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## Risk factors for inpatient violence and self-harm in forensic psychiatry

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**Risk factors for inpatient violence and self-harm in forensic psychiatry: The role of head injury, schizophrenia and substance misuse**

*Objective:* To investigate factors relevant to violence and self-harm in forensic psychiatric inpatients the cross-sectional association between four potential contributory factors; head injury, schizophrenia, drug and alcohol misuse, and self-harm or violence-related outcomes was examined. *Methodology:* Data were extracted from an existing dataset of routinely collected data on all patients under the care of Scotland's Forensic Mental Health Managed Care Network, of whom ( $n=432$ ) met inclusion criteria. A Factorial MANOVA and Pearson's CHI square tests were conducted to assess the relationship between potential contributory factors and self-harm and violence. *Results:* Forty-seven individuals had a documented head injury (10.9%). The presence of head injury was significantly associated with inpatient violence and assessed violence risk. Number of historic violent offences was significantly associated with a history of drug misuse and co-morbid alcohol misuse and schizophrenia. Self-harm was significantly associated with drug misuse and a diagnosis of schizophrenia. *Conclusion:* These findings highlight a significant association between head injury and actual/assessed risk in forensic psychiatry, over and above that of substance misuse and a diagnosis of schizophrenia, emphasizing the need for routine assessment of head injury in clinical practice. Further examination of the impact of head injury in forensic psychiatric populations is needed.

Keywords: violence; risk assessment; self-harm; forensic psychiatry, head injury

### **Introduction**

The rate of violent behaviour in inpatient mental health settings is higher than in community mental health settings, with evidence suggesting that up to one half of inpatients exhibit violent or assaultive behaviour while in the hospital [1-3]. Violence and aggression within inpatient units can have an adverse effect on treatment settings, work contentment and productivity and often result in a negative atmosphere in the environment [3]. Moreover, fear of future violence in the workplace is associated with employee burnout [4] and emotional exhaustion [5]. Such burdens are likely to impair treatment success and patient recovery.

In addition to an increased risk of harm to others, psychiatric inpatients are also at a significantly increased risk of self-harm. A review by James, Stewart & Bowers (2012) [6] found that the average self-harm prevalence rate within psychiatric inpatient settings to be 17.4% (range 1- 69%), rising to the considerably higher rate of 42.9% in forensic psychiatric inpatients. Given the physical and psychological effects of self-harm on patients and indirect impacts on carers and staff [6-7], the need to address self-harm in forensic services is paramount.

Given the high rates of harm to self and others, the management, reduction and prediction of risk is the cornerstone of forensic psychiatric practice. Structured professional judgement approaches have gained clinical momentum over the last few decades, yet their ability to accurately predict violence remains debatable. Indeed, the results of meta-analyses demonstrate that many predict violence with only small to moderate effect sizes [8-9], indicating that greater specificity could result from an increased understanding of violence and aggression leading to the inclusion of further risk factors.

The assessment of patient risk to self has also gained momentum, with the development of tools aimed to assess risk of self-harm emerging in the mid 1970's, including the Suicide Intent Scale [10], Beck scale for suicide ideation [11] and SAD PERSONS scale [12]. Yet their validity

and accuracy in mentally ill populations remains largely unknown [13] suggesting that a greater understanding of the risk factors for self-harm in forensic psychiatric practice is also necessary.

### ***Risk factors for violence and self-harm***

Two of the most commonly cited risk factors for *both* violence and self-harm in forensic psychiatric populations are a diagnosis of schizophrenia and substance misuse. Variations of one or both of these risk factors are routinely included in the most common violence-risk assessment tools, including the HCR-20 (Historical Clinical Risk Management – 20) [14-15], VRAG (Violence Risk Appraisal Guide) [16] and the SAVRY (Structured Assessment of Violence Risk in Youth) [17].

Schizophrenia is commonly the most prevalent diagnosis in forensic psychiatry inpatients and, while a majority of those diagnosed are not violent, a diagnosis of schizophrenia is now recognised as conferring an increased risk for violence and aggression in comparison to the general population [18-19]. This increased risk has been attributed to symptomology, comorbidities, cognitive abilities and neurobiology [18-21], highlighting the wide array of underpinning mechanisms. A diagnosis of schizophrenia is also associated with significantly increased risk of self-harm in both men and women, with comorbid substance abuse significantly increasing this risk [22-23]. It has been suggested that the relationship between violence risk, schizophrenia and self-harm is interrelated, with suicidal threats yielding an independent association with violence risk [24].

Forensic psychiatric inpatients are also considerably more likely than the general population to meet the criteria for substance abuse or dependence, with suggested prevalence rates of 46-55% [25-27]. Undeniably, the significantly higher rates of risk of violence found in serious mental illnesses in comparison to general populations are exacerbated by comorbid substance use disorder [28], and there are direct associations between substance use and/or intoxication and recidivism within mentally ill offender populations [29-30]. This relationship has been evidenced even after adjustment for diagnoses, age and history of violence [31]. Furthermore, patients who

misuse drugs have been found to be six times more likely to be readmitted and four to six times more likely to be involved in a serious incident if they misused alcohol or drugs, highlighting the increased risk associated with both alcohol and drug misuse [32].

The relationship between substance misuse and self-harm is likewise well documented. A multisite, UK-based study found that alcohol was involved in over half of assessed self-harm episodes [33]. Furthermore, in individuals diagnosed with schizophrenia both drug abuse and dependence have been found to significantly contribute to risk of deliberate self-harm [34], and polysubstance abuse has been shown to be an independent predictor of self-harm [35].

Adverse childhood experiences (ACEs), for example childhood abuse, exposure to domestic violence, and household substance abuse, have also been highlighted as contributors to self-harm, substance abuse, and perpetration and victimisation of violence later in life. In a meta-analysis across 37 studies and over 250 000 participants, the attributable risk for individuals with four or more ACEs were 7.51% and 8.10% for violence victimisation and violence perpetration respectively, 10.22% for problematic drug use and 30.14% for a suicide attempt as compared to individuals without an ACE [36]. Interestingly, this study did not find a strong association between experiencing at least four ACEs and problematic alcohol use. Although ACEs were not a focus for the present study, their relevance highlights the complex and multi-faceted risk factors also contributing to inpatient self-harm and violence.

### ***Head injury, violence and self-harm***

The increased prevalence of head injury amongst offender populations has been well documented. In an early study examining homicide perpetrators, Dr. Otnow Lewis and colleagues [37] found that in a sample of 15 death row inmates that were waiting execution 100% had histories of severe head injury. In a subsequent study by the same research group in 1988, over half of the juveniles sampled awaiting execution had suffered a head injury prior to conviction [38]. These influential studies highlighted the role that head injury may play in violent crime. In a more recent 2010 meta-analysis of twenty studies in adult offender populations the overall estimated prevalence of brain

injury was 60.25% (range 10-100%) [39]. Similarly, amongst forensic psychiatry inpatients the prevalence of head injury is significantly higher than in the general population, with approximately one quarter of patients in American low and medium security wards recorded as having a history of loss of consciousness (LOC), and up to 64% of those in maximum-security wards documented as possessing multiple indicators of brain dysfunction [40-41].

Despite the high rates of prevalence, historically head injury has not received much attention in forensic psychiatric contexts. This is surprising given the suggested direct association between head injury and violence and indirect association between head injury and common risk factors for violence. More specifically, head injury is known to have a high degree of co-existence with psychiatric disorders [42], whereby rates of comorbid psychiatric diagnosis in traumatic brain injury (TBI) are as high as five-fold as those without [43]. There remains debate as to whether head injury influences, or triggers, the onset of mental health symptoms or whether individuals with mental illness are more susceptible to head injury [44-45]. However, in psychiatric inpatient populations there is a high reporting of head injury, and the majority of these patients report their head injury as predating the onset of their psychiatric symptoms [46]. Furthermore, evidence suggests that the use of alcohol and drugs in TBI populations commonly predates injury, although TBI also acts as a risk factor for development of behavioural disorders and relapse into substance misuse post TBI [47]. Indeed, two systematic reviews indicate that approximately 37-51% of individuals with a diagnosed TBI reported being intoxicated at time of injury [48-49].

The direct association between brain injury and increased aggression, antisocial behaviour and offending are well documented [50-52], and the link between TBI and a significantly increased risk of violent crime has been seen longitudinally [53]. For decades' studies have been providing evidence that violent offenders are more likely than non-violent offenders to have a history of TBI or head injury with LOC for a prolonged period [54-55], and more recently the impact of TBI on earlier onset of violent offending and reconviction has been highlighted [56].

The combination of head injury and mental illness appears to further increase the risk of violence. When examining mentally ill offenders (MIO), patients with head injury are more likely than patients without to have had a violent index offence and are at significantly more risk of self-harm and harm to others [41, 57]. Hawley & Maden's (2003) study concluded that MIO's with head injury are significantly more difficult to discharge as compared to those without a head injury, highlighting the need for prolonged rehabilitation in this group. Indeed, patients with brain injury in a mental health care setting need specialised care which is not available in other health care settings [58].

### *The present study*

Despite the apparent overlap between head injury, schizophrenia and substance misuse, there has been little examination of the relationship between these variables, self-harm and violence in forensic psychiatric inpatients on a population-level. We therefore sought to examine the prevalence of violence and self-harm in a population cohort and its association with historical head injury, historical drug and alcohol misuse, and a diagnosis of schizophrenia. It was hypothesised that presence of head injury and substance misuse within patients would predict increased risk of harm to others and risk of harm to self, over and above a diagnosis of schizophrenia.

## **Methodology**

### *Study population*

Data were extracted from the Forensic Network Census Dataset (FNCD) - an existing dataset comprising routinely collected data on all patients under the care of Scotland's Forensic Mental Health Managed Care Network in November 2013. Information on 526 individuals within the Forensic Network (FN) was received from the FN manager, of which 94 were excluded based on primary or secondary learning disability diagnoses, resulting in a total of 432.

## ***Procedure***

### *The forensic mental health service user database*

The forensic network in Scotland currently hosts a database of routinely collected service-user data that was developed in 2013 with the intention of collecting data annually. The data returns from 2013-2014 were used for the purpose of this study. The census includes a wide range of data from case-notes including demographic details, psychiatric and forensic history, medication details, physical and social history, and risk assessment. The data are available by application in non-identifiable, anonymised format, as requested for the purpose of this study.

### *Data collection*

Anonymized data was extracted from the FNCD. Risk-related outcomes, head injury, substance abuse and demographic FNCD variables of interest were pre-determined. Measures of head injury were drawn from questions inquiring about historic diagnoses, brain scans, brain scan abnormalities, International Classification of Diseases 10 (ICD-10) [59] diagnoses and birth problems or incidents. Measures of substance abuse were drawn from questions pertaining to alcohol consumption problems, use of drugs/substances, history of intravenous drug use, and ICD-10 diagnoses. Measures of risk-related outcomes included previous convictions, current or historic self-harm, violent incidents during admission and assessment of violence proneness (HCR-20).

## ***Outcome variables***

### *Quantity of violent offences*

For the purpose of this study violent offences were defined as: with intention to attempt, threaten or inflict harm on another human. By this definition, homicide, attempted homicide, serious assault, robbery with assault, arson with intent to endanger life, sexual assault, rape/attempted rape, and abduction were all considered violent offences. These definitions and classifications are in line with other recent publications on violence and mental illness [53, 60]. Quantity of violent offences were recorded by responsible medical officers, or a member of the health care team, for each individual.

### *Risk of harm to self:*

Self-harm was defined as intentional bodily harm to oneself. Patient episodes of self-harm/suicide were coded as a dichotomous variable or 'unknown' and was a combination of variables relating to 'current admission' or 'previous history'. For the purpose of this analysis we examined the impact of risk factors on a singular self-harm outcome due to restricted ability to self-harm within inpatient settings.

### *Violence proneness*

Violence proneness was conceptualised through scores on the Historical Clinical Risk Management – 20 (HCR-20) violence risk assessment. Scores were only included if there were a minimum of 17/20 historic factors, and 4/5 risk and clinical factors completed. Scores were adjusted based upon how many factors were answered.

### *Head injury*

Head injury was coded as either medical history of head injury, current head injury (within the past year), diagnosis of acquired brain injury, and/or brain scan abnormalities confirming head injury. Presence of head injury was *not* recorded solely on the basis of brain scan abnormality, as we know this can occur for a variety of reasons other than head injury. Head injury was coded as a dichotomous variable based on the information available.

### *Alcohol and drug misuse*

Misuse included harmful (recreational) use, dependence and secondary diagnosis in both cases. Alcohol and substance misuse were coded as dichotomous variables.

### *Diagnoses*

Diagnoses were made using ICD-10 or Diagnostic and Statistical Manual of Mental Disorders (DSM) [61] criteria and recorded as either a primary or secondary diagnosis by responsible medical officers.

### ***Statistical analysis***

SPSS statistical software was used to conduct analyses. Descriptive statistics were computed for the remaining cohort after excluding learning disabilities. Presence of head injury and history of substance abuse were coded into dichotomous variables (1=yes, 0=no) in order to determine prevalence. A factorial MANOVA was employed to examine the impact of risk factors on violence outcomes. Chi square tests were run to examine the differences between groups with and without presence of risk factors on violence during admission, current self-harm episodes (<1 year) and history of self-harm episodes. Unless otherwise specified, statistical significance was based on a minimum  $p$  value of 0.05.

## **Results**

### ***Participants***

Demographic and psychiatric characteristics are displayed in table 1. The mean age for the sample was 44.47 years, ranging from 21-79. The modal participant was male (90.7%), White Scottish (78.7%), had a diagnosis of schizophrenia (70.4%), and was currently residing in high secure care (32.9%). There were 142 individuals within high secure care, 57 in medium secure, 114 in low secure, 45 in an open ward environment and 74 for whom this was unrecorded.

### ***Forensic history***

There were 322 individuals with a documented previous conviction, 82 without a previous conviction and 28 for whom conviction status was unknown. Over one quarter of the sample ( $n=121$ , 28%) had 10+ previous convictions, 63 (19%) had 5-10, 104 (24.1%) had <5, and 144 (33.3%) for whom the number was unknown. The average number of violent offences was 2.22, ranging from 1-13.

The most common type of violent offence committed was serious assault ( $n=65$ , 21.2%), followed by attempted murder ( $n= 42$ , 13.7%), culpable homicide ( $n=35$ , 11.4%), and murder ( $n=31$ , 10.1%). There were 28 individuals for which type of previous offence was unknown (6.5%) and a further 16 that had a confirmed conviction but no recording of type of conviction, suggesting

these data could be skewed. In addition to their formal convictions, there were 183 (42.4%) individuals who had a documented violent incident during admission. Violence was most commonly directed at nursing staff ( $n=142$ , 77.6%), followed by patients ( $n=29$ , 15.8%), other ( $n=5$ , 2.7%), other health professionals ( $n=2$ , 1.1%), self ( $n=2$ , 1.1%), unknown ( $n=2$ , 1.1%) and responsible medical officer ( $n=1$ , .5%).

A total of 286 participants had a sufficient proportion of the HCR-20 completed by their care teams (see operational definition). The average total HCR-20 score was 27.55 (SD = 6.62), ranging from 6.75 to 40. Forensic history is presented in table 2.

### ***Comorbidities***

There were 314 individuals who had a history of alcohol misuse, including harmful use ( $n=213$ ), dependence ( $n=67$ ), secondary diagnosis ( $n=9$ ) and other ( $n=25$ ). Similarly, 322 individuals had a history of drug misuse. Harmful use was the most common type of historical drug problem ( $n=204$ ), followed by dependence ( $n=63$ ), other ( $n=37$ ) and secondary diagnosis ( $n=10$ ). The mean number of drugs used, from patients where drug use was known, was 3.53 (sd =2.47), ranging from 0-10. There were 47 individuals with a documented head injury (10.9%). Thirty-nine individuals had a history head injury, four had a current head injury (within the past year) and for 4 individuals time of head injury was not documented. Only 140 individuals had record of a brain scan, 27 of which showed abnormalities. There were 135 individuals who had not had a brain scan and 157 for which it was unknown. The most common scan type was CT Scans ( $n=108$ ). Six of these individuals had a primary diagnosis of acquired brain injury, and seven had a secondary diagnosis.

### ***Self-harm history***

A majority of the sample ( $n=310$ , 71.8%) had a history of self-harm, 68 (15.7%) did not and self-harm history was unknown for 54 (12.5%).

### ***The impact of comorbidities on violence-related outcomes and self-harm***

In order to test the relationship between head injury, alcohol misuse, drug misuse and violence-related outcomes a Factorial MANOVA was conducted (see table 3). Head injury, alcohol misuse

and drug misuse were entered into the model as categorical independent variables. The HCR-20 total score and total number of violent offences were entered as multiple continuous outcome variables. As we know a diagnosis of schizophrenia has been consistently examined in relation to violence in psychiatric populations, we included a diagnosis of schizophrenia as a dichotomous variable in the analysis to see if it accounted for more variance than the aforementioned predictor variables.

Using Pillai's Trace, there was a significant effect of head injury ( $F(2,258) = 4.39, p = .013$ ; partial  $\eta^2 = .046$ ), drug misuse ( $F(2,258) = 4.45, p = .013$ ; partial  $\eta^2 = .033$ ) and the alcohol misuse \* schizophrenia interaction ( $F(2,258) = 3.74, p = .025$ ; partial  $\eta^2 = .028$ ).

Between-subjects ANOVAs suggested that head injury was the only variable to have a significant effect on HCR total scores ( $F(1,259) = 6.68, p = .010$ ; partial  $\eta^2 = .025$ ). Drug misuse ( $F(1,259) = 8.93, p = .003$ ; partial  $\eta^2 = .033$ ) and the interaction between alcohol misuse \* schizophrenia ( $F(1, 259) = 7.52, p = .007$ ; partial  $\eta^2 = .028$ ) had a significant effect on total number of violent offences, as did head injury at a .1 p-value only ( $F(1,259) = 3.50, p = .063$ ; partial  $\eta^2 = .013$ ) (see table 4).

In order to test the relationship between violence during admission and presence of head injury, alcohol misuse, drug misuse and a diagnosis of schizophrenia, a Pearson's CHI square test was conducted (table 5). Our results suggest that head injury was the only independent variable included in the analysis that was able to differentiate those who were and were not violent during admission  $\chi^2(1, n = 394) = 5.55, p < .05$ , relative risk = 1.45. Conversely, we did not find that alcohol misuse, drug misuse or a diagnosis of schizophrenia significantly differentiated those who had recorded violent incidences during admission versus those who did not.

As self-harm was coded as a dichotomous variable, Pearson's CHI square test was run to examine if there was a difference between those with presence of risk factors (table 6). Our results suggested that individuals with a diagnosis of schizophrenia ( $\chi^2(1, n = 378) = 12.52, p < .001$ ,

relative risk = 1.22) and a history of drug misuse ( $\chi^2(1, n = 369) = 8.99, p < .01$ , relative risk = 1.20) were significantly more likely to have a history of self-harm compared to those who did not. Conversely, we did not find that head injury or alcohol misuse history significantly differentiated those who currently or previously self-harmed versus those that did not.

### **Discussion**

The present study aimed to examine prevalence of violence and self-harm in a population cohort of mentally ill offenders and their association with head injury, schizophrenia, and drug and alcohol misuse. It was hypothesised that presence of historical head injury and substance misuse would be associated with increased risk of harm to others and harm to self, over and above a diagnosis of schizophrenia. The results of this study indicate that all four factors have an effect on violence, with head injury emerging as the most prominent. Conversely, while drug misuse and schizophrenia had an effect on self-harm, head injury and alcohol misuse did not.

#### *Prevalence of self-harm and violence*

The prevalence of violence and self-harm identified are both substantially higher than previously observed in offending populations. Approximately seven out of ten individuals included in the present analysis had a documented episode of self-harm, highlight the breadth and scope of the problem. This is nearly 1.7-fold the average prevalence rates in forensic psychiatric inpatient samples reported in James, Stewart & Bowers (2012) review [6].

Similarly, the prevalence of individuals who had an episode of inpatient violence was alarmingly high at 42.2%. Assessed violence proneness was just slightly higher than that seen within previous literature [21, 62], however, direct comparison of assessed violence proneness using the HCR-20 is difficult due to cross-culture and service variabilities. Nonetheless, these results highlight the startling prevalence of harm to self and others documented within the present sample.

### *The impact on violence-related outcomes*

There is a paucity of research examining the impacts of head injury on violence and self-harm in mentally ill offenders, despite the direct impact of these factors in other populations. Those that have examined the relationship between violence and head injury conclude that there is a strong association between head injury and increased aggression and antisocial behaviours [50] and increased risk of violent crime longitudinally [53] in offending populations. The current results support these findings and further suggest there to be a strong effect of head injury on violence in mentally ill offenders. More specifically, head injury had a significant impact on violence proneness (HCR-20 total scores) and violence during admission over and above alcohol misuse, drug misuse, and a diagnosis of schizophrenia. Evidence regarding the link between substance and alcohol misuse and violence is extensive, whereby presence of a substance misuse comorbidity, or intoxication on its own, significantly increases the number of violent reconvictions [63], recidivism [29-30] and assessed risk of violence [64]. The present results contrast significantly with those found within previous literature, in that alcohol misuse was not found to have a significant effect on violence-related outcomes in the overall model, and although drug misuse did, follow-up analyses revealed this was only the case for historic violence variables. However, this is possibly attributable the limited access to substances and alcohol during admission, or the use of an inclusive operational definition whereby misuse, dependence and harmful use were all included under the substance and alcohol misuse umbrella.

When examining the interaction between comorbidities, no significant effect of dual diagnoses of schizophrenia and alcohol or drug misuse on violence risk factors was found. This finding contradicts previous meta-analytic results that suggest that the increased risk of violence associated with schizophrenia and psychosis is mediated by substance abuse comorbidities [20]. Subsequent analysis however, indicates that co-occurring schizophrenia and alcohol misuse were significantly associated with violence risk, but that this effect was over-ridden by the stand-alone effects of head injury and drug misuse. In this sample therefore both head injury and drug misuse

individually proved to be greater predictors of assessed violence risk than comorbid schizophrenia and alcohol misuse.

It is plausible that involvement in historic violence could have led to head injury rather than head injury being a precursor to violence, however we were unable to determine if head injury predated individual's history of violence or vice versa. It is also possible that head injury acts as a distal factor to more proximal factors, which may be suggestive as to why head injury has not gained increasing levels of focus in forensic psychiatric care. More specifically, it may be that the changes in personality and cognition resulting from head injury, such as lack of foresight, inability to plan and conceive consequences of actions and decreased inhibition, that directly impact violent behavior [65], are the primary areas of focus. However, if it is head injury that precedes the proximal factors related to violence, determining the presence of injury can aid in identifying those at most risk of violence and who consequently require the most attention in terms of prevention and management of risk. These findings emphasize the need for more robust reporting and monitoring of head injury in secure settings, given its direct relationship with inpatient violence in a high-risk population with whom robust measures for the management and prevention of violence are essential.

In contrast to Hawley & Madden's (2003) findings, head injury was not found to have a significant impact on risk of harm to self [57], however drug misuse and a diagnosis of schizophrenia was significantly related to whether or not an individual had a historic episode of self-harm. This is in line with previous literature suggesting an increased risk of self-harm in schizophrenia in both men and women, with comorbid substance abuse significantly increasing this risk [22-23]. In contrast to our findings, a multisite, UK-based study found that alcohol was involved in over half of assessed self-harm episodes [33]. It is plausible that alcohol use during self-harm episodes is a risk factor whereas historic alcohol misuse is not.

Currently there is little provision for head injury within forensic psychiatric settings, despite the clear link between head injury and adverse individual and service-level outcomes. Perhaps the reason for lack of provision is that there currently exists only one study in the UK that examines head injury in mentally ill offenders. Hawley and Maden (2003) found that violent offences were more common in those patients who had a history of head injury, and that these patients also demonstrated greater risk of violence and self-harm and were rated as more difficult to discharge in comparison to those with no such history [57]. Their results clearly highlighted the impact of head injury on the management and treatment of mentally ill offenders leading them to call for further examination of the incidence of head injury amongst mentally ill offenders. There have, however, been no studies that have examined head injury in MIO's in the UK since.

Patients with brain injury in mental health care settings need special care [58], something for which there appears little provision. In order to provide effective care, there must first be a consistent method for recording the presence and severity of head injury. The current results, alongside Hawley and Maden's, emphasize the importance of both: (a) recording and measuring head injury within forensic psychiatric services, and; (b) including head injury in the assessment and management of risk.

### ***Limitations***

We are grateful for the opportunity afforded by the use of routinely collected clinical data which provided a, possibly unique, entire population sample. However, the collection of data for clinical rather than research purposes potentially contributed to an increase in missing data and a reliance on patient's self-report or those medical records that were in the clinical team's possession. Indeed, many head injuries go unreported due to differing operational definitions of head injury, for example whether it is based on injury severity, such as the length of any loss of conscious or post traumatic amnesia or the presence of residual impairment. Indeed, in forensic populations many patients report not having sought medical care. Clinicians must therefore often rely on self-report, rather than, for example, brain scanning or neuropsychological screening. We observed a dearth

of clinical notes that had reported brain scan history, and even fewer that had reported conclusive results, similar to the difficulties observed in of Hawley and Maden's (2003) study [57]. Based on the availability of data, the rates of head injury reported are likely to be significantly underestimated. The present results therefore emphasize the need for a gold-standard, easily employed tool for measuring the presence, quantity and severity of head injury in mentally ill offenders. The use of existing screening tools, such as the Glasgow Coma Scale or the Ohio State University TBI Identification Method, may also yield benefit.

Information on the timing or severity of head injury, substance or alcohol misuse was not available, which restricted our ability to determine if these factors predated violence or vice versa. Neither was it possible to examine the mechanism by which head injury, substance misuse or alcohol misuse affected violence outcomes, such as impulsivity or increased aggression, and this should remain a key target for research in this field. Neuropsychological assessment can also augment our understanding of which cognitive domains are impaired and require treatment, such as cognitive remediation, following brain injury. Indeed, evidence suggests that cognitive enhancement therapies can help preserve gray matter volume, thus potentially enhancing long-term cognitive outcomes [66].

Unfortunately, it was not possible to examine the mediating impacts of adverse childhood events. Adverse childhood events, including child maltreatment and low levels of education, are also prevalent in mentally ill offender populations, and are known to be associated with an increased risk of suicidal behavior [67-69] and violence [70]. It is believed that childhood abuse in particular creates a cycle of violence, whereby previous exposure can cause perpetrating and/or antisocial behaviour later in life [71]. As such, mental illness in isolation is never the singular cause of violence, however the additional factors that predispose violence in mentally ill offenders highlight the complex and multidimensional treatment needs of this population. It is recommended that future research aim to disentangle the relationship between head injury, substance misuse, schizophrenia, self-harm and violence by further examining underpinning mechanisms and

predisposing factors, such as adverse child events. Allowing for a more holistic understanding of predictors of self-harm and violence.

### ***Conclusion***

Mentally ill offenders with a history of head injury are significantly more likely to be violent during admission and have a higher assessed risk for violence than those without a head injury, over and above other prominent risk factors including psychiatric diagnosis. A diagnosis of schizophrenia, history of drug misuse or history of alcohol misuse was significantly associated with historic violence as well as episodes of self-harm. These results highlight the importance of examining, managing and treating head injury in forensic psychiatric populations, and emphasize the need for further research in this area.

### **Declaration of interest**

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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