	77	94 (67-121)	47 (29-95)[c]	62†
Category Fluency	77	19.8 (5)	19.8 (4.2)[d]	20~
Letter Fluency	77	27.6 (10.0)	39.9 (9.8)[e]	50~
DEX Self	78	34.1 (15.9)	22.1 (8.9)[f]	46^
DEX Independent	73	26.4 (16.9)	20.6 (10.5)[f]	27^
WMT Delayed (median, interquartile range for sample mean)	78	38 (35-39)	39.4 (2.4)[g]	9‡

~N 1 S.D < Norm Mean
^N 1 S.D > Norm Mean
†N below the 20th percentile in the norm sample
‡N below the 'clear fail' cut-off of 33. The mean and S.D are not used as the norm sample data presented in the WMT manual are not normally distributed (Green, 2005)
 a Kiely et al. (2014)

b Coughlan & Hollows (1985)

c Tombaugh (2004)

d Tombaugh et al. (1999)

e Ruff (1996)

f Chan (2001)

g Green (2005)

Head Injury

Two participants reported no HI and 14 mild HI without multiple HI; these comprised the 'No/mild HI' group (n=16). All 10 participants with moderate-severe HI had 'Multiple HI' and are included in that group (n=62). The median age at first HI was 9 years. Twenty-two participants (28%) had HI with LoC before age 15 and are considered as 'likely to have ongoing difficulties' using OSU TBI-ID criteria; differences between HI groups were non-significant (Fishers Exact Test; p=0.136). Cause of Multiple HI was 'fighting' for 79%. High deprivation was common across HI groups. Group differences in age, education and deprivation (Table 1) were non-significant.

HI and Offence Characteristics

Violent Offences

Fifty-six prisoners (90%) with Multiple HI had convictions for violent offences and eleven (69%) with No/Mild HI. As one cell had an expected count less than 5, Fishers Exact Test is reported (p=0.042; Cramers V= 0.25).

Prison Incidents

The data were not normally distributed. Median prison incidents for Multiple HI (3) was higher than those with No/Mild HI (0.5), U= 665.6, z= 2.27, p=0.023, r=0.3 (N=1 missing).

Convictions

The data were not normally distributed. Median number of self-reported convictions was higher for Multiple HI (4) than for No/Mild HI (2.5), U= 679.5, z=2.29, p=0.022, r=0.3 (N=1 missing).

Disability

Overall, 39 participants were rated as disabled (Upper moderate-Lower severe) using disability attributed to any cause, as the multi-morbid presentation of participants made it difficult to attribute disability to head injury only. One participant was who was not disabled, was excluded because they reported no HI and no other illness to recover from.

Table 6. GODS Any Cause Disability Rating by HI Group

	No/Mild HI	Multiple HI	TOTAL N(%)
Lower SD	1	5	6 (8)
Upper SD	1	3	4 (5)
Lower MD	0	4	4 (5)
Upper MD	2	23	25 (33)
Lower GR	9	24	33 (43)
Upper GR	2	3	5 (7)
TOTAL N (%)	15 (20)	62 (81)	77 (100)

Univariate Analyses of HI Group by Outcome Variables

HI group (No/mild or multiple) was the primary predictor and was analysed for all outcomes. There was a significant association between HI group and Good Recovery/Disabled (X^2 (1)= 4.29, p<0.047). The odds of being categorised as disabled were 3.6 times higher in the Multiple HI group.

Table 7. Any Cause Disability by No/Mild HI and Multiple HI Group

	Good Recovery	Disabled	TOTAL N (%)
No/Mild HI	11 (73)	4 (27)	15 (20)
Multiple HI	27 (44)	35 (57)	62 (81)
TOTAL N (%)	38 (49)	39 (51)	77 (100)

On the cognitive measures, group differences were only significant for the SDMT, with the Multiple HI group performing more poorly (U=278, p=0.007, r=-0.3). The composite cognitive score was not significant (p>0.05, r=0). Prisoners with multiple HI had higher scores on the DEX-self (t{76}=-4, p<0.001, r=0.5) and not the DEX-independent (p>0.05, r=0). The WMT was not significant between groups (p>0.05, r=0.3).

Multiple HI had higher scores for Anxiety (t{76} =-3.9, p<0.001, r=0.5), and Depression scores (t{52.78}=-5.6, p<0.001, r=0.5) and PCL-5 (t{48.43} =-6.1, p<0.001, r=0.6). More traumatic events (TLEQ total; U=776.5, p<0.001, r = 0.4) and ACEs (t{76} =-2.4, p=0.02, r=0.3) were reported by the Multiple HI group. The Multiple HI group had higher scores for alcohol (AUDIT-C; U=679.5, p=0.02, r=0.3) and drug use (DAST; t{76}=-2.5, p=0.01, r=0.3). Appendix 2.8 details all test results

Multivariate Analyses

Significant results in the univariate analyses, were used to model Good Recovery/Disability outcomes using logistic regression. HI group was entered as a predictor with ADHD, DAST, AUDIT, ACE, PTSD as categorical cut-off variables and co-variates of age and years of education. Logistic regression assumptions were checked; none were violated.

The model was significant (X^2 (8) =27.8, p=0.001), and explained 40% (Nagelkerke R^2) of the variance in disability, correctly classifying 75% of cases. Only PCL-5 cut-off was a significant predictor (p=0.001); HI category did not have a significant association with disability when all the predictors were included. The odds of being categorised as disabled on the GODS are 10.7 times greater for those above the cut-off on the PCL-5 questionnaire.

Table 8. Logistic Regression: relationships between HI and Disability Outcome

Outcome: GODS Disability	OR	95% CI	p	Nagelkerke R^2
				0.40
Multiple HI Group	0.7	0.2-3.3	0.654	
ADHD Diagnosis	1.2	0.3-5.3	0.791	
DAST (cut-off =>6)	2.2	0.7-7.1	0.205	
AUDIT-C (cut-off =>4)	3.9	0.3-57.3	0.315	
ACES (cut-off =>4)	2.7	0.9-8.3	0.093	
PCL-5 (cut-off =>33)	10.7*	2.7-41.2	0.001	
Age	1.0	0.7-1.4	0.776	
Years of Education	1.0	0.7-1.7	0.576	

PCL-5=PTSD checklist for DSM-5; OR=Odds Ratio; CI=Confidence Interval

N=76 (1 missing PCL-5; 1 no illness to recover from)

*p<0.05

A multiple regression was used to model DEX-self as an outcome. Co-variates and other predictors remained as entered above; no assumptions were violated. The model was significant; $F(8, 68)=4.164$, p=0.001 (Table 10) and explained 25% (adjusted R^2) of the variance. PTSD cut-off was a significant predictor (p=0.001); HI group approached significance (p=0.068). Predicted DEX-self score for those above the cut-off on the PCL-5 is 12.2 greater than those without, holding all other variables at their reference values.

Table 9. Linear Regression analysing the relationship between HI Severity and DEX-Self score

Outcome: DEX Self	B	SE	p	Adjusted R^2
				0.25
Multiple HI Group	8.5**	4.6	0.068	
ADHD Diagnosis	0.2	4.4	0.972	
DAST (cut-off => 6)	6.2	3.5	0.076	
AUDIT-C (cut-off => 4)	-3.1	6.3	0.627	
ACES (cut-off => 4)	0.0	3.4	0.996	
PCL-5 (cut-off =>33)	12.2*	3.7	0.001	
Age	-0.7	1.1	0.536	
Years of Education	-1.6	1.3	0.21	

PCL-5=PTSD checklist for DSM-5; SE=Standard Error

N=77 (1 missing PCL-5)

*p<0.05

** p<0.1

Discussion

In 2018, 385 male prisoners resided at HMPYOI Polmont (HM Inspectorate of Prisons for Scotland, 2019). Seventy-five percent were aged 18-21 and 48% were convicted. Seventy-eight prisoners were interviewed for this study comprising about 20% of the population and seem representative, with the average age being 19 and 53% convicted.

HI and Multi-morbidity in Juvenile Prisoners

Multiple HI is very prevalent in Scottish juvenile prisoners (80%), with 'fighting' being a common cause. The association between more severe HI (Multiple HI) and poorer mental health, greater substance use and greater traumatic backgrounds has implications

for service need, however this is a multi-morbid population generally, with a high prevalence of self-reported problematic drug use (71%) and interpersonal trauma (86%). One third report clinical anxiety and score high on a PSTD checklist and have poor performance on cognitive tests compared to norms. Effort on tests was also below standardised norms, with 76% scoring below the normed mean of 39.4 in 'healthy volunteers' and 12% scoring at or below the 'clear fail' score. This could indicate that many of the participants were not putting in adequate effort when completing the task or it could be reflective of other difficulties such as ADHD, anxiety or their ability to recall words impacting on their performance. Walker (2017) similarly found that that adult male Scottish prisoners with more severe HI had greater anxiety, cognitive difficulties and disability and complex mental health needs in juvenile prisoners at HMPYOI Polmont has recently been highlighted (HM Inspectorate of Prisons for Scotland, 2019).

Univariate associations between Multiple HI and outcomes of disability and self-reported dysexecutive functioning did not remain significant when included in regression modelling with ADHD, drug/alcohol use, ACEs and PTSD screening. Only the last variable remained significant, indicating that the distress captured by PTSD screening has a large effect on outcomes.

Disability and Dysexecutive Functioning

The more common occurrence of disability after more severe HI (Multiple HI) is also consistent with Walker (2017), however, regression modelling in the present study suggests that disability and dysexecutive outcomes are explained by high scores on a PTSD checklist. Walker (2017) did not assess PTSD. Crowe (2018) carried out regression modelling in female prisoners with HI and found that high PTSD scores on the PCL-5 were associated with self-reported dysexecutive difficulties and not history of

multiple HI. High scores on a PTSD screening tool predict outcomes in female and juvenile offending samples.

Sumpter and McMillian (2006) found that non-prisoners with brain injury make self-report errors on PTSD questionnaires. This was attributed to several factors including symptom overlap between TBI and PTSD. As TBI, trauma and other MH conditions (anxiety) are prevalent in juvenile prisoners their occurrence may be attributable to more than one cause. Trauma and anxiety were common in the Multiple HI group and it is possible that the PTSD cut-off indicates high stress associated with trauma found in prisoners (Goff et al., 2007), but as McMillan and Sumpter (2006) and the authors of the PCL-5 (Weathers et al., 2013) indicate, semi-structured interview is required to ascertain whether PTSD is present. The checklist score could reflect symptom overlap between effects of HI or other conditions such as substance abuse or the more general distress found in prison populations.

Offence Characteristics

Compared to participants with No/mild HI, those with Multiple HI self-reported more violent offences and convictions and had more prison incidents as predicted. These results indicate greater HI severity could increase likelihood of offending. Research has indicated that TBI could be a risk factor for earlier, more violent, offending and that several factors can increase an individual's likelihood of committing crime alongside TBI (Williams et al., 2018). Another contributory factor towards offending could be recurrent fighting which was a common cause in those with Multiple HI. It is possible that there is a bi-directional relationship between HI, offending and other related factors whereby sustaining a HI could increase an individual's risk of offending and offending could increase the likelihood of sustaining a HI. Increased understanding of the relationship

between HI and offending could inform treatment programs designed to reduce recidivism and influence risk management tools, as HI is not an item on the HCR-20 (Douglas et al., 2013).

Limitations

Self-report was used for HI, trauma and criminal characteristics, which could be inaccurate. These methods were not corroborated with official hospital, social service or criminal records which could have increased the validity of these measures. The reliance on self-report is highlighted as a common limitation by O'Rourke et al., (2018) as one of the several challenges in conducting HI related research with juvenile prisoners. Schofield et al. (2011) found self-reported TBI in prisoners was generally accurate when compared to hospital records although this work requires replication.

Some prisoners were on remand (13%) and they were less likely to have long-term relationships with officers, potentially reducing the validity of the DEX-independent measure. There is also limited data available on the use of this questionnaire in juvenile prisoners.

Structured clinical interviews would be required for a PTSD diagnosis, which was not part of this study design. This limits the conclusions that can be made about the role of PTSD on outcomes in juvenile prisoners.

Multiple HI group was defined using step 3 of the OSU, which includes those who have never been dazed by HI. This grouping may have included participants with less severe effects of HI. Alternative definitions of greater HI severity may have produced different results.

Implications

Multiple HI is highly prevalent in this population and is associated with poorer health, cognitive and offending outcomes. The NPHN report (2016) recommends that research should estimate numbers with disability associated with HI. This study suggests that Multiple HI is associated with disability, but that its effects may be difficult to capture when distress related to trauma backgrounds are present. Prison healthcare staff could be provided with guidance on management of prisoners with Multiple HI and psychological interventions could be delivered to those with on-going cognitive difficulties.

Persisting effects of trauma are an important consideration in juvenile prisoners and could explain the relationship between HI and disability/executive functioning outcomes. SPS and NHS staff should be aware of the impact of trauma when providing care and managing future offending risk.

Future Directions

Large sample, longitudinal studies are needed to explore the causal relationships between trauma, disability and dysexecutive difficulties in juvenile prisoners. Further research is required to understand what contributes towards offending with corroboration of self-report measures with official records.

Conclusion

Multiple HI is highly prevalent in juvenile prisoners and has associations with disability, dysexecutive difficulties and offence characteristics. A PTSD screening score was the only significant predictor of outcomes when several confounding variables and HI were included in regression models. However, Sumpter and McMillian (2006) indicate self-

report errors can be made by those with HI and the PCL-5 may simply capture prisoner distress. Future longitudinal research in juvenile prisoners could provide further evidence for the role of HI in disability and offending. HI and trauma should be important considerations for staff providing care and managing offending risk of juvenile prisoners.

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Appendices

Appendix 1.1 Author Guidelines for Submission to Youth Violence and Juvenile Justice

Manuscript Submission to *Youth Violence and Juvenile Justice* (*YVJJ*)

All new manuscripts to *YVJJ* must be submitted using the SAGE track manuscript submission website. Please read below for instructions on submitting manuscripts to *YVJJ*.

Log onto the SAGE track manuscript submission website at http://mc.manuscriptcentral.com/yvjj and click on "**Create Account: New users click here.**"

Follow the instructions and make sure to enter your current and correct email address. Once you have finished creating a user account, your User ID and Password will be sent via email.

Submission of a New Manuscript

Log onto the manuscript central website and select "Author Center." Once at the Author Center, select the link "Click here to Submit a New Manuscript." Follow the instructions on each page. Once finished with a page, click on the "Save and Continue" option at the end of each page. Continue to follow the instructions for loading a new manuscript and/or other files at the appropriate stages (e.g., abstract, title page, etc.). When loading the manuscript file, make sure to use the "Browse" function and locate the correct file on your computer drive. Make sure to "Upload Files" when you are finished selecting the manuscript file you wish to upload. NOTE: All text files must be in word format and de-identified (please also remove any identifying information from the manuscript's properties before you upload the manuscript). The system will convert the submission to a PDF file.

After uploading your manuscript, review your submission in one of the provided formats (e.g., PDF). Once you have reviewed your submission, click on the "Submit" button. You should receive a submission confirmation screen and an email confirming submission. You can revisit the website at any time to review the status of your submission.

Submission of a Revised Manuscript

To submit a revised manuscript to *YVJJ*, log onto the SAGE track manuscript submission website at http://mc.manuscriptcentral.com/yvjj. Once at your **Author Dashboard**, view your "Manuscripts with Decisions" and select the option to "Create a Revision." Continue to follow the directions to upload your revised manuscript. Make sure to upload a de-identified version of your revision as with the initial submission. Also provide comments regarding changes that were made to your revised manuscript. These comments will be provided to reviewers.

Submission of a manuscript implies commitment to publish in the journal; simultaneous submissions are not acceptable.

All copy should be typed, double-spaced, and should follow the style of the *Publication Manual of the American Psychological Association* (5th ed.). Notes and references should appear at the end of the manuscript. Each manuscript should include a brief abstract of 100-150 words describing the subject, general approach, intended purpose of the article, and findings; include 4-5 keywords for indexing and online searching. Also, please supply a 2-3 line (within 50-75 words) bio for each author. Ordinarily, articles should be less than 35 pages in length. However, research notes should not exceed 15 pages.

Referees will evaluate submitted manuscripts anonymously. Therefore, potential contributors should send two electronic copies of the manuscript via e-mail, one copy that

includes a cover page giving the title, author(s), and author(s) affiliation and complete contact information, and a second electronic copy in which only the title of the paper is included as a means of identification.

Book Reviews: Books for review and book review manuscripts should be sent to Ashley G. Blackburn, Book Review Editor, *Youth Violence and Juvenile Justice,* University of North Texas, Department of Criminal Justice, Denton, Texas 76203.

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Appendix 1.2 Variables included in Statistical Models

Citation	Variables in Statistical Models
1. **Baglivio et al. (2016)**	i. Child welfare placement ii. Male iii. Black iv. Age at first offence v. Prior detention placements vi. Prior residential placements vii. Prior misdemeanours viii. Prior felonies ix. Substance abuse x. School conduct xi. Difficult temperament
2. **A) Baglivio et al. (2015)**	A) The effects that remained significant in the final model were: i. Gender ii. Race iii. Aggression iv. Situational Perception v. Special education vi. Substance use vii. ADHD viii. Mental health ix. Parenting, parenting authority and supervision x. School behaviour xi. Residential history
B) Naramore et al. (2017)	B) Potentially contributory factors in the models were: i. Sex ii. Age iii. Race iv. Age at first offence v. Being a runaway or kicked out of the home
3. **Basto-Perreria et al. (2016)**	Predictors in logistic regression model: i. emotional abuse, ii. physical abuse, iii. sexual abuse, iv. emotional neglect

	v. parental separation or divorce, vi. witnessing domestic violence vii. having an incarcerated household member
4. **Brown & Shillington (2017)**	Included in model: i. gender ii. ethnicity

5.
A) Craig et al. (2019)
 	
B) Craig et al. (2017)
 	
C) Craig (2019)
 	
D) Wolff & Baglivio (2017)
 	
E) Wolff, Baglivio & Piquerio (2017)
	A)
	Control variables entered into the logistic regressions were:
	   i. Gender
	  ii. Age at release
	 iii. Black
	 iv. Hispanic
	  v. Age at first offence
	 vi. Prior felonies
	 vii. Mental health
	viii. Antisocial peers
	 ix. Impulsivity
	B)
	Considered key confounding variables:
	   i. Gender
	  ii. Age
	 iii. Race
	 iv. Impulsivity
	  v. Antisocial peers
	 vi. Concentrated disadvantage
	C)
	Included control variables of:
	   i. Race/ethnicity
	  ii. Sex
	 iii. Age
	 iv. Socioeconomic status
	  v. Antisocial peer associations
	 vi. Impulsivity
	 vii. Social bonds
	viii. Criminal history
	 ix. Criminal attitudes
	
	D)
	Included as control variables:
	   i. Gender
	  ii. Age
	 iii. Race
	 iv. Individual risk factors
	
	E)

	Included as controlling variables in the model:
	   i. Age
	   ii. Gender
	   iii. Race
	   iv. Individual risk factors:
	   v. Personal history risk factors:

6.
Hall et al. (2018)
	Variables in logistic regression analyses (discrete-time survival analyses):
	
	   i. Four time points that aggression/behaviour could have occurred at
	   ii. Interactions between ACE x number of placements
	   iii. ACE x placed in time interval
	   iv. Number of placements x placed in time interval

ACE=Adverse Childhood Experience

Appendix 2.1 Author Guidelines for Journal of Head Trauma Rehabilitation

SCOPE

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

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

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

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

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

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

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

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

MANUSCRIPT SUBMISSION

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

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

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

Authors are strongly encouraged to consult relevant guidelines for research reporting found at <www.equator-network.org>. Authors have the option of uploading a completed checklist with page and line numbers indicated for each criterion met.

Unless an author has been invited by an issue editor to submit a manuscript for a topical issue, all original research should be submitted as "Unsolicited (Focus on Clinical Research)".

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

As of 2016, JHTR will accept brief reports that do not exceed 2000 words, 3 tables and/or figures and 15 references.

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

First-time users: Please click the Register button from the menu above and enter the requested information. On successful registration, you will be sent an e-mail indicating your user name and password. *Note:* If you have received an e-mail from us with an assigned user ID and password, or if you are a repeat user, do not register again. Just log in. Once you have an assigned ID and password, you do not have to reregister, even if your status changes (ie, author, reviewer, or editor).

Authors: Please click the Log-in button from the menu at the top of the page and log-in to the system as an Author. Submit your manuscript according to the author instructions. You will be able to track the progress of your manuscript through the system. If you experience any problems, please contact John D. Corrigan, PhD, Editor-in-Chief at corrigan.1@osu.edu.

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

Conflicts of Interest and Source of Funding: Author A has received honoraria from Company Z. Author B is currently receiving a grant (#12345) from Organization Y and is on

the speaker's bureau for Organization X—the CME organizers for Company A. For the remaining authors none were declared.

In addition, each author must complete and submit the journal's copyright transfer agreement, which includes a section on the disclosure of potential conflicts of interest based on the recommendations of the International Committee of Medical Journal Editors, "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" (www.icmje.org/update.html).

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

LWW AUTHOR'S MANUSCRIPT CHECKLIST FOR JOURNALS
Authors should pay particular attention to the following items before submitting their manuscripts:

Manuscript Preparation

- *JHTR* uses the *American Medical Association Manual of Style*, 10th edition.
- *JHTR* requires authors to use person-first language—avoid phrasing such as "the brain-injured participant"or the "TBI patient"and replace with "participant with a brain injury" or "patient with a TBI."
- Manuscripts should be line numbered in their original format (eg, Microsoft Word line numbering).
- Manuscripts should be double-spaced, including quotations, lists, references, footnotes, figure captions, and all parts of tables. Do not embed tables in the text.
- Manuscripts should be ordered as follows: title page, abstracts, text, references, appendices, tables, and any illustrations.
- To maintain a masked review process, it is the author's responsibility to make every attempt to mask all information in the manuscript that would reveal the identity of the author to the reviewer. This version of the manuscript is referred to as the "masked" manuscript when uploading documents.
- An accompanying cover letter should include attestations that (1) the work is original and has not been published or under review elsewhere; (2) all authors contributed to the work; and (3) the research was conducted consistent with ethical guidelines for the conduct of research.
- The cover letter should also summarize any conflicts of interest affecting any authors.
- Title page including (1) title of the article; (2) author names (with highest academic degrees) and affiliations (including titles, departments, and name and location of institutions of primary employment); (3) all possible conflicts of interest including financial, consultant, institutional, and other relationships that might lead to bias or a conflict of interest; (4) disclosure of funding received for this work including from any of the following organizations with public or open access policies: National Institutes of Health (NIH), National Institute on Disability Independent Living and Rehabilitation Research, Veterans Administration, Wellcome Trust, and the Howard Hughes Medical Institute; and (5) any acknowledgments, credits, or disclaimers.

- A structured abstract of no more than 200 words should be prepared. Authors should use telegraphic language where possible, including omission of introductory clauses. Headings should typically include the following: Objective, Setting, Participants, Design, Main Measures, Results, and Conclusion. The Conclusion section should encapsulate the clinical implications of the results, not merely restate the findings.
- Include up to 10 key words that describe the contents of the article such as those that appear in the Cumulative Index to Nursing and Allied Health Literature (CINAHL) or the National Library of Medicine's (NLM's) Medical Subject Headings (MeSH).
- There should be a clear indication of the placement of all tables and figures in text.
- The author is responsible for obtaining written permission for any borrowed text, tables, or figures.

References

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

Figures

A. Four Steps for Submitting Artwork

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

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

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

- Artwork saved as JPG, TIFF and EPS files. Do not save TIFFs as compressed files.
- Artwork created as the actual size (or slightly larger) than it will appear in the journal. (To get an idea of the size images should be when they print, study a copy of the journal. Measure the artwork typically shown and scale your image to match.)
- Crop out any white or black space surrounding the image.

- Text and fonts in any figure are one of the acceptable fonts: Helvetica, Times Roman, Symbol, Mathematical PI, and European PI.
- Color images are created/scanned and saved and submitted as CMYK only. Do not submit any figures in RGB mode because RGB is the color mode used for screens/monitors and CMYK is the color mode used for print.
- Line art saved at a resolution of at least 1200 dpi.
- Images saved at a resolution of at least 300 dpi.
- Each figure saved as a separate file and saved separately from the accompanying text file.
- For multipanel or composite figures only: Any figure with multiple parts should be sent as one file, with each part labeled the way it is to appear in print.

Remember:

- Artwork generated from office suite programs such as CorelDRAW, MS Word, Excel, and artwork downloaded from the Internet (JPEG or GIF files) cannot be used because the quality is poor when printed.
- Cite figures consecutively in your manuscript.
- Number figures in the figure legend in the order in which they are discussed.
- Upload figures consecutively to the Editorial Manager Web site and number figures consecutively in the Description box during upload.
- All electronic art that cannot be successfully uploaded must be submitted on a 31/2-inch high-density disk, a CD-ROM, or an Iomega Zip disk, accompanied by high-resolution laser prints of each image.

Tables Tables should be on a separate page at the end of the manuscript. Number tables consecutively and supply a brief title for each. Include explanatory footnotes for all nonstandard abbreviations. Cite each table in the text in consecutive order. If you use data from another published or unpublished source, obtain permission and acknowledge fully.

Supplemental Digital Content Authors may submit SDC that enhances their article's text to be considered for online posting. SDC may include standard media such as text documents, graphs, audio, video, etc. On the Attach Files page of the submission process, please select Supplemental Audio, Video, or Data for your uploaded file as the Submission Item. If an article with SDC is accepted, our production staff will create a URL with the SDC file. The URL will be placed in the call-out within the article. SDC files are not copyedited by LWW staff; they will be presented digitally as submitted. For a list of all available file types and detailed instructions, please visit the Checklist for Supplemental Digital Content.

SDC Call-outs: SDC must be cited consecutively in the text of the submitted manuscript. Citations should include the type of material submitted (Audio, Figure, Table, etc.), be clearly labeled as "Supplemental Digital Content," include the sequential list number and provide a description of the supplemental content. All descriptive text should be included in the call-out, as it will not appear elsewhere in the article.
Example:
We performed many tests on the degrees of flexibility in the elbow (see Video, Supplemental Digital Content 1, which demonstrates elbow flexibility) and found our results inconclusive.

List of Supplemental Digital Content: A listing of SDC items must be submitted at the end of the manuscript file. Include the SDC number and file type. This text will be removed

by our production staff and not be published.
Example:
Supplemental Digital Content 1. wmv

SDC File Requirements: All acceptable file types are permissible up to 10 MB. For audio or video files greater than 10 MB, authors should first query the journal office for approval. For a list of all available file types and detailed instructions, please visit the Checklist for Supplemental Digital Content.

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open access license for approved funders. Information about the approved funders can be found here: http://www.wkopenhealth.com/inst-fund.php

FAQ for open access

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

Appendix 2.2 Ethical Approvals

WoSRES
West of Scotland Research Ethics Service

NHS
Greater Glasgow and Clyde

West of Scotland REC 5
West of Scotland Research Ethics Service
West Glasgow Ambulatory Care Hospital
Dalnair Street
Glasgow
G3 8SJ

Miss Julia McVean
Trainee Clinical Psychologist
University of Glasgow
Institute of Mental Health and Wellbeing
Gartnavel Royal Hospital
Glasgow
G12 0XH

Date	12 December 2018
Direct line	0141 232 1809
E-mail	WoSREC5@ggc.scot.nhs.uk

Dear Miss McVean

Study title:	Persisting Disability as a Result of Head Injury in Young Offenders
REC reference:	18/WS/0210
Protocol number:	N/A
IRAS project ID:	246905

Thank you for your letter of 11 December 2018. I can confirm the REC has received the documents listed below and that these comply with the approval conditions detailed in our letter dated 28 November 2018.

Documents received

The documents received were as follows:

Document	Version	Date
Copies of advertisement materials for research participants [Recruitment Poster]	4	29 November 2018
Other [Response Letter to the REC]		11 December 2018
Participant information sheet (PIS) [Prisoner information sheet]	5	29 November 2018
Research protocol or project proposal [Research Proposal]	9.4	11 December 2018
Validated questionnaire [Benton's Verbal Fluency Test]		

Approved documents

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

Document	Version	Date
Copies of advertisement materials for research participants [Recruitment Poster]	4	29 November 2018
Interview schedules or topic guides for participants [Data Capture Form]	1	31 October 2018
IRAS Application Form [IRAS_Form_26102018]		26 October 2018

Other [Email explanation why Validated Qs not submitted]		07 November 2010
Other [Response Letter to the REC]		11 December 2018
Participant consent form [Prisoner consent form]	1	10 September 2018
Participant consent form [Prison officer consent form]	1	10 September 2018
Participant information sheet (PIS) [Prisoner information sheet]	4	20 September 2018
Participant information sheet (PIS) [Prison officer information sheet]	4	20 September 2019
Participant information sheet (PIS) [Prisoner information sheet]	5	29 November 2018
Research protocol or project proposal [Research Proposal]	9.4	11 December 2018
Summary CV for Chief Investigator (CI) [CI CV]		
Summary CV for student [Julia McVean CV]		23 October 2018
Summary CV for student [Hira Research Worker CV]		17 October 2017
Validated questionnaire [Central Nervous System Questionnaire completed with Ohio State University Traumatic Brain Injury Identification Tool]		
Validated questionnaire [The Drug Abuse Screen test (DAST-10)]		
Validated questionnaire [Adapted Traumatic Life Events Questionnaire (TLEQ)]	2	31 October 2018
Validated questionnaire [Adverse Childhood Experiences (ACE) Questionnaire]		
Validated questionnaire [Glasgow Outcome at Discharge Scale (GODS)]		
Validated questionnaire [Hospital Anxiety and Depression Scale (HADS)]		
Validated questionnaire [Ohio State University Traumatic Brain Injury Identification Tool]		
Validated questionnaire [The PTSD Checklist for DSM-V (PCL-5)]		
Validated questionnaire [The Alcohol Use Disorders Identification Test (AUDIT-C)]		
Validated questionnaire [Trail Making Test]		
Validated questionnaire [Benton's Verbal Fluency Test]		

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

18/WS/0210	Please quote this number on all correspondence

Yours sincerely

Sharon Macgregor
REC Manager

Copy to: Mr Raymond Hamill, NHS Lanarkshire
             Lead Nation - Scotland: nhsg.NRSPCC@nhs.net

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 2.3 Participant Information Sheet

PARTICIPANT INFORMATION SHEET FOR PRISONERS

Persisting Disability as a Result of Head Injury in Young Offenders

We would like to invite you to help us in a research study.

Before you decide whether or not to take part it is important for you to understand why the research is being done and what it will involve.

Please take time to read the following information carefully and discuss it with others if you wish.

If anything is unclear and you would like to ask us questions about the study please speak to a staff member who will notify us.

Take time to decide whether or not you wish to take part.

** You can take part in this study even if you have not had a head injury**

What is the purpose of the study?

We are carrying out this study to find out more about head injury in young offenders in Scottish prisons.

We want to find out more about:

- how many young offenders in Scottish prisons have had a head injury and how many young offenders haven't had a head injury.
- the impact of head injury on young offenders in prison and any disability caused by the head injury.
- the causes and types of head injury in young offenders in prison.
- the differences between people who have had a head injury and people who have not had a head injury (for example, we want to know if people who have had a head injury have more difficulties in their daily lives).

We hope that this information could be used to help:

- understand more about the needs of young offenders with head injuries in prison.
- help inform treatment approaches for young offenders in prison with head injury.

This study will contribute towards the researchers' qualifications by fulfilling a component of their Doctorate in Clinical Psychology degree.

Why have I been chosen?

You have been chosen because you are currently serving a custodial sentence at young offender's institution in Scotland.

Do I have to take part?

No, it is up to you to decide whether or not to take part.

There will be no consequences for you either way, except the time required to complete the study, should you decide to take part.

You will be given this information sheet to keep and if you would like to take part you will be asked to sign a consent form.

If you decide to take part, you can still withdraw from the study at any time and do not have to give a reason.

Participation in this study will not alter your sentence or affect your earnings from a work programme.

What will happen to me if I take part?

You will be invited to attend for a single assessment session lasting about 70 minutes (a little over an hour).

If you need to you can take a break at any point during the session. You can also pull out of the study/stop the session at any stage if you want to.

The session will involve:

- a brief interview about your recent health and history of any head injuries you might have had
- demographic questions such as your age
- brief questions on your previous forensic history such as number and types of offences you have been charged for
- questionnaires about your psychological wellbeing
- brief questions on how you might have got the head injury and any other difficult experiences you have had that may have had an impact on you

- tests of cognition, or 'thinking skills', such as concentration and memory.

You will not be asked to go into detail in any question and can choose not to answer any question you feel uncomfortable with.

If it is ok with you, we would also like to ask your named prison officer/prison key worker to answer surveys about any head injury-related symptoms or difficulties they think you might have. Your named prison officer/prison key worker will also be asked about prison incident reports for incidents that you have been involved with in the prison with your consent. This is to inform us about your behaviour while you have been in prison and to understand how this could relate to potential disabilities that you may have.

Where will the assessment take place?

The assessment will take place in the prison. If you need to miss work to attend the study, you will not lose out on any work payments.

What do I have to do?

You will be asked to attend for an assessment that will take around 70 minutes.

We will also ask your permission to talk to your named prison officer/prison key worker about your difficulties.

What are the possible disadvantages and risks of taking part?

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

Some questions asking about your head injury or psychological wellbeing might cause some distress for you. For example, we will ask some questions about how you might have got a head injury and whether or not you've experienced traumatic and distressing events that might have impacted on you. We have made the questions as short as possible to reduce the chance of them causing you distress. You will not be asked to go into detail in these questions and can choose not to answer any question you are uncomfortable with. You can stop for a break or choose to pull out of the assessment at any time.

What are the possible benefits of taking part?

You will receive no direct benefit from taking part.

The information collected in the study will give us a better understanding of head injury in young offenders in prison, and may allow us to make recommendations for prison health service improvements.

Will my taking part in this study be kept confidential?

You will be identified by a number only and not by your name/prison number. Any information about you will have your name removed so that you cannot be recognised from it. Information collected will be kept in the University of Glasgow department in a locked cabinet for 10 years in order to meet record keeping guidelines and for future research. Researchers from the University of Glasgow collect, store and process all personal information in accordance with the General Data Protection Regulation (2018).

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 researchers working on this study and the study sponsor, NHS Lanarkshire, who will make sure that the study is being conducted correctly.

We will let prison staff know that you are taking part in this study. However, all the information you tell us will be kept confidential and we will not notify the prison staff of the things you tell us in the interview. If during the assessment we find that you are experiencing distress as a result of a traumatic experience we will ask your permission to let NHS prison health service know about this. We will also ask for permission to let the NHS prison health service know if you have had a head injury that seems to be impacting on your life. **We will not pass this information on to the NHS prison health service if you do not want us to.**

However, the following exceptions to confidentiality apply.
If during the course of the research we become concerned that you or another person is at risk of harm (for example, if you tell us you are thinking of suicide), we are obligated to pass this information on to the Scottish Prison Service and the Prison Health Service. We also have to tell the Scottish Prison Service if you tell us about a crime that has been committed.

If we find out that you have a very severe head injury and disability and you may be at risk as a result of this, we will inform the Prison Health Service of this so that it can inform your future care.

Use of your personal data in the above healthcare research study

As the research sponsor, NHS Lanarkshire will be using information from you in order to undertake this study and will act as the data controller. This means that they are responsible for looking after your information and using it properly.

The NHS organisation that enrolled you into the research (*this may be NHS Lanarkshire, or another NHS organisation if the research is being carried out more than one area*) will use your personal information (your name and other details if required) to contact you about the research study, and make sure that relevant information about the study is recorded for your care, and to oversee the quality of the study.

The only people who will have access to information that identifies you will be people who need to contact you about the research study.

If you enrolled in another NHS organisation (i.e., not NHS Lanarkshire) then the researchers there will pass on any of your details that are required for the research study to NHS Lanarkshire. The NHS organisation where you enrolled will keep identifiable information about your participation in the study for no longer than 3 months after the study has completed.

What happens if I lose capacity?

Capacity means your ability to understand and consent to taking part in this research. If you lose capacity before taking part in this study or while you are taking part in it, you will be withdrawn from the study and any data you have provided up to that point will be destroyed. However, if you lose capacity after you have taken part in the research (after you have completed the assessment) your data will remain in the study. As all the data you provide us during the study will be anonymised, it will not be possible to withdraw your data at a later stage after you have participated in the study.

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 academic journals. The results may be used in conference presentations and will be included in theses to fulfill the requirements of the Doctorate in Clinical Psychology. A summary of results will be provided to the National Prisoner Healthcare Network and to the Scottish Government.

Analysing the research data

NHS researchers occasionally need assistance to analyse the research data from specialist colleagues in Universities.   If their assistance is required, then the data that is

used will be completely anonymised - all personal information that could identify research participants will removed before it is passed on to the University for analysis.

Help to analyse data is not required for every study – the information you will have been given before you decided to take part in this research study will explain whether that is the case here.

Checking the accuracy of research data

Individuals from NHS Lanarkshire, as sponsor of the research, and regulatory organisations may look at your medical and research records to check the accuracy of the research study. These individuals will not share any of your information, and will keep it completely confidential.

Who is organising and funding the research?

The research is organised by the University of Glasgow. The research is funded by the University of Glasgow and partly by the Scottish Government.

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.

Complaints process

You have the right to complain about your involvement in this study if you are not happy with it. If you have any complaints about any part of your involvement in this research study, these will be dealt with by the NHS complaints process.

Your rights

Your rights to access, change or move your information are 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. To safeguard your rights, we will use the minimum personally-identifiable information possible.

If you wish to discuss the project at HMPYOI Polmont, the contact at the site is Rosemary Duffy, NHS Forth Valley Prison Healthcare Manager.

Contact for Further Information

If you have any questions you can contact the researchers by telephone on 0141 211 0354. The researchers working on this study are:

Julia McVean (Trainee Clinical Psychologist)

Hira Aslam (Research Worker)

Professor Tom McMillan (Clinical Neuropsychologist and Principal Investigator supervising this research).

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

Appendix 2.4 Data Capture Form

Participant ID no				
Age				
Ethnicity	White			
	Mixed or multiple			
	Asian			
	Caribbean/Black			
	Other			
Postcode - Socio-economic status (DEPCAT or SIMD scores)				
Years of education				
Schooling type	Mainstream			
	Mainstream with 1:1 support			
	Specialist			
Did you miss any school? Approximately how often?		<20 times through school career	At least once/ month (from – until)	At least once/ Week (from – until)
	Truancy			
	Illness			
	Suspension/ exclusion			
Most recent occupation category	Managers, directors and senior officials			
	Professional occupations			
	Associate Professional And Technical Occupations			
	Administrative And Secretarial Occupations			
	Skilled Trades Occupations			
	Caring, Leisure And Other Service Occupations			
	Sales And Customer Service Occupations			
	Process, Plant And Machine Operatives			
	Elementary Occupations			
	None			

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

	Other	
Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID) category	Likely	
	Not likely	
OSU TBI-ID category of severity	No HI	
	Mild (no LOC)	
	Mild (LOC <30 minutes)	
	Moderate (includes multiple) – most severe injury LOC between 30 minutes and 24 hours	
	Severe includes multiple most severe injury LOC > 24 hours	
Glasgow Outcome at Discharge Scale (GODS) category	Dead (1)	
	Not conscious (2)	
	Lower Severe Disability (Lower SD) (3)	
	Upper Severe Disability (Upper SD) (4)	
	Lower Moderate Disability (Lower MD) (5)	
	Upper Moderate Disability (Upper MD) (6)	
	Lower Good Recovery (Lower GR) (7)	
	Upper Good Recovery (Upper GR) (8)	
Hospital Anxiety and Depression Scale (HADS) score	Depression score	
	Anxiety score	
Adult Memory and Information Processing Battery (AMIPB) - List Learning Sub-Test score		
Symbol Digit Modalities Test (SDMT) score		
Trail Making Test (TMT) score	Part 1 score (seconds)	
	Part 2 score (seconds)	
Verbal Fluency (FAS) score	F	
	A	
	S	

Word Memory Test score	
Drug Abuse Screening Test (DAST-10) score	
The Alcohol Use Disorders Identification Test (AUDIT-C) score	
Adapted The Traumatic Life Events Questionnaire (TLEQ) score	
The PTSD Checklist of the DSM-5 (PCL-5) score	
The Adverse Childhood Events Questionnaire (ACE) score	
Number of incident Reports	
The Dysexecutive Questionnaire (DEX) score	

Appendix 2.5 Demographics by Multiple-Mild and Moderate-Severe HI Groups

Demographics by Multiple-Mild and Moderate-Severe HI groups

	Multiple-Mild HI N= 52	Moderate-Severe HI N=10
Age Median (Interquartile Range)	19 (18-20)	20 (17-20)
Years of Education Median (Interquartile Range)	10 (10-11)	11 (10-11)
Scottish Index of Multiple Deprivation (SIMD 2016) N (%) 1 High 2 3 4 5 Low*	31 (63) 7 (14) 4 (8) 4 (8) 3 (6)	4 (40) 4 (40) 1 (10) 1 (10) 0 (0)

Missing N=3

Forensic History by Multiple-Mild and Moderate-Severe HI groups

	Multiple-Mild HI N= 52	Moderate-Severe HI N=10
Number of Convictions Median (Interquartile Range)	5 (1-8)	4 (2-13)
History of Conviction Type N (%) Violent Sexual Property Other	 47 (90) 4 (8) 36 (69) 27 (52)	 9 (90) 1 (10) 7 (70) 7 (70)
Age at First Offence Mean (S.D)	13 (3)	12 (3)
Number of Prison Incidents Median (Interquartile Range)*	3 (1-16)	4 (1-9)

Missing N=1

Appendix 2.6 Traumatic Life Events Questionnaire; Event Frequencies

Natural Disaster (%)	2 (3)
Motor Vehicle Accident (%)	27 (35)
Other Accident (%)	16 (21)
Exposure to War (%)	0 (0)
Death of friend/loved one (%)	69 (89)
Loved one accident/assault/illness (%)	28 (36)
Life threatening illness (%)	4 (5)
Robbery with a weapon (%)	43 (55)
Assault by stranger (%)	48 (62)
Witnessed assault (%)	59 (76)
Threats of serious harm (%)	58 (74)
Childhood physical abuse (%)	18 (23)
Witnessed family violence (%)	34 (44)
Intimate partner violence (%)	31 (40)
Sexual abuse (%)	5 (6)
Unwanted sexual attention (%)	8 (10)
Stalking (%)	13 (17)
Miscarriage (%)	21 (27)
Abortion (%)	8 (10)
Other (%)	21 (27)

Appendix 2.7 Details of Test Norms

Citation	Test	Age	Gender	Education (years)	Nationality
Kiely, K., Butterworth, P., Watson, N., & Wooden, M. (2014)	Symbol Digit Modality Test	15-19	Male	-	Australian
Coughlan, A.K. & Hollows, S.E., (1985)	AMIPB List Learning	18-30	Male/Female	-	UK
Tombaugh, T. (2004)	TRAILS A and B	18-24	Male/Female	= > 12	Canada
Tombaugh, Kozak, & Rees (1999)	Category Fluency	16-59	Male/Female	9-12	Canada
Ruff, R., Light, R., Parker, S., & Levin, H. (1996)	Letter Fluency	-	Male	< 12	USA
Chan, R. C. (2001)	DEX-Self and Independent	18-50	Male/Female	12	Hong Kong
Green, P. (2003)	WMT	36.7	Male/Female	14	Canada

Appendix 2.8 Univariate Test Results

Outcome Measure Means (SD) and Univariate Test Results for those with No/Mild HI and Multiple HI

Variable	No/Mild HI (N=16)	Multiple HI (N=62)	r	t/U	p	Confidence Interval (95%)	
						Lower	Upper
HADS Anxiety	4.9	9.3	0.5	-3.9**	0.000	-6.7	-2.1
HADS Depression	2.1	5.7	0.5	-5.6[a]**	0.000	-4.9	-2.3
PCL-5[b]	8.5	28.3	0.6	-6.1 [a]**	0.000	-26.3	-13.3
TLEQ Median (range)	4 (1-9)	7 (1-15)	0.4	776.5**	0.000	†	†
ACE	2.4	4	0.3	-2.4*	0.02	-3.0	-0.3
AUDIT-C Median (range)	7.5 (0-11)	10 (0-12)	0.3	679.5*	0.02	†	†
DAST	3	5	0.3	-2.5*	0.01	-3.6	-0.4
DEX Self	21.2	37.5	0.5	-4.0**	0.000	-24.4	-8.2
DEX Independent[c]	25.4	26.6	0.0	-0.24	0.81	-11.0	8.6
Verbal Fluency Category [b]	18.8	20.1	0.1	-0.92	0.36	-4.2	1.5
Verbal Fluency Letter Median (range)[b]	23.5 (12-43)	28 (10-58)	0.1	566.5	0.32	†	†
SDMT Median (range)	46 (31-76)	42 (25-71)	-0.3	278*	0.007	†	†
Trails A Median (range)	29.5 (19-67)	34.5 (17-73)	0.2	623.5	0.11	†	†
Trails B Median (range)	97 (44-163)	94 (34-238)	0.1	495	0.93	†	†
List Learning	42.9	40.2	0.1	1	0.3	-2.4	7.8

Composite Cognitive Score	0.03	-0.01	0.0	0.3 [a]	0.76	-0.2	0.3
WMT Delayed recall Median (range)	38.5 (23-40)	37.5 (23-40)	0.3	473.5	0.78	†	†

[a] Welch t statistic reported

[b] Missing N=1

[c] Missing N=5

†Mann Whitney U Test

*p<0.05

**p<0.001

Appendix 3. Research Proposal

Persisting Disability as a Result of Head Injury in Young Offenders

Date of submission to University for Blind Review: 05/04/18

Version number: 9.4

Chief Investigator: Professor Tom McMillan, Professor of Clinical Neuropsychology, University of Glasgow

Protocol Author: Ms Julia McVean, Trainee Clinical Psychologist, NHS Lanarkshire

Abstract

Background

A recent meta-analysis estimates the prevalence of head injury (HI) in juvenile offenders to be 30%. All studies in the meta-analysis are based on self-report. A systematic review exploring the persisting disability in offenders with HI history found that limited quality research exists. Furthermore, a recent DClinPsy project found that adult offenders who had a moderate-severe HI history were more likely to experience disability, cognitive impairment, and anxiety than those with a mild HI history (Walker, 2017). This project aims to further develop investigations into disability in offender populations with HI history by exploring persisting disability in young offenders.

Aims

1. To explore the relationship between HI severity and disability in young offenders.
2. To explore whether additional variables of cognitive ability, drug/alcohol use, trauma history and mental health have a relationship with HI severity to understand whether HI severity could predict disability independently in juvenile offenders.
3. To explore the relationship between HI severity and criminal characteristics.

Methods

Participants will be interviewed at Polmont Young Offenders institution for 70 minutes to ascertain their HI history, cognitive ability, disability, mental health, trauma history and drug/alcohol use. Prison officers will be interviewed to gather information about the offender's disability.

Applications

This investigation will inform stakeholders with estimations of service need and content required for this specialist population.

Introduction

The lifetime prevalence of head injury (HI) in offending populations has been found to be significantly higher than in the general population (Farrer & Hedges, 2011). Furthermore, a meta-analysis reported that 30% of young offenders had a HI history (Farrer, Frost & Hedges, 2013). Given these prevalence rates, a recent Scottish Government report recommended further investigations into the associated disability of prisoners with HI to better estimate the service provision required for this population (NPHN, 2016). The NPHN report (2016) describes potential service provision for mild HI as providing information and advice to patients. Guidance could be given to prison staff regarding management of these difficulties and potential psychological interventions that could be delivered. For severe HI, intensive neurorehabilitation may be required and would be provided out with a custodial setting.

Cognitive deficits and additional difficulties are prevalent in those with HI histories. A moderate-to-severe HI is often associated with deficits in memory, attention, processing speed and executive functioning (Rabinowitz & Levin, 2014). Additionally, those with HI have been found to have increased use of drug and alcohol two years post injury (Ponsford et al., 2007; Bombardier & Turner, 2009). Anxiety and depression are also commonly found in HI samples (Whelan-Goodinson et al., 2009). Persisting disability is also reported 5-7 years after HI (Whitnall et al., 2006). Given the complex relationships between HI, cognitive deficits, mood, substance use and disability, offenders with HI history can have a multi-morbid presentation.

Prison populations have been found to have greater prevalence rates of PTSD than the general population, indicating the significant trauma history that can be present (Goff et al., 2007). Additionally, traumatic events can be experienced before the age of 18 in prisoners with a Welsh study reporting that 38.5% of adults surveyed who had experienced four or more Adverse Childhood Experiences (categorised as abuse, neglect or household dysfunction; ACEs) had spent time in prison compared to 3.7% who had reported no ACEs (Public Health Wales, 2015).

When considering the effects of HI on offending behaviour, the aforementioned cognitive deficits, impulsivity, aggression and disinhibited behaviour can lead to challenges in managing behaviour and learning from prior mistakes (Shiroma et al., 2010). Therefore, the risk of offending may increase after HI, highlighting the additional needs and service provisions required for these prisoners when compared to other offenders.

There are factors which contribute towards both increased risk of HI and increased risk of offending in young people. McKinlay et al (2010) identified in a large birth cohort study that experiencing a greater number of adverse life events and punitive parenting style were important risk factors for children who had experienced a HI. Similarly, male offenders were found to have four times more adverse childhood experiences than a normative sample (Reavis et al., 2013) and a link has been found between parenting style and delinquency in a meta-analysis by Hoeve and colleagues (2009).

Younger age of imprisonment has been found in offenders with HI compared to offenders without HI (Durand et al, 2016). However, it is difficult to determine whether HI is a casual factor for the offence or whether HI occurs as a result of risk taking associated with the offending behaviour. Age at injury may be particularly important in determining relationship with offending as typical skills developing at that time could be disrupted (Anderson, 2010). Williams (2012) highlights that earlier and effective management of HI in young offenders may improve individual and societal outcomes.

In their systematic review on HI prevalence and disability, Moynan and McMillan (2018) found no published study reported prevalence of disability after HI. Classification, severity and source of information for the HI varied. Using the Glasgow Outcome at Discharge Scale (GODS; McMillan, 2013), disability can be defined as from HI or from any cause. An unpublished study on adult offenders using the GODS found those with moderate-to-severe HI histories were more likely to experience disability, cognitive impairment and anxiety than those with mild HI histories (Walker, 2017). This study will aim to investigate the associations in young offenders between HI history, disability and associated difficulties.

Aims and hypotheses

Aims

4. To explore the relationship between HI severity and disability in young offenders.

5. To explore whether additional variables of cognitive ability, drug/alcohol use, trauma and mental health have a relationship with HI severity to understand whether HI severity could predict disability independently in juvenile offenders.

6. To explore the relationship between HI severity and criminal characteristics.

Hypotheses

1. More severe HI is associated with persisting disability.

2. Young offenders categorised as 'likely' to have ongoing problems on the OSU-TBI screening tool will be i) more disabled ii) have greater cognitive deficits iii) will routinely have consumed greater amounts of alcohol and drugs iv) have greater mental health difficulties and trauma backgrounds than young offenders categorised on the OSU-TBI screening tool as 'not likely' to have ongoing problems after a HI. It is anticipated that HI will predict disability independently of the aforementioned additional variables.

3. Young offenders with greater HI severity will have committed more offences, committed a greater number of violent offences than non-violent offences and have more recorded prison incidents than those without a HI history.

Plan of Investigation

Participants

The participants will be young offenders at Polmont Young Offenders Institution (HMYOI). The prisoner's personal prison officer will also be interviewed to inform assessment of disability in the prisoner.

Inclusion and Exclusion criteria

Those included will be male young offenders with and without a history of HI i) aged 16-25 years ii) fluent in English iii) have capacity to consent to the research iv) have no significant communication difficulties that would render the assessments invalid and v) would not pose a significant risk to the researcher. Women will be excluded because of potential differences in cause and comorbidity between male and female prisoners and because there are relatively few women prisoners in Scotland (McGinley and McMillan submitted).

Recruitment Procedures

Participants will be recruited using posters in the HMYOI. This procedure was successful in a previous project at HMP Shotts (Walker, 2017). Posters will advertise the project as exploring health outcomes to recruit a wide range of HI severity. The study will be presented to HMYOI Scottish Prison Service staff to increase engagement with recruitment processes.

Measures

Head injury

The HI screen will be the Ohio State University Traumatic Brain Injury identification method (OSU TBI-ID, Bogner & Corrigan, 2009). McGinley (2017) found that this measure has greater construct validity than other HI screening tools such as the Brain

Injury Screening Index. For data analysis, HI can also be categorised by number of HI and duration of loss of consciousness (LoC). The primary method of categorising HI severity will be defining participants into subgroups of 'likely' or 'not likely' to have ongoing difficulties after an HI as defined by the OSU-TBI.

Primary outcome measure: Disability

To evaluate disability, the Glasgow Outcome at Discharge Scale will be used (GODS, McMillan et al, 2013). It is a specialist tool developed for those with HI nearing discharge from hospital and has been used with prisoners (McGinley, 2017). The GODS is based on the Glasgow Outcome Scale-Extended (GOS-E) which is for use with people with HI who are living in the community (Wilson, Pettigrew & Teasdale, 1998). The GODS places the participant in one of eight categories of disability. It takes 10 minutes to complete. The GODS has good predictive validity with GOS-E (r= 0.51) and high inter-rater reliability at 98%.

Secondary outcome measures

These secondary outcome measures have been selected as they provide further information about specific difficulties that the participants may experience as a result of their HI or otherwise. The data will be used to test the second hypothesis aimed at understanding the relationship between HI severity and disability when other potentially related variables are taken into account.

Symbol Digit modalities test (Smith, 1982). The test takes 10 minutes and assesses information processing. Participants are required to de-code symbols on a sheet which correspond to nine numbers. The number of correct answers in ninety seconds provides the score. Strauss et al., 2006 reported that it is sensitive to the deficits of those with a HI.

Verbal Fluency Test (Benton, 1967). This test takes 3 minutes and assesses executive functioning and language ability. The participant is asked to name as many words as they can in 60 seconds that begin with the letters 'C/P', 'F/R' and 'L/W'. The participant is

also asked to name as many animals as they can in 60 seconds. It is commonly used in HI samples (Zaninotto et al., 2014).

List learning (AMIPB sub-test, Coughlan & Hollows, 1985). This test takes 10 minutes and assesses verbal memory and learning. The participant is asked to recall 15 words that have been presented to them over 5 trials. A second list is then presented as an interference trial, after which the participant is required to recall the first list.

The Trail Making Test (Armitage, 1946). This test takes 10 minutes and measures divided attention which is related to executive functioning. There are two parts. The first part requires the participant to draw a line through escalating numbers. The second part requires them to connect an escalating number followed by an escalating letter. Time for each trial is recorded.

The Word Memory Test would be used as a measure of effort (WMT; Green et al., 2003). A test of effort should be included in a neuropsychological assessment (McMillan et al, 2009). Effort testing is particularly relevant in a forensic setting as there could be a motivation to deceive (McMillan et al, 2009). The WMT takes approximately 20 minutes in total and involves learning 20-word pairs, an immediate recall task and 30-minute delayed recognition task. It has been validated in forensic samples.

The Hospital Anxiety and Depression Scale measures symptoms of anxiety and depression (HADS, Snaith & Zigmond, 1983). Whelan-Goodinson et al., (2009) found HADS to be reliable for detecting emotional distress in a HI sample.

Intake of alcohol and substances would be recorded using the *Drug Abuse Screening Test* (DAST-10, Skinner, 1982) and the *Alcohol Use Disorders Identification Test Consumption* (AUDIT-C, Bush et al., 1998). The DAST-10 is a 10-item questionnaire and has been used in HI samples, which is scored from 0-10 (Whitnall et al, 2006).

AUDIT-C is a three-item alcohol screen which has also been used in HI populations, which is scored from 0-12 (Herrold et al., 2014).

Dysexecutive Questionnaire (DEX, Wilson et al, 1996). This short test is part of the BADS and measures everyday difficulties associated with dysexecutive syndrome. It has high internal consistency, in excess of a=0.91 (Bennett, Ong & Ponsford, 2005). The patient and prison officer will complete this.

The *Traumatic Life Events Questionnaire (TLEQ; Kubany et al., 2000)* is a 24 item scale that assesses exposure to 16 potentially traumatic events ranging from natural disasters, childhood and adult abuse and other traumatic events. This measure was previously used in a project involving female Scottish prisoners (Crowe, Submitted thesis, 2018).

The *PTSD Checklist of DSM-5 (Weathers et al., 2013; PCL-5)* is a 20-item self-report measure that assesses the 20 DSM-5 symptoms of PTSD. This measure was previously used in a project involving female Scottish prisoners (Crowe, Submitted thesis, 2018).

The Adverse Childhood Experiences (Anda, Croft & Felitti et al., 1999; ACEs) Questionnaire is a ten-item measure which is calculated by receiving a 'point' for each of the ten difficult events experienced before the age of 18. These events involve abuse, neglect and household dysfunction. The questionnaire has been used in with individuals who have been incarcerated in Welsh prisons (Public Health Wales, 2015).

<u>*Additional information gathered*</u>

Demographic information will be gathered using a proforma similar to that used in studies on HI and prisoners in Scotland (Walker, 2017). Included in this would be self-reported

forensic history which would be used in the regression analyses. Patient postcodes would also be obtained and social deprivation would be estimated using the Scottish Index of Multiple Deprivation (SIMD; Scottish Government, 2016).

Design

A between subjects, quantitative, cross-sectional design where the participants would be classified as 'likely' or 'not likely' to have ongoing difficulties related to a HI by the OSU TBI-ID. Those 'likely' or 'not likely' to have ongoing problems will be compared on the primary outcome measure of the GODS and aforementioned secondary outcomes.

Data Analysis

H1

Chi-squared will be used to ascertain whether there is a relationship between HI severity and disability. This will be conducted by comparing the subgroups on the OSU-TBI categorised as likely to have ongoing difficulties after a HI or not and disabled or not on the GODS in the young offender population.

H2

The participants will be grouped as likely to have ongoing problems or not using OSU-TBI ID categories. For ease of data analysis HI severity can also be treated as continuous, by using number of HI or LoC. HI severity, social deprivation, number of years of education, cognitive deficits, alcohol/drug intake, trauma history, effort and disability will be entered into regression analyses to understand whether HI severity predicts disability independently or if other factors can explain the relationship.

The raw cognitive test scores would be converted into standardised z scores for inclusion in the regression analysis. A composite score for the all of cognitive tests for each

participant would be obtained by calculating their average standardised z score and then transforming this into a percentile score.

Multiple logistic regression will explore whether GODS outcome category (categorical variable) is predicted by HI severity (using LoC, number of HI or OSU-TBI ID category) when alcohol use (continuous score 0-12), drug use (continuous score 0-10), trauma history (continuous score) and social deprivation (SIMD; categorical) are entered as additional independent variables.

A second multiple linear regression will explore whether composite cognitive score (continuous percentile score) is predicted by HI severity (using LoC, number of HI or OSU-TBI ID category) when years of education (continuous variable), alcohol use (continuous score 0-12), drug use (continuous score 0-10), trauma history (continuous score) and effort (categorised as pass or fail) are entered as additional independent variables.

A third logistic regression will explore whether mental health (PTSD-PCL-5 or abnormal anxiety or depression on the HADS as categorical variables) is predicted by severity of HI, trauma history, social deprivation or drug or alcohol use as defined above.

The WMT would be used to understand whether the participant has put adequate effort into the testing, particularly as this is a forensic population. It will also be used to analyse whether there is a relationship between HI severity and effort using a Chi-Square. It would be useful to know whether greater HI severity could be related to poorer effort scores when understanding the results of the cognitive tests. Effort can also be included as a factor in the cognitive regressions to understand whether it accounts for trends in the cognitive test results. Effort can also be evaluated by analysing whether there is a difference between disability and cognitive test scores for the participants.

H3

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A Chi-Square analysis will be used to evaluate whether there is a relationship between HI severity (mild/moderate or severe) and offending characteristics (violent or not violent offence history). Offending characteristics can also be explored by using criminal history and the number of recorded prison incidents.

Research Procedures

Participants will be recruited using posters and asked to contact a prison officer if interested in taking part. The prison officers would provide them with an information sheet and would take their details using a sign-up sheet if they are interested. This recruitment method has been successful in previous studies within six prisons.

At the beginning of the interview each participant will be provided with the information sheet again and a consent form. If they consent, each participant would complete the HI screen (OSU TBI-ID), HADS, TLEQ, PCL-5, ACE questionnaire, cognitive tests (including effort test), GODS and DAST/AUDIT-C. Their postcode to ascertain SIMD and nature of offending history would also be gathered using a proforma. It is anticipated that the interview will last 70 minutes. Interviews will also be conducted by Ms Hira Aslam, Research Worker at the University of Glasgow.

The prison officer relevant to the prisoner's care would be provided with an information sheet and consent form. If they consent, they would complete the DEX and would be asked to provide information on prison incidents involving the participant.

Justification of Sample Size

A sample size calculation was used to estimate how many participants will be needed to reach sufficient power for the statistical analyses. The power calculation is based on the predictor variable of HI severity and primary outcome variable of disability.

Walker (2017) recruited 83 participants using similar recruitment procedures exploring HI severity and disability in adult offenders. Walker (2017) found medium effect sizes for both LoC and number of HI when exploring disability associated with HI. Duration of LoC was a predictor of anxiety, disability and cognitive impairment with medium effect sizes after controlling for factors that could be independently associated these outcomes. For disability these factors were drug and alcohol use.

For the first hypothesis, using G*Power (Faul et al., 2009), n=88 would be required to detect a medium effect (w=0.3) in disability with 80% power, α=0.05, with 1 degree of freedom, using chi-square. For the second hypothesis, based on Walker (2017) to detect a medium effect (f^2=0.15) in disability (GODS) with alpha set as 0.05 and power set at 0.8, n=85 would be needed, using a multiple logistic regression with four variables. Given these estimates, a sample size of 90 will be aimed at in the study.

Settings and Equipment

The setting for data collection will be Polmont HMYOI. It will be important to develop relationships with the officers in the prison to secure a room for the testing sessions and to aid recruitment.

Cognitive tests will be sourced from the University and questionnaires will be printed there.

Health and Safety Issues

Researcher safety issues

The participants could have a history of aggressive or violent behaviour, consideration of current risk to others would be essential. The prison officer relevant to the participant's care would be asked about their current risk level prior to assessment. All participants

will be seen in a prearranged room at Polmont HMYOI. The researcher will attend SPS training on safety and risk management procedures.

Participant safety issues

The testing procedure should not pose any health or safety risk to the participant. If concerns are present after interview about the participants risk to self or others this information would be passed on the relevant prison officer. Although unlikely, if the participant becomes distressed when discussing HI history or mental health, clinical skills will be used to assist them.

Ethical Issues

If a significant health issue requiring the attention of health services arises, the information would be passed on to relevant heath care staff with the participant's permission. Care would be taken to schedule the testing sessions at an appropriate time in the participants routine that would cause minimal disruption to any educational/work programmes that are being undertaken. Collected data would be anonymised and stored securely in line with NHS Ethics and University of Glasgow policies. Ethical approval will be sought from the Scottish Prison Service (SPS) and the NHS.

Financial Issues

Areas of cost include measures to be obtained, measures to be printed at the University and return travel to Polmont HMYOI.

Timetable

April 2018 – Submission of MRP Proposal

July -September 2018 - Applications for ethical approval

October 2018-April 2019 Data collection and scoring

May-July 2019 – Data analysis and write up

July 2019 – Final project submitted

<u>Practical Applications</u>

This investigation will inform the levels of need and content required for health services to juveniles in prison in Scotland by providing data about HI history in offenders and associated disability

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