Prevalence of Head Injury and Associated Disability in Prison Populations: A Systematic Review

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Abstract

Objective: This review systematically assesses literature on the prevalence of head injury (HI) and associated disability in adults in prison.

Methods: Searches were carried out using electronic databases (PsycINFO, Cochrane Databases, MEDLINE, EMBASE, Web of Science). Reference lists of two meta-analyses were checked for relevant papers. Methods were rated for risk of bias.

Results: The ten studies included report a range in prevalence of HI in prisoners from 25-86%. Risk of bias was high overall, probably because a range of HI definitions were used, assessments were often not validated and samples were not or not evidenced to be

representative of the prison population. There was absence of appropriate population controls from which to compare relative risk of HI in different countries. No study reported the prevalence of disability associated with HI.

Conclusion: The wide range in prevalence estimates of HI in prisoners is associated with high risk of bias from study design and methods. Persisting disability associated with HI was not reported and as a result the service need for prisoners with HI is unclear. Future studies should indicate that samples are representative of prison populations, use validated tools, internationally accepted definitions of HI and link prevalence to persisting disability.

Keywords: Systematic Review, Prison, Head Injury, traumatic brain injury, prevalence, disability

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Introduction

Risk factors for sustaining a traumatic brain injury (TBI) and for criminal offending overlap, and include lower socioeconomic status (SES), being young, male and abusing alcohol[1,2]. Personality changes associated with antisocial behaviour are often reported after severe TBI

and these include aggression, poor judgement, egocentricity, poor insight, tactlessness and a lack of concern for others[1,3]. It is easy to forsee that behaviour associated with these personality changes could result in offending and in criminal conviction. Indeed, meta-analyses estimate the prevalence of TBI in prisoners to be 50% or 60% in adults[4,5] and 35% in juveniles[6] and if accurate, could signify a significant service-need in prisoners. The range in prevalence in studies included in these meta-analyses is very large (10-100%) and the quality of the evidence may not be robust, as many studies use different definitions and methods of screening for TBI and sample a range of incarcerated sub-groups[2,4]. In order to develop an appropriate service for prisoners with a brain injury, there is also a clear need to understand whether there is consequent persisting disability and if so how severe this is. For example, over 90% of TBI in the general population is mild and the prognosis for a single mild TBI tends to be good[7,8]. Clearly, in addition to prevalence it is necessary to estimate the persistence of disabling effects if planning and developing a service. The wide range in prevalence reported in studies on offenders is also particularly salient for service development and in these studies, the occurrence of 'brain injury' is inferred from self-report and objective evidence for TBI is often absent. The term 'head injury' (HI) does not make the assumption of brain injury and is used throughout this paper to be mindful of this and in so doing reflects the fact that those reporting an injury to their head may or may not have sustained a brain injury.

This systematic review assesses the quality of evidence on the prevalence and severity of HI in adult prisoners and the prevalence of associated disability as a basis for considering potential service needs.

Methods

Search Strategy: Studies were identified by searching the following electronic databases: Ovid Medline® In-Process and Other Non-Indexed Citations (1946-31.3.15); Ovid EMBASE 1947–Present, updated daily (1946-31.3.15); Ebsco PsycINFO (1987-31.3.15); Web of Science (1990-31.3.15); Wiley Cochrane Library. The search criteria used in text-word searches were: ((criminal* OR inmate* OR prisoner* OR offender*)); ((“Traumatic Brain Injury” OR TBI OR “Head Injur*”)). To denote a Traumatic Brain Injury as a phrase *Traumatic Brain Injury* was used in the Cochrane Library, OVID, Web of Science and EBSCO. The two text-word searches were combined using the Boolean operator AND. In addition, the reference lists of the two meta-analyses were searched[4,5].

Selection Criteria: Studies identified were initially screened by title and then by abstract. Articles that were not excluded were then read and considered using the following inclusion criteria: printed in English; an adult prison sample or population (aged 18 and over) and specifically identifying the incidence or prevalence of HI. Exclusion criteria were unpublished dissertations, book chapters, conference abstracts or studies on sub-groups of an incarcerated population that were not representative of the prison population, such as those in high security inpatient psychiatric hospitals, on death row, sexual offenders or a mixed group of offenders (e.g. in prison and in police custody).

Search Results: After removing duplicates, 730 articles were identified. Of these, 675 were excluded on the basis of title and a further 38 by abstract. Seventeen articles were read in full. Of these, 7 were excluded because they involved non-prison participants. Ten studies were included in the final review (see figure 1). Selection was carried out by CM.

Figure 1 about here please

Rating Risk of Bias: Papers selected for inclusion were systematically rated for methodological bias using criteria developed for observational studies in epidemiology[9] in six key domains. Other potential domains for bias such as statistical methods[9] were not appropriate because reporting in included studies was largely descriptive. The following defines low risk of bias for each domain:

1. Methods for selecting participants: Inclusion and exclusion criteria are clear.
2. Methods for assessing the occurrence of HI: (i) Use of an assessment tool that is validated for HI and preferably validated for a prisoner population. (ii) Use of an internationally recognised definition and cut-offs categorising HI severity. (iii) Assessment of number and severity of HI. (iv) Ideally, use of an appropriately matched control group for prevalence of HI in prisoners to facilitate comparison between studies in different geographical regions or countries.
3. Methods of assessing the prevalence of impairments/symptom complaints: (i) Use of validated tools appropriate for HI. (ii) Comparison of rates in prisoners with HI to prisoners with no HI.

4. Methods of assessing the prevalence of disability outcomes: (i) Use of a validated tool for assessing disability after HI. (ii) Comparison of self-reported disability rates in prisoners with HI to prisoners with no HI.

5. Design-specific confounders: (i) The sample is demographically representative of the prison population (ii) The sample/prison population is representative of a larger prison service eg a State or Country. To consider any other confounders specific to the study design that might affect results.

6. Methods to control confounding: Specific to study design. These might include blinding of raters to the study specific questions or hypotheses and consideration of potential confounding by current substance abuse and cross-checks of self-report in hospital records, especially for more severe head injury.

Both authors independently assessed each paper in these six domains as having a 'high' or 'low' risk of bias or as 'not applicable' for domains 3 or 4 if symptom complaints or disability was not addressed by the study. There was inter-rater concordance for 58/60 (97%) ratings with the two exceptions resolved by discussion.

Results

Risk of methodological bias was high overall with respect to the research questions asked in the review (see table1) and particularly in relation to confounding. No study assessed disability, and of those assessing impairments or symptom complaints, risk of bias was low in only one study[10].

Table 1: About here please

Table 2: About here please

Barnfield & Leathem[11] (1998) investigated HI in one prison in New Zealand in a sample of prisoners (N=118) that comprised a third of the population in that prison. It is not clear how representative the sample was of the prison population. HI was assessed using a non-validated questionnaire designed for the study. Overall 86% reported at least one HI (28% a single HI and 57% more than one). The authors used a (non-validated) method to classify HI severity that combined total duration of LoC and the number of HI reported, that they describe as having arbitrary cut-off points. In this way HI severity is reported as mild, in 41%, moderate in 29% and severe in 11%. In addition, selected questions from the Patient Competency Rating Scale, which comprises items on cognitive function, interpersonal problems, emotional reaction and activities of daily living[12] and the Cognitive Failures Questionnaire[13] were reworded to simplify language and combined into a 'Problem Rating Scale' (PRS) to assess difficulties in those reporting HI. The association between HI severity and the PRS was not significant. They compared scores on the PRS in prisoners with controls from another study that may have used a different scale. The authors note the need for a classification of HI severity that combines the number and severity of HI.

The main purpose of the study by Bogner & Corrigan[10] was to investigate the reliability and predictive validity of the Ohio State University TBI Identification Method (OSU-TBI-ID) of assessment. They did so in a convenience sample of 210 prisoners in US Ohio State, with 78% reporting a HI. Severity of HI was defined by length of LoC, and for 14% their worst injury was moderate-severe (LoC > 30 minutes). More than one HI was reported in 79% of participants. Medical attention for the HI was received by 55% overall and in 92% if the HI was moderate-severe.

Colantonio et al[14] examined the prevalence of HI in a random sample of men and women recently admitted to four prisons in Ontario in a three-month period. There was a 72% recruitment rate (N=235/388) in those invited. It is unclear if the sample was representative of the prison population. Prisoners were initially asked; 'have you ever had an injury to the head, which knocked you out or at least left you dazed, confused or disoriented' and 'how many injuries like this have you had over your lifetime'. If reporting a history of HI, follow-up questions about LoC duration were asked. Severity of HI was defined as mild (LoC <30 minutes) or moderate to severe (LoC >30 minutes)[15]. HI was reported in 43% (37% of females and 50% of males) and was moderate-severe in 15%; 83% reported attending hospital. Of those reporting a HI, 51% reported sustaining more than one.Twenty percent of the HI sub-group had been involved in violent crime and this was not significantly different from non-HI prisoners. They conclude that there is a need to screen for HI in correctional programmes using a validated questionnaire (such as the OSU-TBI-ID) that provides a more detailed HI history than they gathered. They provide no data on problems or disability associated with HI.

Diamond et al[16] investigated the reliability and validity of the Traumatic Brain Injury Questionnaire (TBIQ) in 225 offenders in the USA who were part of a larger study (n=1433). They present some demographic comparisons between the sample and the federal prison population (eg age, race; but not education or gender). They compared those with no or one suspected 'minimal' HI (14%) with those with multiple suspected or minimal HI and no mild, moderate or severe HI (22%) and with those reporting mild, moderate or severe HI and alteration of consciousness (64%). They considered the criterion validity of the TBIQ in relation to mental health and neurobehavioural assessments (the main purpose of their paper) and provide no prevalence data. Of possible note, their intermediate group ('multiple minimal/suspected injuries but no mild, moderate, or severe injuries') seemed more symptomatic than the definite TBI or no TBI groups.

Durand et al[17] considered all offenders (including juveniles) consecutively admitted to Fleury-Merogis prison in France in a three-month period, using a self-report interview developed for the study, with a 94% participation rate (n=1148). HI was defined as injury to the head resulting in being 'knocked out and/or dazed and confused'. The prevalence of HI was 31% (32% for males and 22% for females), although 61% of males reported a HI with some LoC (and 40% of males HI with hospitalisation). The proportion with severe (coma), moderate (hospitalisation without coma) and mild (no hospitalisation, with or without LoC) HI was 17%, 24% and 61% respectively. Most males reported sustaining their first HI prior to imprisonment (76%) and 33% of them reported more than one HI. Comparison of those with/without HI on demographic and offending factors revealed more imprisonments and a younger age at first imprisonment in those with HI. Prisoners with a history of HI reported poorer health and greater use of recreational drugs.

Ferguson et al[18] reported HI in samples of prisoners from 30 prisons in South Carolina who were released during the data collection period or had lifetime or death sentences. A customised version of the OSU-TBI-ID[9] was used to assess HI occurrence and severity. The authors note that their findings may not generalise because of exclusion criteria that included arrests outside South Carolina, being younger than 18 years or having difficulty giving informed consent. Overall 69% reported a HI with altered consciousness or LoC (65% of males and 72% of females). A third to a half self-reported more than one HI. In males, HI with LoC was reported in 42% of those at release and 50% of those with life or death sentences; in females these figures were 50% and 33% respectively. The number of persisting symptom complaints increased with HI severity. The most common persisting symptom for both genders was headache (males 59%; females 66%). Dizziness and balance problems were commonly endorsed by women (50%) and feeling slowed down (42%) and visual problems (44%) by men. Of 431 participants, 29% of male releases, 41% of male non-releases, 47% of female releases and 25% of female non-releases reported that family or friends said they "acted differently" after their HI. Although the prevalence of persisting symptoms is reported, the prevalence of disability is not given. No non-prison or non-HI comparison group was used and the use of a specific geographical cohort limits generalisability.

Morrell et al[19] report prevalence and effects of HI in a prison sample (N=1000), consecutively admitted to an unreported number of prisons in a US Midwestern state. A brief structured interview assessed whether participants ever had a "head injury" before asking about hospitalisation, duration of LoC and long-term effects. A HI was reported in 25%. Eight percent self-reported a moderate-severe HI, defined as LoC of >30 minutes. Severity of HI was stratified by self-report of duration of LoC as none (24%), one minute or less (7%), 1-5

minutes (26%), 5-30 minutes (15%), ½-2 hours (13%), 2-6 hours (2%), 6-12 hours (2%), 12-48 hours (5%) or more than 48 hours (4%). The rationale for these severity categorisations is not clear. At least one persisting symptom was reported in 20% with a HI of any severity. Disability is not considered. It is unclear if the sample was representative of the prison population. There are no comparisons with prisoners without HI or general population groups.

Ray et al[20] examined the prevalence of HI in male prisoners in the Indiana State prison system using a short version of the OSU-TBI-ID. Participants (N=831) were prison entrants in a 28-day period; no details are provided about the wider prison population. Severity was categorised by estimated duration of LoC. Overall, 36% reported any HI and 26% a HI with LoC. 'Possible' (6%) or mild (20%) HI was defined as being dazed, or having a 'brief' lapse in memory or LoC, and moderate (6%) or severe (4%) as LoC for more than 30 minutes. Those with HI were more likely to have committed crimes against the person. This study did not compare results to the general population or report persisting problems or disability. The authors are cautious about their findings given their focus on males in a single US state.

Templer et al[21] explored the prevalence of HI which received no medical attention in male prisoners in California compared to four control groups of University students. Participants were given a brief questionnaire asking if they had a HI with LoC. No details are provided about the wider prison population. A HI was reported in 36% of male prisoners and in 41% of male controls. In the prisoner group 47% reported permanent "lasting effects" of HI compared to 5-25% of controls; details of what constituted "lasting effects" are not given nor are inferential statistics. The study is limited by insufficent detail and by the use of inappropriate control groups.

Williams et al[22] (2010) investigated the prevalence of HI in a sample of adult males in one UK prison. Of 453 prisoners approached 43% participated; details are not provided on those who declined. A non-validated self-report questionnaire was used to determine the presence of HI and severity was defined by LoC duration as mild (no LoC or less than 10 minutes), moderate (LoC 10 minutes to 6 hours) or severe (LoC more than 6 hours). In this way, HI is reported in 65% (48% mild and 16% moderate-severe). Sixty-percent of those with mild HI reported more than one mild HI. They did not evaluate persisting problems or disability.

Discussion

The risk of bias was high with respect to the prevalence of HI and persisting disability in prisons in the ten studies reviewed. This reflects methodological issues that make it difficult to reach confident estimates.

What is the prevalence of HI in prisoners? Despite excluding studies on offender sub-groups such as death row inmates where the prevalence of HI may not represent the prison population, the range in prevalence estimates of HI in adults remains wide in the reviewed studies (25-86%), and only slightly narrower than in the studies in the meta-analyses that included offender sub-groups (10-100%)[4,5]. Neither meta-analysis assessed the quality of included studies. As noted by Crombie and Davies[23] meta-analyses are "fundamentally limited by the quality of the underlying studies" (p.7) and it can be inappropriate to calculate a summary measure if relying on papers of

low quality. It may then be that the quality of studies, rather than simply the range of prisoner sub-groups included is key to explaining the wide range in prevalence reported.

The definitions of severity of brain injury varied markedly in the reviewed studies and may contribute to the wide range in prevalence reported. In nine studies severity is reported and was most often based on LoC duration, but only four used a recognised cut-off to stratify severity[10,14,19,20]. All studies used self-report of HI and none obtained corroboration of severity from hospital records. This check may be important given that the validity of self-report of HI has been questioned[24]. The assessment tools for HI also varied and only four studies used a validated tool[10,16,18,20], although the range in prevalence remained wide (36-78%) in these studies. The reviewed studies did not demonstrate that their samples were representative of the prison population and these populations were often only described briefly and this is a potentially crucial source of bias. An exception was Durand et al[17] who present prison population data, but did not use a validated tool to assess the occurrence or severity of HI. Prison admission criteria are also likely to be a source of variation between studies and there is a need to clearly describe prison populations and compare those with HI within them. Demographic and deprivation differences in samples might contribute to the wide range in prevalence reported. Most studies indicate age and gender and these factors do not seem to be explanatory. For example the range of prevalence in males (36-86%) and females (23-72%) is wide in studies reviewed here and the average age of prisoners with HI in most studies is around 30-35 years. Deprivation is not well described. In studies reporting type of offence (eg violent or non-violent) there seems little difference in prisoners with and without HI. This emphasises the need for studies on prevalence to report how representative their samples are of the population of that prison and of the prison system as a whole, to clearly

define the demographics of the prison population in relation to its geographical catchment and to provide comparative data on the prevalence of HI in relation to the general population. Finally, the ten studies reviewed here were conducted in five Western countries and their relevance to global prison populations, and in particular to low and middle economy countries is unclear.

A recent systematic review of HI in juvenile offenders concluded that given the heterogeneity of research designs in published studies it is not possible to calculate a robust prevalence estimate[27]. Methodological issues included different definitions of HI, assessment of HI using a range of measures and the representativeness of samples. It would seem from this, that there are parallels in the juvenile and adult literature in terms of limitations.

What is the prevalence of disability arising from HI in prisoners? A single mild HI is typical of the majority with HI in the general population[25], the outcome is usually good[8] and this is likely to be reflected at least to an extent in prisoners. As most prisoners are not likely to require extensive assessment or intervention for their HI, prison health services need to operate a triage system given that the overall numbers self-reporting a history of HI are likely to be substantial. Triage may for example be to education about brain injury or to nothing required if outcome seems good or to further assessment and perhaps then to intervention if effects are more severe. Education about causes and effects of brain injury for those with mild HI may be inexpensive if provided to groups or via media and might be delivered as part of a more general preventative strategy for offenders where drug and alcohol abuse are common as is the risk of suicide and behaviours resulting in reoffending and reconviction. Given that a risk factor for sustaining a further HI is already having had one and

because repeated HI can have cumulative effects[26], preventative strategies are important. Multiple HI in relation to disability is in itself a complex issue. In some sub-groups of offenders such as gang members and victims of domestic violence, HI is reported to be an almost daily event. These HI can often be sub-concussive and often involve no hospital attendance, making their impact difficult to determine in a population where confounds of alcohol, drug abuse and deprivation are common[2,24]. The long term impact of repeated HI is a focus of considerable interest in sports and the military, the results of which may in future benefit this area. Nevertheless, those who are disabled by HI may benefit from neurorehabilitation and there is a need to estimate the prevalence of this sub-group in order to plan and develop services and use resources effectively.

Although the majority of studies considered disability outcome to be important, it was not systematically investigated. For example, Barnfield and Leathem[11] found that prisoners reported persisting problems after HI but did not provide details about the prevalence of problems or of any disabling consequences. Given this, specific conclusions regarding service-need cannot currently be drawn.

Future research: There is a need to use a standard, valid and internationally accepted definition of HI and its severity and to use a validated assessment tool[10,16,31]. To better understand the epidemiology, studies need to incorporate demographically matched controls and reflect the prevalence of HI and disability in prison populations or clearly identified representative samples in relation to prisoners without HI. There is also a need to investigate the corroboration between the evidence for HI in medical records and by self-report, especially for moderate to severe HI, where both hospital admission and long term effects are more likely. Future studies also need to use

validated assessments of disability for HI and to estimate service-need for which there are well validated tools available[32]. Furthermore, comparatively little is known about HI in female prisoners, and a research focus here is overdue. In many ways the limitations of studies reporting prevalence of HI in prisoners are similar to those more generally in epidemiological studies on HI[15,27,28] but arguably prisoners are a special case given that they should at least have equivalence of healthcare, but these needs can be easily overlooked [2,29,30].

Conclusions

While studies often report that HI is common in adult prisoners, methodological limitations mean that the quality of evidence is low. Several studies suggest that the high prevalence of HI in prisoners reflects a need for neurorehabilitation, but little evidence is provided to support this, and none adequately establish a link between self-report of HI and associated disability requiring intervention. To do this, and simultaneously improve study quality, greater homogeneity in research design is needed. If achieved, this can help to ascertain the clinical need in this population and the development of appropriate services.

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Figure 1: Flow chart of inclusions and exclusions

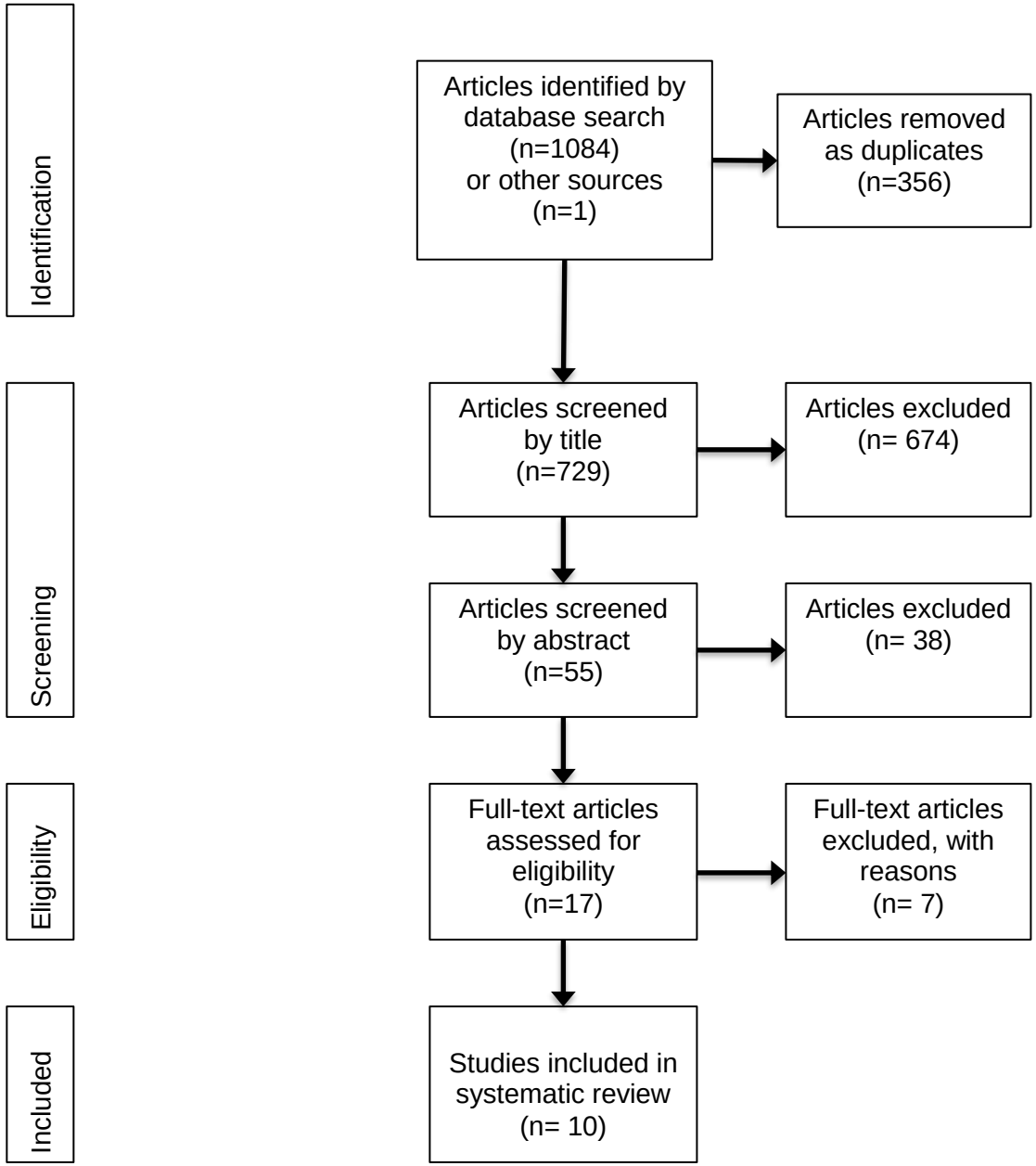

Table 1 Risk of bias

	Methods for selecting study participants	**Methods for measuring exposure to HI**	**Methods of assessing prevalence of impairment/ symptom complaints**	**Methods assessing prevalence of disability outcomes**	**Design Specific sources of confounding**	**Methods to control confounding**
Barnfield	High	High	High	Not applicable	High	High
Bogner	Low	Low	Low	Not applicable	High	High
Colantonio	Low	High	Not applicable	Not applicable	High	High
Diamond	Low	Low	Not applicable*	Not applicable	High	High
Durand	Low	High	Not applicable	Not applicable	Low	High
Ferguson	Low	Low	High	Not applicable	High	High
Morrell	Low	High	High	Not applicable	High	High
Ray	Low	Low	Not applicable	Not applicable	High	High
Templer	High	High	Not applicable	Not applicable	High	High
Williams	High	High	High	Not applicable	High	High

*(relevant data collected but not reported in relation to prevalence)

Table 2: Data extracted from included studies

Authors	Country, (sample size by gender)	HI definition	HI severity	HI assessment method; tool	Prevalence of HI in prison sample or population (%)	Prevalence compared to a non-prisoner group ?	Prevalence of cognitive impairment or symptom complaints reported?	Prevalence of disability outcome assessed?
Barnfield & Leathem 1998)	New Zealand (118M)	Any HI	LoC duration combined with number of HI	Self-report; questionnaire (non-validated)	86	No	Yes	No
Bogner & Corrigan 2009	USA (105M; 105F)	HI requiring medical attention or injury to head or neck resulting in altered consciousness	LoC duration	Self-report; validated structured Interview (OSU-TBI-ID)	78	No	Yes	No
Colantonio et al 2014	Canada (131M; 104F)	Any HI	LoC duration	Self-report; interview	43	No	No	No

Diamond et al 2007	USA (107M; 118F)	Any physical assault to the head including penetration, blunt trauma and acceleration/ deceleration injury	+/- LoC of 1 hr or PTA of 1 day	Self-report; the TBI Questionnaire	64	No	No	No
Durand et al 2016	France (991M ; 88F and 69 juveniles)	Injury to head resulting in being knocked out and/or dazed and confused	Severe if coma; moderate if hospitalised and no coma and otherwise mild	Self-report; interview	32 M 23 F	No	No	No
Ferguson et al 2012	USA (320M; 216F)	HI requiring medical attention or injury to head or neck that resulted in altered consciousness	Altered consciousness / LoC duration	Self-report; validated structured Interview (OSU-TBI-ID)	65 M 72 F	No	Yes	No
Morrell et al 1998	USA (1000)	Any HI	LoC duration	Self-report; structured Interview	25	No	Yes	No
Ray, Sapp, & Kincaid 2014	USA (831M)	HI requiring medical attention or injury to head or neck resulting in altered consciousness	LoC duration	Self-report; validated structured Interview (OSU-TBI-ID)	36	No	No	No

Templer et al 1992	USA (322M prisoners and 733 student controls of which 437F)	Any HI with LOC	Not reported	Self-report questionnaire	36	Yes (5-25%)	No	No
Williams et al 2010	UK (196M)	Any HI	LoC duration	Self-report; questionnaire	65	No	Yes	No

Abbreviations: F, Females; M, Males; LoC, Loss of Consciousness; HI, Head Injury; OSU-TBI Ohio State University TBI Identification; PTA, Post Traumatic Amnesia

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