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Neurodevelopmental Disorders, Head Injury and Offending in Young  
People

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

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## Foreword

Due to the Covid-19 pandemic, the original proposal for the Major Research Project did not go ahead (Appendix 3.1, p. 104). The original proposal investigated links between head injury, neurodevelopmental disorder and offending by interviewing young people, their parents or carers and social workers. The research was altered to a secondary data project, exploring rates of reported head injury and neurodevelopmental disorders in mental health case notes and associations between these conditions and offending behaviour. Recruitment was no longer required for the rescue project and data was extracted and amalgamated from NHS service records by an assistant psychologist.

## Chapter 1: Systematic Review

A Systematic Review of the Criminal Offending Patterns Reported in the  
Last Two Decades for Young People with Neurodevelopmental Disorders:  
2002-2022

Prepared in accordance with the author requirements for Psychology,  
Crime and Law;

[https://www.tandfonline.com/action/authorSubmission?show=instructions  
&journalCode=gpcl20](https://www.tandfonline.com/action/authorSubmission?show=instructions&journalCode=gpcl20)



## **Abstract**

Background: Neurodevelopmental disorders (NDDs) are highly prevalent in young offending populations compared to the general young population (Hughes et al., 2012). Less is known about the specific influence NDDs may have on frequency of offending, types of offending behaviour and how other factors impact on this relationship. Aim To systematically review, critically appraise and synthesise the available evidence on the relationship between NDDs and patterns of offending. Methods: ASSIA, CINAHL, MEDLINE and PsychINFO databases were searched for published studies that investigated the relationship between NDDs and offending. Observational, case-control or cohort studies from peer reviewed journals that explored the relationship between NDD and offending, included more than one NDD, utilised formal diagnoses, had an age range up to age 35 and were published between 2002 and 2022 were included in the review. Results: Ten eligible papers were identified and reviewed; two had low risk of bias. Prevalence rates of NDD in young offenders could not be conclusively established, due to the poor quality and different NDD and offending focuses between papers. Two low risk of bias papers found that ADHD featured in increased risk for violent offending. Conclusion: There is a link between NDD and offending in young people, particularly with certain NDDs. Quality of the evidence base requires refining and developing through more research to support young people with NDD who offend. Keywords: Juvenile, neurodevelopmental, offending, crime.

## Introduction

### *Neurodevelopmental disorders*

‘Neurodevelopmental disorder’ (NDD) is a broad term that comprises a variety of diverse neurological and psychiatric difficulties that differ in terms of clinical presentation and need, and are etiologically diverse (Thapar et al., 2017). Generally, NDDs are related to disruption in brain development, resulting in difficulties with communication, cognition, adaptive behaviour and psychomotor skills (Parenti et al., 2020). The Diagnostic and Statistical Manual of Mental Disorders (DSM; 5th ed.; DSM–5; American Psychiatric Association, 2013) refined the definition of NDDs to encompass several specific neurodivergent diagnoses (Attention Deficit Hyperactivity Disorder (ADHD), Intellectual Disability, Communication Disorders, Specific Learning Disorders and Motor Disorders) (American Psychiatric Association, 2013). However, evidence suggests that NDDs tend to co-occur, for example ADHD and learning difficulties are commonly comorbid (Billstedt et al., 2017) and it is suggested that differential diagnosis training is vital so that the ranges of NDDs can be recognised (McCarthy et al., 2015). Some features of NDDs such as hyperactivity and impulsivity, cognitive and language impairment, alienation, and poor emotional regulation are linked to increased likelihood of criminal behaviour (Hughes et al., 2012). However, the influence, if any, of different NDDs on frequency of offending and types of offending behaviour and the interaction of other factors with the NDD-offending relationship need to be better understood.

### *Traumatic brain injury and neurodevelopmental disorders*

Traumatic Brain Injury (TBI) occurs when normal brain functioning is disrupted due to a direct blow or penetrating injury to the head (Centers for Disease Control and Prevention, 2022). Childhood TBI is thought to affect brain development (Centers for Disease Control and Prevention, 2022) and result in neurocognitive problems, developmental difficulties and changes to behavioural functioning (Williams et al., 2015). Changes to social skills, communication, impulsivity and emotional regulation are some of the consequences of TBI that

have been noted in the literature (Williams et al., 2015). There is a high prevalence of TBI in young people in who are incarcerated (65-75%) in comparison to the general population of young people (5-24%) (Hughes et al., 2012). Children aged under three who experienced mild to severe TBI were found to be at increased risk of global cognitive deficits (Keenan et al., 2007). Additionally, it is suggested that TBI and NDD are connected, either because the characteristics such as impulsive behaviour that are associated, for example with ADHD, increase the likelihood of TBI occurring or because TBI predisposes the development of other neurodevelopmental conditions (Hughes et al., 2012). It is suggested that there is overlap between specific NDDs such as ADHD and specific learning difficulties (Hughes et al., 2012) that are defined in diagnostic manuals such as the DSM (American Psychiatric Association, 2013). It has therefore been suggested that the overlap may impact how these conditions are experienced, assessed and treated (Hughes et al., 2012). Therefore, this may suggest that reliance on rigid categorisation of NDDs may be more problematic in research where TBI and NDD are intertwined.

#### *Neurodevelopmental disorders and offending*

Published prevalence rates of all NDDs in young, offending populations is limited because available estimates of prevalence rates focus on individual diagnoses, as opposed to all NDDs. A meta-analysis showed the prevalence rates of different categories of NDDs in young people in custody (Hughes et al., 2012). Twenty-three to 32 percent had learning disabilities, 43-57% had Dyslexia, 60-90% had communication disorders, 12% had ADHD and 15% had Autistic Spectrum Disorder (ASD) (Hughes et al., 2012). A study with male adults in prison found that 36.3% of the sample screened positive for ASD, ADHD or Learning Disability (McCarthy et al., 2015).

Alongside personality factors associated with NDD; increased antisocial and aggressive behaviour; exposure to environmental and social risk factors; unnecessary criminalisation and discrimination by services due to lack of recognition of NDD were proposed as factors that

increased offending (Hughes, 2017). For example, impaired ability to understand and participate in legal proceedings may negatively impact how a young person interacts in a court setting, thus worsening legal outcomes (Hughes et al., 2012).

Emerging findings about the high prevalence of NDDs in offending populations has led to an emphasis on the importance of early recognition and intervention to meet young peoples' needs and to prevent premature criminalisation from an early age (Bower et al., 2018). However, most research on NDDs and offending focuses on one or a limited number of diagnoses of interest, as opposed to NDDs more broadly (Billstedt et al., 2017). Less is therefore known about the specific influence of neurodivergence on patterns of offending and whether offending patterns differ depending on specific NDDs and their diagnostic features.

#### *Youth criminal justice systems*

Young people with NDD are more likely than the general young population to be involved in youth criminal justice systems, despite preventable factors that contribute toward their involvement (Hughes et al., 2012). As interventions and criminal justice proceedings are not adapted for young people with NDDs, this can be considered a health inequality, as there is not consistent equity in the treatment, culpability and outcomes for youth with NDDs in comparison to young people who do not exhibit neurodivergence (O'Rourke et al., 2020). The lack of consistency, despite the known impact of NDDs across multiple areas of functioning highlights the importance of recognising NDDs when determining criminal responsibility to ensure that this vulnerable population is not unnecessarily criminalised. Holland et al. (2021) suggested that specific tools for identification of NDDs in youth criminal justice settings are not sensitive enough to effectively detect NDDs and that further research is vital, alongside holistic screening, assessment and treatment for young people with NDDs who offend.

As the existing literature tends to investigate only one or two types of NDD in relation to offending, rather than all NDDs, general links between NDD and offending have been made

when it is not known whether this applies to all types of NDD. Additionally, factors that may also influence emerging patterns between NDD and offending, such as adverse childhood events (ACEs) have not been conclusively established so far. Therefore, this review aims to describe and critically examine the existing literature that investigates certain NDD populations (namely intellectual disabilities, communication disorders, autism spectrum disorder, attention-deficit/hyperactivity disorder, specific learning disorder, motor disorder) and sub-groups of offending types.

### **Aims and Research Questions**

#### Aims

To systematically review, describe, critically appraise, and synthesise the existing literature that addresses the relationship between a specific subset of neurodevelopmental disorders, the types of offending and frequency of criminal offending behaviour.

#### Research questions:

1. Do the included subset of neurodevelopmental disorders increase risk of offending?
2. How frequent is offending in young people with the subset of neurodevelopmental disorders in comparison to the general offending population?
3. What are the reported reasons for differences in offending rates in young people with neurodevelopmental disorders in comparison to the general offending population?
4. Are certain neurodevelopmental disorders associated with particular types of offending?
5. How do factors such as alcohol use or adverse childhood events influence the relationship between the included neurodevelopmental disorders and offending?

## Methods

### Registration

A systematic review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42022327648).

### Study inclusion criteria

- Study samples include people who have been convicted or charged with a criminal offence who also have an established diagnosis of a NDD. This could be using a recognised diagnostic system such as the DSM (DSM–5; American Psychiatric Association, 2013). The DSM category of neurodevelopmental disorder includes intellectual disabilities, communication disorders, autism spectrum disorder, attention-deficit/hyperactivity disorder, specific learning disorder, motor disorder and other neurodevelopmental disorders
- Explores the relationship between NDD and offending
- Focuses on more than one NDD
- Children/adolescents up to age 35
- Observational studies such as cohort, case-control and cross-sectional studies using quantitative data
- Studies from peer reviewed journals
- Papers published between 2002 and 2022

### Study exclusion criteria

- Studies published in a language other than English
- Non peer-reviewed studies including grey literature

As noted in the introduction, although head injury (HI) is known to cause neurocognitive impairments (Williams et al., 2015), HI was not included in the review because it is not referred to as an NDD within the literature (Thapar & Rutter, 2015) and the review sought to investigate only the NDD-offending relationship. Additionally, HI is also not included within the definitions of NDD in the DSM-5 (American Psychiatric Association, 2013) or ICD-11 (World Health Organization, 2019) which are primarily used for diagnosis classification in research and in clinical settings (Tyrer, 2014).

#### Search Methods for Identification of Studies:

Four electronic databases were searched on 26<sup>th</sup> May 2022: the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medical Literature Analysis and Retrieval System Online (MEDLINE), Psychological Information Database (PsycINFO) and Applied Social Sciences Index & Abstracts (ASSIA). Date limiters between 2002 and 2022 were applied to ensure that contemporary studies were retrieved. The reference lists of relevant studies from the original search were reviewed to discover and include publications that may not have been identified by electronic searches. Dependent on the database, searches used a combination of subject headings and titles and abstracts using Boolean operators. Search terms used included juvenile, neurodevelopmental disorders, offending and childhood adversity. A full search strategy sample can be found in Appendix 1.2 (p. 94).

#### Search results

The first rater (REB) conducted the search and selected the final articles. As demonstrated in Figure 1, 3213 articles retrieved from the four databases and 1126 duplicates were removed. The titles and abstracts of the remaining 2087 articles were screened and 2036 of these were excluded. A second rater (KAD) independently screened 10% of the 2087 of the titles and abstracts by random selection. It had been planned that discrepancies would be resolved by discussion, but this was not necessary as there was 100% agreement. The full texts of the remaining 51 articles were then screened by the first rater, of which 42 were excluded. Nine

articles remained, with one additional article included after the reference lists of the 9 included articles were screened for eligible papers, leaving 10 papers in total for the review.



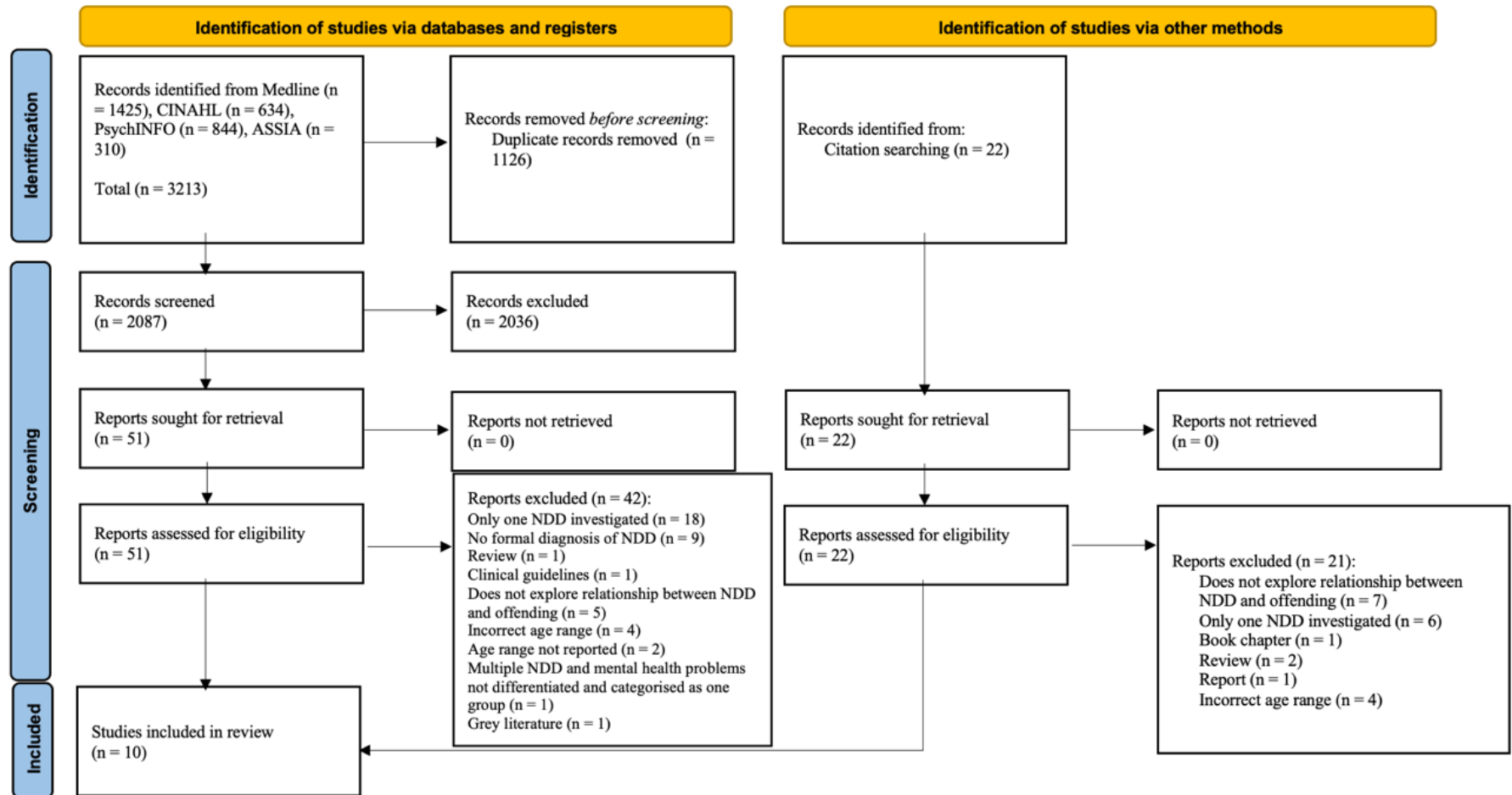


Figure 1.1 PRISMA Flow Diagram

### Critical Appraisal

The risk of bias was assessed using the Critical Appraisal Skills Programme (CASP) tool for cohort studies (CASP, 2018). The checklist is comprised of 12 questions, although two questions require qualitative information relating to study outcomes and implications. For this reason, the two qualitative questions have been removed from the assessment of bias table (Table 1.1) as these findings are already included in the study characteristics summary table (Table 1.2). The remaining 10 assessment of bias checklist questions can be rated as “yes”, “can’t tell” or “no”.

Risk of bias was assessed for 10 checklist items per paper by applying the following ratings ‘Yes’ (low risk), ‘Can’t tell’ (unknown risk) or ‘No’ (high risk). An overall risk of bias rating was then given using the following ratings (Mathie et al., 2017):

- Rating A = low risk of bias for all 10 items;
- Rating B<sub>x</sub> = uncertain risk of bias for x items, low risk of bias in all other items;
- Rating C<sub>y,x</sub> = high risk of bias in y items, uncertain risk of bias in x items, low risk of bias in all other items.

All studies were assessed for quality and risk of bias by the first rater and all included studies were assessed by the second rater [Interrater reliability agreement was 84% (101/120)].

Disagreements or areas of uncertainty, for example the accuracy of how NDDs were measured were resolved through discussion. No studies were excluded based on the risk of bias assessment outcome.

### Strategy for synthesising results of the study

A narrative synthesis approach (Popay et al., 2006) was used to consider the impact of NDDs on offending and other factors alongside NDDs that might influence offending behaviour.

Findings, quality assessment and risk of bias are summarised in written text and in a summary table.

## **Results**

### Study Characteristics

The 10 studies included all used a cohort sample design and the combined, total number of participants was 371,618. Four studies were conducted in Sweden (Billstedt et al., 2017; Heeramun et al., 2017; Hofvander et al., 2019; Lundström et al., 2014) and two studies respectively in Australia (Baidawi & Piquero, 2021; Baidawi & Sheehan, 2020), Netherlands (Van Vugt & Garofulo, 2021; Van Wijk et al., 2007) and the United Kingdom (McCartan et al., 2011; Vizard et al., 2007). All studies utilised a data mining technique on pre-existing files to screen for NDD diagnoses and to check historical records of offending up until the present time-point. All studies employed a cohort or cross-sectional cohort design. Three studies recruited from a sample who had appeared in front of the children's court (Baidawi & Piquero, 2021; Baidawi & Sheehan, 2020; Van Wijk et al., 2007), two studies recruited from a prison sample (Billstedt et al., 2017; Hofvander et al., 2019), two recruited from specific treatment centres for young offenders (McCartan et al., 2011; Vizard et al., 2007), two from general population databases (Heeramun et al., 2017; Lundström et al., 2014) and one from a juvenile correctional facility (Van Vugt & Garofulo, 2021). The studies are summarised in further detail in Table 2.

### Risk of Bias

There were two studies with low risk of bias ('A' rated) (Heeramun et al., 2017; Lundström et al., 2014), one with uncertain risk of bias ('B' rated) (Baidawi & Piquero, 2021) and seven

studies with high risk of bias ('C' rated) (Baidawi & Sheehan, 2020; Billstedt et al., 2017; Hofvander et al., 2019; McCartan et al., 2011; Van Vugt & Garofalol, 2021; Van Wijk et al., 2007; Vizard et al., 2007) (see Table 1.1). As per findings from the checklist, overall, all of the studies tended to have a clearly focussed issue, appropriate recruitment procedures and measures of exposure and outcome.

Failure to adequately address confounding factors tended to be the most problematic checklist question. Some, but not all, important confounding factors were identified by three of the studies (Baidawi et al., 2020; Billstedt et al., 2017; Van Wijk et al., 2007) and two of the studies did not identify any relevant confounding factors such as age and level of education (Hofvander et al., 2019; McCartan et al., 2011), age, looked after and accommodated status and sociodemographic status (Van Vugt & Garofulo, 2021) and age and gender (Vizard et al., 2007). One paper controlled for age and experiences of Adverse Childhood Events (ACEs) (Baidawi & Piquero, 2021) and one paper controlled for maternal and paternal income and education, comorbid oppositional defiance disorder/conduct disorder and comorbid mental health problems (Lundström et al., 2014). Heeramun et al. (2017) controlled for sex, age, family income, year of diagnosis, family size, parental age/education, migrant status, history of violent crime, psychiatric diagnoses, diagnosis given after crime committed and comorbidity.

Table 1.1 Risk of bias quality appraisal

	1. Baidawi & Piquero (2021)	2. Baidawi & Sheehan (2020)	3. Billstedt et al. (2017)	4. Heeramun et al. (2017)	5. Hofvander et al. (2019)	6. Lundström et al. (2014)	7. McCartan et al. (2011)	8. Van Vugt & Garofalo (2021)	9. Van Wijk et al. (2007)	10. Vizard et al. (2007)
1. Did the study address a clearly focussed issue?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Was the cohort recruited in an acceptable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes
3. Was the exposure accurately measured to minimise bias?	Can't tell	Can't tell	Yes	Yes	Yes	Yes	Yes	Can't tell	Can't tell	Yes
4. Was the outcome accurately measured to minimise bias?	Can't tell	Can't tell	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes
5a. Have the authors identified all important confounding factors?	Can't tell	No	No	Yes	No	Yes	No	No	No	Can't tell

5b. Have they taken account of the confounding factors in the design and/or analysis?	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No
6a. Was the follow up of the subjects complete enough?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
6b. Was the follow up of the subjects long enough?	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell	No	No	No
8. How precise are the results?	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
9. Do you believe the results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell	Can't tell	Yes
10. Can the results be applied to the local population?	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes
11. Do the results of this study fit with other available evidence?	Yes	Yes	Can't tell	Yes	Yes	Yes	Can't tell	Can't tell	Can't tell	Yes
Overall rating	B3	C2,2	C1,1	A	C2	A	C2,3	C5,3	C3,5	C2,1

\* Questions 7 and 12 are not included in this table as they relate to qualitative information that will be reported in the narrative synthesis and in Table 1.2

Table 1.2 Summary of study characteristics

Author and Country	Setting	Sample	NDD measure and NDDs included	Violence Measure	Main Findings
I. Baidawi & Piquero (2021)	Children's courts	<p>N = 300</p> <p>NDD status only available for N = 279, mental health status available for N = 283, ACEs status available for N = 300</p> <p>Gender = 68% male, 31% female, 1% transgender</p> <p>Mean age = 16.2 (range 10 - 20)</p>	<p>Diagnoses in case files</p> <p>Any neurodisability (n = 134), ADHD (n = 81), learning/communication disorder (n = 63), intellectual disability (n = 48), ASD (n = 16)</p>	<p>Recorded police charges and contextual information from case files</p>	<p>48% of children who are both in the criminal justice system and who are also looked after and accommodated ("crossover children") had NDD and this group experienced greater adversity (measured by allocating a score between 0-10 by calculating cumulative exposure to 10 adverse childhood events) (5.9 vs 5.2, p&lt;0.05), earlier offending onset (p&lt;0.001) and a greater volume of charges (p &lt;0.05)</p> <p>Crossover children with any NDD had greater odds of engaging in acts</p>

					of criminal damage OR = 2.57 and engaging in acts of motor vehicle charges OR = 2.21, perpetrating adolescent family violence (AFV) OR= 2.03 and perpetrating residential based charges OR = 2.19, but were no more likely to have other violent charges
2. Baidawi & Sheehan (2020)	Children's courts	This study used the same sample (database) as Baidawi & Piquero (2021)	As above	As above	Any NDD significantly correlated with AFV ( $p < 0.01$ ), group offending ( $p < 0.05$ ) and motor vehicle theft ( $p < 0.01$ )  ADHD/ADD significantly correlated with AFV and residential charges ( $p < 0.05$ )
3. Billstedt et al. (2017)	Prison	N = 269 Gender = 100% male	Assessment by clinical psychologist according to DSM-IV criteria. Asperger	Self-report questionnaires and criminal history as recorded	NDD group had earlier onset antisocial behaviour $t(266) = -4.75, p$



		Mean age = 22.3 (SD = 1.9)	<p>Syndrome/high functioning autism</p> <p>Diagnostic Interview (ASDI) was used to assess ASD. Diagnostic Interview for Social and Communication Disorders (DISCO) also used where possible for assessment of participants that were thought to meet criteria for an ASD disorder.</p> <p>Adulthood ADHD (n = 116), childhood ADHD (n = 170), ASD (n = 26), Tourettes (n = 17) intellectual disability (n = 3)</p>	by Swedish Prison and Probation Service	<p>&lt; 0.001 and more aggressive behaviour <math>t(266)=-3.98, p= &lt; 0.001</math> and lower school achievements (<math>p&lt;0.05</math>).</p> <p>Of those who had committed 'hands on' violent offences, 63% met criteria for childhood ADHD and 43% met adulthood ADHD criteria.</p>
4. Heeramun et al. (2017)	Population databases	<p>N = 295,734</p> <p>Gender = 51.2% male, 48.8% female</p> <p>Age range = 15-27</p>	<p>Diagnoses by specialist teams, recorded as per ICD 10 criteria in case files</p> <p>ASD (n = 5739), no ASD (289,995)</p>	As recorded on National Crime Register	<p>Individuals who had co-occurring ASD and ADHD or CD had an increased risk of violent criminality (RR = 0.85, CI = 0.75 – 0.97)</p>

			<p>Comorbidities:</p> <p>ASD &amp; ADHD (n = 1481),</p> <p>ADHD &amp; no ASD (n = 7250),</p> <p>ADHD or Conduct Disorder &amp; no ASD (n = 7830),</p> <p>ASD and ADHD or Conduct Disorder (n = 1630)</p>		
5. Hofvander et al. (2019)	Prison	<p>N = 269</p> <p>Gender = 100% male</p> <p>Age range = 18 -25</p>	<p>Assessment by clinical psychologists using SCID-I and SCID-II. For disorders not included (developmental disorders, impulsive control and sexual disorders) a DSM-IV checklist was used.</p> <p>ASD (n = 26)</p> <p>Comorbidities:</p> <p>ADHD (childhood or adulthood) &amp; ASD (n = 32)</p>	<p>Self-report and data recorded on National Council of Crime Prevention database</p>	<p>ASD offenders overrepresented with sex crimes with a child victim (OR = 4.2000, p&lt;.05, CI = 1.22 – 14.50)</p> <p>Offenders with ASD had less convictions than those without ASD (p&lt;.05), but there was no difference in number of crimes recorded</p>

			ADHD (childhood or adulthood) & no ASD (n = 252)		
6. Lundström et al. (2014)	Prison	N = 68,962  Gender = 58% male, 42% female  Age range = 20 – 30 at time of publication (born between 1984 and 1994)	Diagnoses by specialist child and adolescent psychiatrists/psychologists in case files  ASD (n = 19378), ADHD (n = 28169), Tic disorders (TD) (n = 4406)	As recorded on National Crime Register	Elevated risk for committing violent crimes was seen for individuals with ADHD (OR 4.6, p<.01) or TD (OR 3.2, p<.01)
7. McCartan et al. (2011)	NHS or similar service for young offenders	N = 259  Gender = 100% female  Mean age in sexually abusive behaviours group = 14.03  Mean age in non-sexually abusive group = 14.76	Diagnoses in case files, as per ICD 10 criteria, following direct clinical assessment and agreed with a consultant psychiatrist within the service.  ADHD, ASD (n not provided)	As recorded on Forensic Adolescent Consultation and Treatment Service case files held by the service	Females with sexually abusive behaviour were significantly more likely to have learning difficulties (p<.005) and to have been victims of abuse themselves (p= .001)

8. Van Vugt & Garofalo (2021)	Juvenile correctional facility	N = 65 Gender = 100% male Mean age = 17.54 (SD 2.22)	Diagnoses recorded in case files.  Intellectual disability (n = 63), ADHD (n = 65), or ASD (n = 65)	Index sexual offence and three most recent sexual offenses coded as extra or intrafamilial offences	Young people who offended outside of their families were more often diagnosed with ADHD (p<.05) or ID (p<.01) and received longer (p<.01), residential care treatment (p<.05)
9. Van Wijk et al. (2007)	Cross-sectional cohort  Children's courts	N = 5480 Gender = 100% male Age range = 12-20	Psychiatric diagnoses were rated as per DSM-IV criteria and intellectual functioning was assessed using WAIS or WISC.  IQ below 71 (n = 153) ADHD (n = 367) developmental disorder (n = 501)	As recorded on online Dutch Forensic Psychiatric Services case files	Developmental disorders are more common among non-violent sex offenders and child molesters (no p values provided)
10. Vizard et al. (2007)	NHS or similar service for	N = 280 Gender = 91% male, 9% female Age range = 5-21	Diagnostic assessment outcomes from psychiatric or psychology assessments (as per DSM-IV criteria) in case files.  Learning disability was assessed using	Case file notes.	73% of the sample had one or more NDD (LD, developmental delay, language problems and problems with executive function)

	young offenders		WISC-III or clinical assessment as per DSM-IV.  ADHD, pervasive developmental disorder, learning disability		
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## Research Questions

### *Do neurodevelopmental disorders increase risk of offending?*

The prevalence of NDDs in young offenders across the included papers was found to be common across different criminal justice settings. Forty eight percent of young people involved in the criminal justice system and child protective services (“crossover children”) had an NDD (Baidawi & Piquero, 2021) in a study with uncertain risk of bias rating. In a prison setting, 49% of young adult male offenders had an NDD (Billstedt et al., 2017).

In relation to specific types of offending, of those young people who offended within the family, 23% had ASD and 15% who offended outside of the family had ASD (Van Vugt & Garofalo, 2021). Below average IQ was found in 37% of a forensic NHS sample of young offenders, 24% met criteria for learning disability and 45% had additional educational needs (Vizard et al., 2007). The three most recently mentioned papers had a high risk of bias, however, these ratings related to their consideration of appropriate confounding factors and therefore would not impact effective descriptive reporting of prevalence.

Despite varied levels of bias across studies, prevalence rates of any NDD in young offenders was between 15-63%, suggesting that NDDs are common in young offenders and may increase risk of offending.

### *How frequent is offending in young people with neurodevelopmental disorders in comparison to the general offending population?*

No low risk of bias studies explored the frequency of offending in all young offenders with NDD in comparison to the general offending population. Eight out of the 10 studies focussed on frequency of offending in NDD in relation to specific types of offending, as opposed to offending in general (Baidawi & Sheehan, 2020; Billstedt et al., 2017; Heeramun et al., 2017;

Lundström et al., 2014; McCartan et al., 2011; Van Vugt et al., 2021; Van Wijk et al., 2017; Vizard et al., 2007) and therefore could not answer this review question.

Baidawi and Piquero (2021) found that crossover children had a greater number of total charges and younger onset of offending compared to crossover children without NDD (Baidawi & Piquero, 2021). Specifically, crossover children with any NDD, ADHD or learning/communication disorders had a significantly greater number of charges after controlling for age. In contrast, another study found that young offenders without ASD had more convictions than offenders with ASD, but no difference in the number of crimes committed between the two groups, but did not report offending rates for other NDDs (Hofvander et al., 2019). However, the paper was considered high risk as all important confounding factors, such as comorbid NDD diagnosis or age were not considered and incorporated into analysis.

*What are the reported reasons for differences in offending rates in young people with neurodevelopmental disorders in comparison to the general offending population?*

Differences between young people with NDD and young people without NDD who offend were explored across four studies and provide potential explanations for the differences in offending rates between the groups. Crossover children with NDD were found to have had earlier offending onset than young people without NDD (Baidawi & Piquero, 2021). Billstedt et al. (2017), in concurrence found that young offenders with NDD reported a younger age of first criminal offence and first truancy than young offenders without NDD. However, this paper was considered a high risk of bias as confounding factors that might have impacted on results were not considered or incorporated into the analysis.

Billstedt et al. (2017) also found that young offenders with NDD had earlier onset antisocial behaviour, more aggressive behaviour and lower school achievements than the group without NDD. This pattern was also seen in a low risk of bias paper (Heeramun et al., 2017) that

suggested better than average school grades and intellectual disability appeared to be protective in terms of offending in young people with ASD. However, in contrast, a high risk of bias paper (Vizard et al., 2017) which did not consider confounding factors, found that in a sample of young sexual offenders, 37% had below average IQ (< 84) and 24% met criteria for learning disability. Additionally, they found that 45% of the sample had learning or behavioural educational needs, 71% had disruptive behaviour and 42% were excluded due to behaviour.

Five of the studies used mixed samples of males and females (Baidawi & Piquero, 2021; Baidawi & Sheehan, 2020; Heeramun et al., 2017; Lundström et al., 2014; Vizard et al., 2007). One study reported lower prevalence of NDD in females in comparison to males (23.5% vs 58.9%,  $p < 0.0001$ ) and considered this justification for NDDs to be more relevant to understanding offending in males (Baidawi & Piquero, 2021). However, they did not explore whether sex was a confounding variable that could explain differences in offending rates or the potential reasons for lower prevalence in females, such as male-centric criteria and masking of NDDs in females.

### *Are certain neurodevelopmental disorders associated with particular types of offending?*

#### *Violent offending*

Young people with ADHD were found to be at the highest risk of committing violent crimes by two low risk of bias papers (Heeramun et al., 2017; Lundström et al., 2014). Lundström et al. (2014) compared offending histories of young people diagnosed with NDDs to sibling and half-sibling controls. They found that even when controlling for confounding and mediating factors, young people with ADHD or Tic Disorders (TDs) were at elevated risk of committing violent crimes and of recidivism of violent crimes (OR 2.7, 2.0-3.8). The risk of violent offending for those with childhood TDs increased when controlling for confounding and mediating variables (OR 3.2, CI = 1.4-7.5). Heeramun et al. (2017) found that young people with ADHD had the highest risk of violent criminality (RR = 3.87, CI = 3.62-4.13). Billstedt et al. (2017) found that ADHD was the most common NDD in young offenders who perpetrated violent offences, with



63% of the sample meeting criteria for childhood ADHD and 43% for adulthood ADHD. However, the study had a high risk of bias as they did not consider potential confounding factors, such as age, that might have contributed to the effect. Additionally, the sample consisted only of violent offenders and therefore information about non-violent crimes was not collected. Crossover children with any NDD were no more likely than crossover children without NDD to commit violent offences. However, crossover children with ADD or ADHD were more likely to have violent charges than crossover children who did not have an NDD diagnosis (Baidawi & Piquero, 2021).

With regard to ASD, Lundström et al. (2014) found no association between ASD and violent offending. In contrast, Heeramun et al. (2017) found that individuals with ASD without intellectual disability were more likely to be convicted of a violent crime in comparison to the general population without ASD (RR= 1.39, CI = 1.23-1.58). Additionally, they found that comorbid ASD and ADHD or Conduct Disorder (CD) had an increased risk of violent criminality (RR=2.69, CI=2.28-3.17). Both papers had low risk of bias and employed similar methodologies, with large sample sizes, although Heeramun et al. (2017) had a significantly larger sample size and results may therefore be more valid.

#### *Sexually abusive behaviour*

Only high risk of bias studies explored the relationship between NDD and sexual offending specifically. Vizard et al. (2007) found that 73% of the sample of young people referred for sexually abusive behaviour were found to have one or more NDD. However, as this was a descriptive study it is not known whether the results are significant. Studies investigating specific NDDs found conflicting results in terms of the specific types of NDDs that were most associated with sexual offending. McCartan et al. (2011) found that females with sexually abusive behaviour were 3.5 times (CI 1.55 – 7.77) more likely to have learning difficulties. They argued that females who engaged in sexually abusive behaviours are a distinct group, as

females who did not sexually abuse were more likely to engage in other antisocial behaviours, such as criminal damage ( $p=0.02$ ) and aggression ( $p=.001$ ).

A nonlinear canonical correlation analysis showed that developmental disorders were more common among non-violent sex offenders and sexual offenders against children (Van Wijk et al., 2007). However, this paper had a high risk of bias because offenders were categorised only by their index offence, meaning that the details of other, different types of offences were not captured. Additionally, a definition of developmental disorders was not provided in the paper, resulting in difficulty interpreting which NDDs their finding applied to. Another paper found that ASD was overrepresented for sexual offenses against children in a sample of offenders with and without ASD (OR 4.200, CI = 1.216-14.503) (Hofvander et al., 2019). There were no significant differences between rates of intrafamilial and extrafamilial sexual offending in young people with ASD diagnoses, but ADHD ( $p=.05$ ,  $d = .51$ ) or intellectual disabilities ( $p=0.01$ ,  $d = .69$ ) were more frequent in people who displayed sexual offending with victims outside of the family.

A spectrum of diagnoses were implicated in relation to sexual offending (learning difficulties, developmental disorders, ASD, ADHD and learning disabilities). However, all studies had high risk of bias and therefore this mixed evidence should be interpreted with caution in the absence of more robust research.

#### *Adolescent family violence, group offending, motor vehicle theft and drug offences*

Baidawi and Piquero (2021) found that crossover children with any NDD were significantly more likely to be charged for motor vehicle theft (OR 2.21, CI = 1.32 – 3.69), criminal damage (OR 2.57, CI = 1.50 – 4.38) and charges that occurred whilst in residential care (OR 2.19, CI = 1.16 – 4.14) than crossover children without NDD. Baidawi and Piquero (2021) also found significantly higher odds of ADHD and charges relating to residential placement after controlling for placement in residential care (OR = 2.108, CI 1.029-4.321,  $p= 0.04$ ), but not for

those with learning/communication disorders. In addition, Baidawi and Sheehan (2020) found a significant correlation between increased adolescent family violence and NDD, but found no differences between NDD status and drug offenses. However, Hofvander et al. (2019) found that offenders who did not have ASD were more often represented in drug crimes (CI = 0.07 – 4.21). Both papers exploring drug offenses had high risk of bias and therefore their conflicting findings should be interpreted with caution.

*How do factors such as adverse childhood events influence the relationship between neurodevelopmental disorder and offending?*

*Adverse Childhood Events (ACEs)*

Crossover children with NDD were found to have experienced greater cumulative maltreatment and adversity in comparison to non-NDD counterparts (Baidawi & Sheehan, 2020) and had a higher average ACE score in comparison to crossover children without NDD ( $p = 0.05$ ) (Baidawi & Piquero, 2021). In contrast, another study found no differences in childhood adversity experiences between offenders with and without NDD (Billstedt et al., 2017). However, the measure of adversity in this study was not clear, as the specific questions asked to ascertain ACE experiences were not disclosed and therefore a lack of clarity when defining ACE experiences may explain the findings.

Young offenders with specific NDDs (intellectual disability (ID) and learning/communication disorders (LCD)) had higher ACE scores than young offenders without these diagnoses, but there were no significant differences in ACE scores between those with and without ADHD diagnoses (Baidawi & Piquero, 2021). The authors did not consider the role of increased likelihood of victimisation of people with ID (Hershkowitz et al., 2010) in their discussion as an explanation for their findings. McCartan et al. (2011) found that females who engaged in sexually abusive behaviour were more likely to have been victims of abuse themselves ( $p = .001$ ), but they did not provide information about the proportion of the sample who had been victims of abuse themselves who also had an NDD. Baidawi and Piquero (2021) investigated

gender differences and found that offending females with NDD had significantly higher ACE scores than males with NDD and than females without NDD.

Crossover children with NDD and those with diagnoses of ID or LCD were more likely to have more ACEs than crossover children without NDD (Baidawi & Piquero, 2021). Female crossover children with NDD were also more likely to have higher ACE scores than their male counterparts (Baidawi & Piquero, 2021). This was the only paper to investigate the ACES-NDD-offending link, but their results only apply to crossover children and not young offenders in general.

#### *Parental factors*

Crossover children with NDD were found to have experienced or witnessed family violence more than crossover children without NDD (Baidawi & Piquero, 2021). Maternal mental health problems were also found to be common background characteristics of young offenders with NDD (Baidawi & Piquero, 2021; Heeramun et al., 2017), whereas Vizard et al. (2007) found a high prevalence for all young offenders (with and without NDD) and did not differentiate between groups. More parents of young people with NDD who offended had substance or alcohol abuse problems (Baidawi & Piquero, 2021; Billstedt et al., 2017).

#### *Comorbid psychiatric diagnoses*

Several mental health diagnoses were found to be common comorbid diagnoses in young offenders with NDD. Baidawi and Piquero (2021) found that crossover children with NDD were significantly more likely to have a mental health diagnosis compared those without NDD (72.4% vs 50.3%,  $p=0.0002$ ). Specifically, they found that crossover children with NDD were more likely to have been diagnosed with conduct disorder (34.3% vs 7.6%,  $p<0.0001$ ) and trauma related disorders (29.9% vs 11%,  $p<0.0001$ ). Early comorbid conduct disorder diagnosis was more common in young offenders with NDD (37% vs 17%,  $p<0.001$ ) (Billstedt et al., 2017).

Baidawi and Piquero (2021) found that crossover children with NDD were less likely to be diagnosed with personality disorder (PD) than those without NDD (0.7% vs 6.2%,  $p=0.02$ ). Two papers explored comorbid mental health diagnoses in young offenders with ASD. Autism Spectrum Disorder comorbid with psychotic disorders (RR = 1.96, CI = 1.41-2.72) and PDs (RR = 2.32, CI = 1.53 – 3.52) were associated with violent crime (Heeramun et al., 2017). Young offenders with ASD scored higher on the affective facet of the Psychopathy Checklist-Revised (CI = -2.24 - -0.15,  $p<.05$ ) (Hofvander et al., 2019).

## **Discussion**

### Main Findings

Neurodevelopmental disorders appear to be common in young offender populations, but it is difficult to draw definitive conclusions about prevalence of NDD and offending rates in young people who offend in the current review. The conclusions that can be drawn about frequency of offending in young people with NDD is mixed and somewhat incomplete because the papers do not focus on all NDDs and all types of offending. Whilst one study found that specific types of offenders (crossover children) with NDDs offended more than crossover children without NDDs (Baidawi & Piquero, 2021) another found that offending rates did not differ between young offenders with and without the specific NDD of ASD (Hofvander et al., 2019). However, the latter study did not consider potential influences on the NDD-offending relationship, such as age and education level, resulting in a high risk of bias. Therefore, the different focuses between papers and lack of consistency in terms of quality makes it difficult to conclude whether offending rates are elevated in all young people with any NDD in comparison the general young offending population. Additionally, the existence of some diagnoses may be more difficult to establish than others. For example, a gold-standard official diagnosis of ASD is a time-consuming process that is done within a larger team (Falkmer et al., 2013) and this is not likely to be an accessible process for young offenders who already

struggle to engage with services (Heath & Priest, 2016). Some diagnoses may be more easily recognised, such as the hyperactivity elements associated with ADHD, but perhaps difficulty with reading as seen with dyslexia may be missed if, as previously mentioned, there was difficulty attending services. This causes an issue in terms of the measurement and aggregation of findings in relation to NDDs in young offenders, as the systems used to determine diagnoses are not systematic or refined globally and thus negatively impacts accurate synthesis of prevalence.

Reported reasons for differences in offending rates between those with and without NDDs are varied and inconclusive, due to the mixture of papers investigating specific NDDs and a limited amount of low risk of bias papers. Earlier offending onset (Baidawi & Piquero, 2021; Billstedt et al., 2017) earlier anti-social behaviour, more aggressive behaviour and lower school achievements (Billstedt et al., 2017) were more common in young offenders with NDD. Whereas there was not a consensus relating to learning disability status, as one paper found this to be protective (Heeramun et al., 2017), whilst another found this to be a risk factor for offending (Vizard et al., 2017). The lower prevalence of NDD in females who offend was concluded by Baidawi and Piquero (2021) to indicate that NDD is less relevant to understanding offending in females. However, given that ADHD was the predominant diagnosis in the sample and that ADHD is significantly less recognised in females (Young et al., 2020) their findings may not accurately represent the prevalence of NDD in females who offend. Therefore, the potential contribution of gender to differences in offending was not sufficiently explored.

Risk of violent criminality was consistently elevated in those with ADHD (Baidawi & Piquero, 2021; Billstedt et al., 2017; Heeramun et al., 2017; Lundström et al., 2014), but not for all NDDs (Baidawi & Piquero, 2021) and the evidence in relation to ASD and violent offending was conflicting. There was not a consensus within the studies in relation to sexual offending, family offending, group offending, motor vehicle theft and drug offences. This may be due to

aforementioned issues relating to ability to assess for NDD and accuracy of diagnoses or may relate to the way in which offending information is recorded and used in studies. To categorise offending, Baidawi and Piquero (2021) recorded ‘charges’, McCartan et al. (2011) recorded ‘offending behaviour’ and Hofvander et al. (2019) recorded ‘convictions’. The differential approaches to recording offending data means that comparisons between studies should be interpreted with caution, as different categorisation and recording criteria means direct comparisons are difficult to draw.

Elevated number of ACEs were found in crossover children with NDD in comparison to crossover children without NDD (Baidawi & Piquero, 2021), but no other papers investigated the potential influence of ACEs on young offenders with NDD and the available findings are only applicable to crossover children and not all young offenders. Maternal mental health problems and comorbid mental health diagnoses were elevated in young offenders with NDD, in comparison to those without NDD (Baidawi & Piquero, 2021; Heeramun et al., 2017; Hofvander et al., 2019). Increased prevalence of PD (Heeramun et al., 2017) and psychopathy traits (Hofvander et al., 2019) comorbid with ASD were found in young people who offended. However, given that the age range in Heeramun et al. (2017) was 15-27, that children are less likely to be diagnosed with a PD and emerging evidence that PD is a reflection of trauma (Luyten et al., 2019), this result may not accurately represent comorbid mental health problems.

Additionally, Hofvander et al. (2019) was a high risk of bias paper and the authors acknowledged that it was difficult to disentangle factors inherently associated with ASD, such as impairments in theory of mind and genuine indications of psychopathy. Only two papers were of high quality and papers included in the review tended to focus on specific elements of offending and specific types of NDDs, making the more generalised questions about all NDDs and all types of offending difficult to answer. This caused problems when comparing results of all papers.

### Strengths and Limitations

The use of a second screener and rater reduces the overall bias in this review. Additional strengths are that the search strategy was developed alongside two librarians and the explanation of methods and synthesis are clearly described, which aids readers' understanding and reproducibility of the review. The review was also registered with PROSPERO. This review is the first to attempt to synthesise the existing literature relating to the NDD-offending link and has contributed to the evidence base by concluding that the link does exist and by identifying gaps and areas of weakness in the current evidence base that require further input. This has implications for clinical practice to ensure that NDDs are recognised as a potential risk factor, although findings from this review on the specific impact on risk is less clear, which may reduce the effectiveness of risk management planning currently.

There is a lack of papers estimating offending in general amongst young people with NDDs and low risk of bias papers were lacking. It was therefore difficult to answer questions relating to NDDs and offending in general, as many of the papers had focal NDDs and offending types, such as ASD and violent offending. Additionally, although papers investigating specific populations, such as crossover children are undoubtedly crucial in the field of research, the results cannot be generalised across all young offenders who are not care experienced. Poor quality papers were not excluded from the review, meaning that the review provides more insight into the status of the literature and the requirement for more rigorous research, as opposed to conclusively answering questions from the research field. All of the papers employed a data mining approach to some degree, and whilst this limits potential ethical issues in terms of reducing potential pressures on participants, this relies on datasets being accurate which is not always the case. Additionally, any information that was not recorded would then not have been processed for analysis. It should also be noted that as some studies acquired NDD diagnosis information from historical database sources, recognition of NDD at the time



may not have been as fastidious as it is now and therefore NDD rates in some of the papers could be underrepresented.

### Recommendations for Future Research

More robust research is required to investigate prevalence and offending rates more generally, as the current papers in the review focused on specific NDDs or specific offender groups, which does not provide an overall, holistic view of NDDs and offending. Future studies should establish a baseline prevalence rate for all NDDs and offending in young offenders to ensure that the spectrum of NDDs is captured when addressing the NDD-offending question. Clear definitions of what constitutes as ‘offending’ and NDD categories should be established, as well as cross-referencing between clinical records and self-reporting to reduce bias in future studies. Subsequent research could then establish more definitively, whether specific NDDs are associated with certain types of offending as findings between studies could be more readily compared.

### Conclusion

There is a link between NDD and offending in young people, particularly between ADHD and violent offending or ADHD and ASD and violent offending. Further research should explore the link between NDD and offending in young people to establish robust prevalence rates to inform the evidence base and to ensure best care is provided by services that are involved.

Professionals and services should continue to remain up to date with publications in this field to ensure that risk prevention, management and intervention are suited to the needs of the individual

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## Chapter 2: Major Research Project

The Impact of Head Injury and Neurodevelopmental Disorders on  
Frequency of Offending and Violent Offences in Young People

Prepared in accordance with the author requirements for Youth Violence  
and Juvenile Justice; <https://journals.sagepub.com/author-instructions/yvj>

## **Plain Language Summary**

### Title

The impact of head injury and neurodevelopmental disorders on frequency of offending and violent offences in young people.

### Background

Head injury (HI) and neurodevelopmental disorders (NDD), such as autism spectrum disorder or attention deficit hyperactivity disorder are linked to problems such as controlling emotions. Studies have shown that HI and NDD make people more likely to commit crimes and are common in adult prisoners. Less is known about how common HI and NDD are in young offenders and whether there are links with how often young people commit crimes and how violent these are; this study aims to better understand this.

### Aims and Research Questions

To investigate how well HI or NDD are recorded in young peoples' health records and whether HI or NDD influence how often young people offend and whether the crimes are more likely to be violent or non-violent.

### Methods

Information was gathered from 76 young males, aged between 12-18, who had been seen by the Forensic Child and Adolescent Mental Health Service (FCAMHS) in Glasgow between March 2015 and January 2020. The information gathered from these young people formed a database that was used for this research in combination with their health records. Demographic information, predicted risk of reoffending ratings and details of actual reoffending within 6 months was taken from the FCAMHS database and were combined with information about HI and NDD from their electronic mental health records. For analysis, participants were grouped as 'yes' or 'no' to having a HI and 'yes' or 'no' to having a NDD. Offending within a 6-month period was compared between those with and without HI and those with and without NDD.

### Main Findings and Conclusions

There were no significant differences between those with and without HI or NDD in how much they offended and whether their offences were violent or not. This might be because the



sample was recruited from a specialist service (FCAMHS) where the level of severity of offending and legal involvement is less severe than for those who are, for example in prison. Additionally, all information about HI and NDD may not have been present on the electronic databases used in this study and efforts should be made in future to ensure that information on mental health records is thorough and detailed. Attention Deficit Hyperactivity Disorder was the most common diagnosis in the sample and higher social deprivation was significantly associated with re-offending. More research is required to investigate the link between NDDs and offending in young people and to develop more appropriate risk assessment tools. Service design and treatments need to be adapted to meet young peoples' needs so that it is easier for them to engage with services.

## **Abstract**

### Background

Various impairments are associated with head injury (HI) and neurodevelopmental disorders (NDD), which are also risk factors for offending behaviour. Although rates of HI and NDD are high in adult prison populations, less is known about young forensic populations and the impact of HI or NDD on offending behaviours.

### Aims

This study aimed to observe how well HI or NDD are reported on electronic health records and to investigate whether HI or NDD are related to increased frequency of offending, re-offending and violent offending.

### Methods

A retrospective, descriptive observational design using secondary data was employed. Data relating to risk assessment ratings and subsequent offending within a 6-month period from 76 young males, aged between 12-18, held by a Forensic Child and Adolescent Mental Health Service (FCAMHS) in Glasgow was used. Head injury and NDD was then extracted from electronic mental health records and combined with the FCAMHS data. Descriptive statistics described the sample and Fisher's Exact Tests investigated associations between HI, NDD and re-offending and HI, NDD and violent offending. Mann-Whitney U tests explored differences in number of offences between those with and without HI or NDD.

### Results

Head injury and NDD were common in the sample. There were no significant differences between HI or NDD and frequency of offending, reoffending and violent offending. There was a significant association between high levels of socio-economic deprivation and increased offending. Attention Deficit Hyperactivity Disorder was the most common diagnosis in the sample.

### Conclusions

No significant differences were found in frequency of offending, reoffending and violent offending between those with and without HI in this sample, although factors such as sampling

and nature of information available in health records may have influenced this. The most common NDD diagnosis was ADHD and higher socio-economic deprivation was associated with reoffending. Further research in this area is required to inform clinical practice and service design.

## **Introduction**

This study will examine the interface between neurodevelopment, head injury, and behaviours such as criminal offending and recidivism.

### *Head Injury and Neurodevelopmental Disorders*

Head injury (HI) is a broad term that can refer to any minor or major injuries to the head except for superficial injuries to the face (The National Institute for Health and Care Excellence [NICE], 2014). Two hundred thousand people per year are admitted to hospital with head injury, with one fifth showing signs suggestive of skull fracture or brain damage (NICE, 2014). A HI is considered a traumatic brain injury when brain functioning is interrupted (Centers for Disease Control and Prevention, 2022). Due to the challenges associated with assessing this (Brandt et al., 2022; Perron et al., 2014), brain injury is often inferred from self-report measures as opposed to brain scans (Moynan & McMillan, 2018).

Neurodevelopmental disorders are conditions that begin in childhood, such as learning disabilities (LD), learning difficulties, attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) (Baidawi & Piquero, 2021; Usher et al., 2013). Both HI and NDD are associated with cognitive and personality difficulties, including problems with self-regulation and social behaviour (Hughes et al., 2012, 2020). Difficulties which relate to executive function, such as the ability to inhibit impulsive behaviours are linked to heightened risk of offending (Hughes et al., 2012). Therefore, paired with having less understanding of the consequences of violent actions these children may be more likely to engage in violent acts (Hughes et al., 2012).

### *Adults and Offending*

In adult prison populations HI rates are much higher compared to the general population (Farrer & Hedges, 2011) and is associated with aggression, seizures, depression, difficulty learning,

remembering and problem solving (Shiroma et al., 2010). A review indicated that NDD in adult prison populations is under-researched (Underwood et al., 2013). Lack of routine screening, use of differential diagnostic criteria and undiagnosed ‘sub-threshold’ difficulties are barriers to accurately estimating prevalence and understanding of needs (Mccarthy et al., 2016). Research suggests that there are high rates of ADHD in male adult offenders (Young et al., 2011; 2018), whilst estimates of ASD and LD are inconsistent (Mccarthy et al., 2016). Fazel et al. (2008) suggest that prevalence of LD amongst adult prisoners may range between 0.5% and 1.5%. Prevalence rates of HI and NDD in adult forensic settings are not available, although their existence in this setting is acknowledged and prevalence is suggested to be high (Colantonio et al., 2007).

#### *Adolescents and Offending*

Health conditions, including HI and NDD are known to be high in young offender populations (Borschmann et al., 2020), but are not routinely screened for (Billstedt et al., 2017; Farrer et al., 2013; Hughes, 2015; Williams et al., 2018). Evidence suggests that there is a link between childhood HI or NDD and subsequent offending (Leon-Carrion & Ramos, 2003; Lundström et al., 2014; Timonen et al., 2002) and some literature indicates that HI or NDD are risk factors for earlier onset, violent offending (Hawley & Maden, 2003; Williams et al., 2018).

A meta-analysis found that across 9 studies, 30% of young offenders had previously experienced traumatic brain injury (TBI) (Farrer et al., 2013) and Williams et al. (2010) found that 60% of incarcerated young people reported a HI, indicating significant rates of HI in the young offender population, suggesting a potential relationship between HI and criminal behaviour (Farrer et al., 2013). Another study found that males who self-reported HI were significantly more likely to reoffend than those who did not report HI (Perron et al., 2014).

Some studies report extraordinarily high levels of undetected NDD in young offending populations. For example, 89% of a study sample of young people in a youth detention centre

had severe neurodevelopmental impairment in at least one domain (Bower et al., 2018).

Another study found that young people who had NDD and accessed both child welfare and youth justice systems were more likely to have charges for criminal damage and motor vehicle theft but were not more likely to have committed violent crimes. However, ADHD specifically was implicated for increasing likelihood of violent offending (Baiwadi & Piquero, 2021).

However, the prevalence of NDD remains under-researched (Underwood et al., 2013).

Neurodevelopmental impairments are argued to influence criminal behaviour via increased antisocial and aggressive behaviour, increased exposure to environmental and social risk factors, unnecessary criminalisation and discrimination of young people by criminal justice systems (Hughes, 2017). It is suggested that this renders youth justice services as not equitable for those with NDD (O'Rourke et al., 2020; Reid, 2020). This highlights the importance of recognising conditions in young offenders within the justice system so that their specific needs can be understood, and targeted early intervention and risk planning can be undertaken (Bower et al., 2018).

### *Risk Assessment in Adolescents*

Effective risk assessment and prevention of future violence requires the systematic consideration of risk, needs and protective factors (Hoge, 2002). Structured professional judgement (SPJ) tools are frequently used in forensic youth services, as they provide scaffolding when considering factors associated with offending, as well as protective factors that might mitigate risk (Lodewijks et al., 2008). The use of SPJ is meant to reduce the likelihood of inaccurate decision-making that does not effectively weigh developmental stage against predictors of violence (Lodewijks et al., 2008).

The Structured Assessment of Violence Risk for Youth (SAVRY; Borum et al., 2006) is used as a guide to form SPJ about young peoples' violence risk and are frequently used to guide decision making relating to care planning and violence prevention (Witcomb & Jasti, 2007).

Twenty-four separate risk factors are considered within three domains (historical, social/contextual and individual risk factors) alongside protective factors. Each of the items are rated for presence and relevance to risk assessment to then guide an overall risk rating of ‘low’, ‘moderate’ or ‘high’. The predictive validity of the SAVRY has been rated as good, as Singh et al. (2011) found that prediction of violent recidivism had a median area under the curve (AUC) of .71. ‘area under the curve’ is commonly used when evaluating risk assessments, as it measures the ability of a tool to distinguish between those who offend and those who do not offend, where a score of 1 is perfect and 0.5 is equivalent to chance (Szmulker et al., 2012). Although the SAVRY encompasses a comprehensive list of risk factors, HI and NDDs are not included, despite evidence of a link between both conditions and offending. In light of this, it is not known how frequently health professionals take note of such conditions when making decisions, considering that a frequently used SPJ tool does not prompt consideration of such conditions.

### *The Current Study*

This study is needed because so little is known about the prevalence of HI or NDD in young, forensic populations and the potential impact of these impairments on offending behaviours. Despite evidence that there is a link between childhood HI or NDD with recidivism and criminal behaviour, less is known about the specific implications of HI or NDD in relation to frequency of recidivism and types of offending in young people. As these conditions may be under-reported by services, including youth justice services, it has been suggested that equitable treatment is consequently not offered to those with NDD in comparison to those who do not have NDD (O’Rourke et al., 2020; Reid, 2020). It is therefore vital to better understand the link between HI, NDD and offending to aid early intervention and prevention strategies. Furthermore, failures within the system to recognise health conditions poses a human rights argument to understand and support young people with HI or NDD within criminal justice systems (Holland et al., 2021). Additionally, these failures directly conflict with government policy that aims to ensure that young people receive adequate help and support in line with their

specific needs, so that they can reach their full potentials (The Scottish Government, 2006).

The proposed study therefore aims to contribute towards the aforementioned gaps in the literature by exploring how frequently HI or NDD are recorded on the mental health notes of young people who are being seen by a Forensic Child and Adolescent Mental Health Service (FCAMHS) and whether the presence of HI or NDD are related to frequency of offending and violent offending.

### **Research Aims and Questions**

This study has the following aims:

- To observe how frequently HI or NDD are routinely recorded in a Forensic Child and Adolescent Mental Health Service (FCAMHS) sample
- To investigate whether the presence of HI or NDD are related to a higher frequency of offending in young people who have been seen by FCAMHS
- To investigate whether HI or NDD are related to violent offending and re-offending

### Research Question

1. How well are HI or NDD reported in electronic health records and how are these related to key outcomes such as frequency of offending, violence and reoffending within six months?

### Hypotheses

1. Participants in the FCAMHS sample who are recorded as having HI, NDD or a combination of both HI and NDD will offend more than participants who are recorded as not having any of these diagnoses.
2. Participants in the FCAMHS sample who are recorded as having HI, NDD or a combination of both HI and NDD will be involved in violent offences more than participants who are recorded as not having any of these diagnoses.



## **Methods**

### Design

The study is a between-subjects retrospective, descriptive observational design, using secondary data to compare the offending behaviour within a 6-month period of young people with and without HI or NDD diagnoses.

### Research Approvals

Caldicott Guardian Approval (Appendix 2.2, p. 100) and NHS Research Ethics (GN22NE155P, Appendix 2.3, p. 102) was obtained.

### Participants

The participants were young males who had accessed the FCAMHS service and whose risk information and subsequent offending had been recorded in an FCAMHS database.

### Inclusion and Exclusion Criteria

The data of male participants recorded in the FCAMHS dataset were included in the study. More information about the database is detailed below. Participants were excluded if they could not be traced on NHS Greater Glasgow and Clyde's electronic mental health records system (EMIS) or if the data stored was incomplete to the extent that necessary fields in the data extraction form could not be completed.

### Procedure

Data from a pre-existing database held by the FCAMHS service consisting of 76 young people who had accessed the service was extracted. The data was originally collected from young people when they were referred to FCAMHS by social workers at the Intensive Support and Monitoring Service (ISMS) in Glasgow City between March 2015 and January 2020. The FCAMHS service is a specialist, tier 4 service in Glasgow that offers support to young people

experiencing mental health problems and problems with the law. Young people who are considered a risk to themselves or others are supported by ISMS who act as an alternative to secure accommodation or custody. The SAVRY, a structured professional judgement risk assessment tool, was completed upon referral to FCAMHS and subsequent offending data (whether the young person re-offended, whether any offence was violent and number of offences) was provided to FCAMHS by ISMS and added to the database after six months. A Scottish Index of Multiple Deprivation (SIMD; Scottish Government, 2020) score was calculated based on postcode at the time of referral to FCAMHS and was recorded in the FCAMHS database. The SIMD score measures zones of deprivation across seven domains: income, employment, education, health, access to services, crime and housing. Scores range from one to five, where one is the most deprived and five is the least deprived. These data were then linked to data extracted from EMIS notes to create one single database. GDPR compliant data extraction and combining was carried out by an Assistant Psychologist (ESM) at FCAMHS.

Any information about history of HI and NDD was extracted from young peoples' EMIS notes. As HI and TBI are referred to interchangeably in the literature and it is difficult to conclusively differentiate between both in the absence of a brain scan (Brandt et al., 2022), participants in this study were considered to have sustained a HI if they experienced a "bang to the head" despite whether they did or did not lose consciousness as per Brandt et al. (2022) study. Additional details were recorded relating to whether loss of consciousness and TBI were referred to in the case notes; the severity of the HI; and whether neuroimaging information was available. Initial assessment appointment letters, neuropsychological, clinical psychology and neuroimaging reports were screened and electronic notes were searched for key words ('neuro', 'NDD', 'cognitive', 'autism', 'ASD', 'ADHD', 'dyslexia', 'dyscalculia', 'dyspraxia', 'head injury', 'loss of consciousness', 'LOC', 'neuroimaging', 'brain', 'CT', 'EEG' and 'MRI'). Only official diagnoses of NDD were recorded, 'traits' were not considered as sufficient evidence of neurodivergence.

To ensure a good level of fidelity in the data extraction, a Clinical Psychologist at FCAMHS (LL) randomly selected 6 cases and independently reviewed FCAMHS and EMIS files against the data extraction sheet criteria. Agreement was 100%; no discrepancies were found between the Assistant Psychologist and Clinical Psychologist's data extraction and therefore no further checking was required.

### Statistical Analysis

Participants were grouped according to case note recorded HI and NDD status and were then allocated accordingly to groups. Participants were grouped as 'HI' if they were recorded as only having HI, 'NDD' if they were recorded as only having NDD, 'HI and NDD' if they were recorded as having both diagnoses or 'None' if they were recorded as having no conditions.

Analysis was conducted using IBM SPSS Statistics (Version 28, IBM Corp., 2021)

Assumptions for statistical tests were assessed prior to analysis and non-parametric tests were used as a result. Descriptive statistics were used to describe the sample and to portray general themes, such as the level of detail being recorded regarding HI or NDD diagnoses on young peoples' mental health notes.

*HI- Participants in the FCAMHS sample who are recorded as having HI, NDD or a combination of both HI and NDD will offend more than participants who are recorded as not having any of these diagnoses.*

To aid decision-making about appropriate statistical analyses, *a priori* tests were run to determine whether age would be an appropriate covariate to use in an ANCOVA test. Age data was transformed and divided into "youngest", "middle" and "eldest" groups and descriptive statistics were run to determine whether the mean number of offences differed between groups.

Mann-Whitney U tests were run to determine whether the number of offences differed between participants with HI and participants with no diagnoses; participants with NDD and no diagnoses; and participants with HI and NDD and no diagnoses.

*H2 - Participants in the FCAMHS sample who are recorded as having HI, NDD or a combination of both HI and NDD will be involved in violent offences more than participants who are recorded as not having any of these diagnoses.*

Due to small cell counts for some groups ( $n < 5$ ), Fisher's Exact tests were used to determine whether there was an association between presence of HI diagnosis "HI/No Diagnoses" and violent offending within 6 months of SAVRY risk assessment date "yes/no". This analysis was also run for participants with NDD in comparison to those with no diagnoses and for participants with both HI and NDD in comparison to those with no diagnoses.

## **Results**

Information was held about 78 males in the FCAMHS database that was used for this study.

Two were excluded because the overall SAVRY risk rating was missing, leaving a final sample size of 76. Individual SAVRY ratings were completely or partially missing for three participants, however, they were not excluded as their overall SAVRY rating had been completed and information relating to HI and NDD was available on their mental health notes.

The mean age of the group was 14.87 (range = 12-17 years). Of the sample, 14 participants had only HIs (18.4%), 18 participants had only NDDs (23.7%) and 13 participants (17.1%) had both HIs and NDDs recorded in their electronic mental health notes. The Scottish Index of Multiple Deprivation scores (SIMD; Scottish Government, 2020) indicated that the majority of the sample lived in the most deprived quintile in Scotland (Table 2.1).

Table 2.1. Sample and group demographics

	Total sample (N = 76)	HI (N = 14)	NDD (N = 18)	HI and NDD (N = 13)	No Diagnoses (N = 31)
Age M (SD)	14.87 (1.26)	14.9 (1.10)	14.72 (1.41)	15.15 (1.63)	14.84 (1.10)
Scottish Index of Multiple Deprivation N (%)					
1 (Highest)	52 (68.4)	12 (85.7)	12 (66.7)	9 (69.2)	19 (61.3)
2	3 (3.9)	0 (0)	0 (0)	1 (7.7)	2 (6.5)
3	13 (17.1)	2 (14.3)	4 (22.2)	1 (7.7)	6 (19.4)
4	7 (9.2)	0 (0)	2 (11.1)	2 (15.4)	3 (9.7)
5 (Lowest)	1 (1.3)	0 (0)	0 (0)	0 (0)	1 (3.2)

The most commonly recorded NDD diagnosis was ADHD (25%). For 17.1% of the sample, Asperger's syndrome, Dyslexia, Dyspraxia, Global Developmental Delay, Language Disorder, Learning Difficulty (NOS) or Learning Disability were diagnosed. Individual cell counts are not reported to preserve confidentiality.

### *Reporting of HI and NDD*

In this sample, 27 had a HI reported on their file and 5 within this group had a second HI recorded. This group of 27 includes those with both a HI and a comorbid NDD ( $n=13$ ). A small number of participants (less than 5 participants) had more than 2 HIs. To prevent the possible identification of these individuals we have not reported exact numbers. Two participants' files indicated that HI had been sustained, but did not specify how many. For all of the sample reported as having a HI present, 14.8% were referred to in clinical notes as 'severe', 11.1% were referred to as moderate, 51.9% were mild and information regarding severity was unavailable for 22.2%. Of those with at least 1 HI, 37% reportedly lost consciousness, 25.9% were referred to as having suffered a TBI. No further detail relating to loss of consciousness was available for 14.8% of cases, or for evidence of TBI for 11.1% of the group and neuroimaging was available for none of the group, meaning that HI was referred to in clinical notes, but no further detail was provided.

In the group who had a second HI, neuroimaging again was available for none of the cases. As a small number of participants had at least two HIs, further data about available information pertaining to HI details have not been reported to prevent possible identification.

### *Frequency of Offending*

*A priori* tests were run to determine whether there was a relationship between age and frequency of offending (number of offences). A scatterplot indicated that there was no linear relationship between age and offending, meaning that controlling for age as a covariate in analysis was not necessary.

A Mann-Whitney U test revealed no significant difference in frequency of offending in participants with HI ( $Md = 5$ ,  $n = 14$ , range = 0-13 offences) and participants with no diagnoses ( $Md = 3$ ,  $n = 31$ , range = 0-60 offences),  $U = 226$ ,  $z = .222$ ,  $p = .82$ ,  $r = .03$ . No significant differences were found in frequency of offending in participants with NDD ( $Md = 7.5$ ,  $n = 18$ ,

range = 0-48 offences) and participants with no diagnoses ( $Md = 3, n = 31, \text{range} = 0-60$  offences)  $U = 210, z = -1.44, p = .15, r = 0.2$ . No significant differences were found in frequency of offending in participants with both NDD and HI ( $Md = 10, n = 13, \text{range} = 0-76$  offences) and participants with no diagnoses ( $Md = 3, n = 31, \text{range} = 0-60$  offences)  $U = 181, z = -0.53, p = .60, r = 0.08$ .

### *Recidivism and Violent Offending*

As seen in Table 2.2., the majority of the sample reoffended (82.9%) and committed a violent offence (72.4%) within six months of their initial risk assessment. Table 2.2. summarises reoffending and violent offending data of those with HI, NDD, both HI and NDD or no recorded diagnoses. As described below, these numerical differences in the proportions of participants that reoffended and committed violent offences in each group were not beyond what would be expected by chance. For the total sample and all sub-groups, the most common overall risk rating was “high”.

Table 2.2. Offending and risk assessment characteristics

	Total sample (N = 76)	HI (N = 14)	NDD (N = 18)	HI and NDD (N = 13)	No Diagnoses (N = 31)
Reoffended within in 6 months N (%)	63 (82.9%)	11 (78.6%)	16 (88.9%)	10 (79.6%)	26 (83.9%)
Violent offence within 6 months N (%)	55 (72.4%)	10 (71.4%)	14 (77.8%)	7 (53.8%)	24 (77.4%)
Overall Risk rating N (%)					
Low	14 (18.4%)	3 (21.4%)	3 (16.7%)	1 (7.7%)	7 (22.6%)
Moderate	19 (25.0%)	4 (28.6%)	6 (33.3%)	1 (7.7%)	8 (25.8%)
High	43 (56.6%)	7 (50%)	9 (50%)	11 (84.6%)	16 (51.6%)
Average number of offences in 6 months M (SD)	10.66 (14.8)	5.79 (5.0)	13.4 (14.5)	16.15 (23.6)	8.9 (12.79)

Fisher's Exact Tests found no significant association between HI diagnosis (HI/No Diagnoses) and reoffending within 6 months  $p = .48$  (one-sided). There was no significant association between NDD diagnosis (NDD/No Diagnoses) and reoffending,  $p = .49$  (one-sided). There was



also no significant association between mixed diagnoses group (HI and NDD/No Diagnoses) and reoffending  $p=.44$  (one-sided).

Fisher's Exact Tests were also run to explore the relationship between HI diagnosis (HI/No Diagnoses) and violent offending; and NDD diagnosis (NDD/No Diagnoses) and violent offending (Table. 2.3). No significant association was found between HI diagnosis and violent offending,  $p = .47$  (one-sided). There were no significant associations between NDD diagnosis and violent offending within 6 months,  $p = .63$  (one-sided). There were also no significant associations found between diagnoses of HI and NDD (HI and NDD/No Diagnoses) and violent offending,  $p = 0.12$  (one-sided).

Table 2.3 Associations between HI or NDD, recidivism and violent offending, N

	HI		NDD		HI and NDD	
	HI n = 14	No Diagnoses n = 31	NDD n = 18	No Diagnoses n = 31	HI and NDD n = 13	No Diagnoses n = 31
Recidivism						
Yes	11	26	16	26	10	26
No	3	5	2	5	3	5
Violence						
Yes	10	24	14	24	7	24
No	4	7	4	7	6	7

#### *Post-hoc Analyses*

As no significant associations were found between HI or NDD group and offending behaviour, post hoc, exploratory analyses were run to explore whether associations were determined by

level of deprivation or overall SAVRY risk ratings. Fisher’s Exact Tests showed a significant association between SIMD rating and reoffending  $p = .03$  (two-sided) where higher levels of deprivation were significantly associated with reoffending, but no significant association between SIMD and violent offending  $p = .16$  (two-sided) (Table 2.4). Cell numbers for less deprived areas in Table 2.4 were much smaller, with only one participant living in the least deprived area, which may skew the results and impact on their reliability. No significant associations were found between SAVRY risk rating and recidivism  $p = .21$  (two-sided) and risk rating and violent offending  $p = .41$  (two-sided).

Table 2.4 Associations between SIMD rating, recidivism and violent Offending, N

SIMD Rating					
	1 N = 52	2 N = 3	3 N = 13	4 N = 7	5 N = 1
Recidivism					
Yes	43	1	12	7	0
No	9	2	1	0	1
Violence					
Yes	37	1	11	6	0
No	15	2	2	1	1

## Discussion

### *Recidivism, Violent Offending and Frequency of Offending*

This study examined whether offending rates and violence differed significantly between those with HI, NDD, or HI and NDD diagnoses in comparison to those with no recorded HI or NDD diagnoses. No significant differences were found in frequency of offending, reoffending and

violent offences between those with HI or NDD or HI and NDD diagnoses in comparison to those with no diagnoses within 6 months of risk assessment in the FCAMHS sample. These findings are inconsistent with prior literature that suggests that young males with HI were significantly more likely to reoffend (Perron et al., 2014), commit a higher number of offences (Perron & Howard, 2008) and adults were more likely to commit more violent offences (Williams et al., 2010). The current findings also conflict with literature that found a relationship between NDD and increased reoffending (McCarthy et al., 2016), higher frequency of offending (Baidawi & Piquero, 2021) and more violent offending (Billstedt et al., 2017). However, these studies recruited from different population samples to the current study, as their samples had already received convictions or had significant legal involvement due to offending (young offender residential services, prisons and criminal courts), whereas the current study recruited from a specialist, forensic NHS children's service, where the level of severity and legal involvement is less severe and has more of a range (from police warnings to secure residential placements). Therefore, the spectrum of participants involved in the current study may not span to the most severe offending behaviours, as these might be better captured in adult court systems, which would not be captured in the FCAMHS database, and therefore may explain the heterogeneity of offending in the sample despite HI or NDD. Additionally, as frontal lobes which are involved in risk-taking behaviours such as offending (O'Rourke et al., 2020), are still developing in all the young people in the sample due to their ages this may explain the limited differences between those with and without diagnoses.

Additionally, children in Scotland are very unlikely to receive convictions due to the wellbeing-based approach (The Scottish Government, 2013). This is a barrier to accurate reporting of youth offending. The FCAMHS database was inclusive of incidents of violence where a charge could have been brought, to accurately reflect violence risk. This difference in recording, however, compared to other studies that utilised official police charges, might account for the differences in findings. This may have influenced the lack of significant findings in frequency of offending between those with and without HI or NDD or both, as including all crime-related

behaviour, as opposed to only behaviour that resulted in official police charges, may have superficially increased the rate of offending across the whole sample.

### *Quality of HI and NDD Reporting*

Twenty-seven participants in the sample had notes that referred to a HI when combining the group with only HI and the group with HI and NDD. As is reported in other literature, neuroimaging was not done as part of standard care (Moynan & McMillan, 2018) as none of the cases had neuroimaging reports, despite mental health records suggesting that ‘severe’ HI had occurred in some cases. Given that computed tomography (CT) scans are recommended for ‘high risk’ cases in the UK (National Institute for Health and Care Excellence; NICE, 2019) and for moderate to severe cases in the US (National Institute of Neurological Disorders and Stroke, 2022) it is of concern that neuroimaging reports are not available or referred to in mental health records, given the number of HIs referred to as ‘severe’ in the sample.

Additionally, results from questionnaires that assess severity, such as the Glasgow Coma Scale (Teasdale & Jennet, 1974) as recommended by NICE (2019) were not found in participants’ mental health notes, although this may reflect a lack of information sharing between medical and mental health services, as opposed to evidence that the questionnaires were not done. It is possible that CT scans were carried out and questionnaires were administered, but are only recorded on participants’ medical health records, which the current study did not have access to. However, given the potential detrimental implications of HI on cognitive functioning and mental health, it would be pertinent for such information to be shared with and recorded in mental health systems to ensure that written classification of HI is accurate to inform risk assessment and care planning.

Prevalence of HI in the sample may be underestimated, because as other studies found, HI status is often not screened for as standard by systems (Colantonio et al., 2007) and risk assessments, such as the SAVRY, and thus reliance on self-reporting can negatively skew prevalence rates. This may have impacted the current study’s heterogenous offending results

between groups, as young people may have been incorrectly assigned to the ‘no HI group’ because the information was not available on the file or had not been reported by the young person. As it can be difficult for young people who offend to engage with services (Heath & Priest, 2016), the NDD prevalence within this sample may also be under-reported, given that comprehensive NDD assessments are time-consuming and poor engagement may limit opportunity for such assessments. Therefore, the lack of differences in offending between participants may be explained by inaccurate reporting on mental health records. Inaccurate reporting could be the result of simply failing to log these relevant conditions on records or diagnoses may not yet have been recognised or assessed. It cannot be determined whether those allocated to the ‘No Diagnoses’ group for analysis did in fact have no diagnoses.

#### *Prevalence of ADHD*

The most common NDD in this study sample was ADHD, with 25% of the sample recorded as having this diagnosis. This aligns with another study that found 29% of their sample of young people who offended had an ADHD diagnosis (Baidawi & Piqueuro, 2021). However, Billstedt et al. (2017) found that a much larger proportion (63%) of their sample of imprisoned young adult offenders met criteria for childhood ADHD. Variability in prevalence rates may be explained by feasibility of assessing the different samples, as there may be more opportunity to assess an incarcerated sample, suggesting that some diagnoses in the current sample may not have been detected yet. Given that the evidence suggests that ADHD and other NDD commonly co-occur (Hughes et al., 2012), ADHD as the most common diagnosis within this sample may simply reflect that this diagnosis was most easily observed in comparison to other diagnoses that may also be present alongside ADHD.

#### *Risk Assessment, SIMD and Offending*

The finding of a significant association between higher rates of deprivation and reoffending in the current study is consistent with research that suggests youth reoffending is more likely in deprived areas as there are less resources available to support youth to progress financially and

socially without offending (Wright et al., 2014). Additionally, an English report found that deprived communities experience the highest crime rates (Social Exclusion Unit, 2002), which suggests that offenders may live and offend within the most deprived communities. However, due to the smaller cell sizes for the less deprived areas, with scores of '4' and '5', the variation in cell sizes may have impacted the reliability of this result.

### *Limitations*

The collection of offending data over a 6-month period in this study is relatively short and a longer follow-up period may have provided more detail relating to offending outcomes.

Utilising secondary data and a data mining strategy has limitations in terms of the details that can be collected, as the information available is limited to what has been recorded. The database also did not detail young peoples' attendance and engagement with interventions offered, which may have influenced offending outcomes. Additionally, the database relied on offending behaviours that were reported via social work and therefore, there may be more offending that occurred that was not known about. However, despite problems in terms of ascertaining information about HI or NDD status and HI severity, data mining provided important information about the level of detail that is currently being recorded. Finally, the FCAMHS service in Glasgow is the only specialist forensic, young peoples' service of its kind in Scotland currently, with specific referral criteria and therefore the results may not be generalisable to other young offenders in Scotland.

### *Implications*

Findings from the current sample suggest that there may not be an association between HI or NDD or HI and NDD, and offending behaviour, however, this is not consistent with pre-existing literature and may be due to the particular sample used in this study. The high prevalence of ADHD within the sample would suggest that services should tailor interventions to accommodate neurodevelopmental differences and extra consideration should be taken for comorbid, additional needs that may have been masked by ADHD presentation. Characteristics

associated with HI and NDD should be considered as potential treatment responsivity factors and services should be designed with needs profiles of patients in mind. Details of HI or NDD should consistently be recorded on mental health records so that additional needs can be taken into consideration for decision making, interventions and for legal proceedings to ensure equitable care. Risk assessment tools should be developed to incorporate additional factors linked to offending, such as the link between deprivation and offending. Additionally, the link between deprivation and offending presents a social justice issue that requires further attention.

### *Future Research*

To combat the issue of data mining and the sensitivity of recorded diagnoses, future research should investigate the link between HI, NDD and offending by interviewing young people involved in the criminal justice system, utilising screening or diagnostic tools to determine HI and NDD status. More effective SPJ tools that also consider influences on offending behaviour such as geographical location should be developed in future research, alongside interventions that serve to reduce this inequity.

### *Conclusion*

There were no significant differences in frequency of offending, recidivism and violent offending between those with no diagnoses and those with HI or NDD or HI and NDD in this sample, although sampling and use of databases may have influenced this. The most common NDD diagnosis was ADHD and those living in the most deprived areas of Glasgow were most likely to reoffend. Services should be designed to accommodate specific neurodivergent needs and consider these as potential treatment responsivity factors. Future research should focus on studies using primary data looking at HI, NDD and offending and further SPJ tools should be developed to incorporate HI and NDD, given the links found in other research, and geographical location.

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## Appendices

### Appendix 1.1. Author Guidelines for Submission to Psychology, Crime & Law

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## Appendix 1.2. Search Strategy Sample

1. TI (child\* or young\* or youth\* or juvenile\* or adolescen\*) or AB (child\* or young\* or youth\* or juvenile\* or adolescen\*)
2. TI (neurodev\* or adhd or autis\* or asd or “learning disorder\*” or “learning difficult” or “intellectual disabilit\*” or “learning disabilit\*” or “communication disorder\*” or “motor disorder\*” or tourettes or tic\* or “developmental disord\*” or “mental retard\*” or “mental handicap\*” or Asperger\* or “pervasive developmental disord\*”) or AB (neurodev\* or adhd or autism or asd or “learning disorder” or “learning difficulty” or “intellectual disability” or “learning disability” or “communication disorder” or “motor disorder” or tourettes or tic or “developmental disord\*” or “mental retard\*” or “mental handicap\*” or Asperger\* or “pervasive developmental disorder\*”)
3. DE "Neurodevelopmental Disorders" OR DE "Attention Deficit Disorder" OR DE "Autism Spectrum Disorders" OR DE "Developmental Disabilities" OR DE "Disruptive Behavior Disorders" OR DE "Emotional and Behavioral Disorders" OR DE "Intellectual Development Disorder" OR DE "Learning Disorders"
4. DE "Learning Disabilities" OR DE "Learning Disorders"
5. S2 OR S3 OR S4
6. TI (offen\* or crim\* or prison\* or incarcerat\* or delinquen\* or jail\* or perp\* or arrest\* or inmate\* or penitentiari\* or recidiv\* or re-offend\* or violen\* or “non-violent” or “non violent”) OR AB (offen\* or crim\* or prison\* or incarcerat\* or delinquen\* or jail\* or perp\* or arrest\* or inmate\* or penitentiari\* or recidiv\* or re-offend\* or violen\* or “non-violent” or nonviolent)
7. DE "Criminal Offenders" OR DE "Perpetrators"
8. DE "Juvenile Delinquency" OR DE "Criminal Behavior" OR DE "Predelinquent Youth"
9. DE "Prisoners"
10. DE "Violence"

11. DE "Recidivism" OR DE "Criminal Offenders" OR DE "Criminal Record"
  12. S6 OR S7 OR S8 OR S9 OR S10 OR S11
  13. TI ("childhood adversity" or advers\* or ACE or "adverse childhood experience\*" or trauma\* or stress\* or assault\* or drug\* or narcotic\* or substance\* or alcohol\* or neglect\* or abus\* or violen\* or "looked after" or accommodat\* or "parental death" or "parental separation" or "parental divorce" or divorc\* or separat\* or "socioeconomic status" or depriv\*) OR AB ("childhood adversity" or advers\* or ACE or "adverse childhood experience\*" or trauma\* or stress\* or assault\* or drug\* or narcotic\* or substance\* or alcohol\* or neglect\* or abus\* or violen\* or "looked after" or accommodat\* or "parental death" or "parental separation" or "parental divorce" or divorc\* or separat\* or "socioeconomic status" or depriv\*)
  14. DE "Childhood Adversity" OR DE "Adversity" OR DE "Childhood Development" OR DE "Early Childhood Development"
  15. DE "Trauma"
  16. S13 OR S14 OR S15
- S1 AND S5 AND S12 AND S16

## Appendix 2.1. Author Guidelines for Submission to Youth Violence and Juvenile Justice

### Manuscript Submission Guidelines:

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

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#### **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* (7th 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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Ruth Ballantine

Data Protection Officer  
Information Governance Department  
NHS Greater Glasgow & Clyde  
2nd Floor, 1 Smithhills Street  
Paisley PA1 1EB

Date: 04/05/2022

Enquiries to: Stewart Whyte  
Tel: 0141 355 2020  
Email:

[Stewart.whyte@ggc.scot.nhs.uk](mailto:Stewart.whyte@ggc.scot.nhs.uk)

Dear Ruth,

**Re: The impact of head injury and neurodevelopmental disorders on frequency of offending and violent offences in young people**

Thank you for your updated Caldicott application received on 20/04/2022 regarding your proposed research project.

I have reviewed this application and can confirm that I am happy to approve this application on behalf of the Caldicott Guardian.

Please note that this approval only covers access to NHSGGC patients and is subject to the appropriate ethical and research and development approval being obtained.

If you are considering publishing any anonymised data as part of this work please ensure you are familiar with the ICO Guidance on anonymisation which can be found here <https://ico.org.uk/media/for-organisations/documents/1061/anonymisation-code.pdf>

Please find attached a signed copy of your application for your records.

Yours sincerely

Stewart Whyte  
Data Protection Officer  
Information Governance

## Appendix 2.3. Research and Innovation Management Approval Letter



Research & Innovation  
Dykebar Hospital, Ward 11  
Grahamston Road  
Paisley, PA2 7DE  
Scotland, UK

Senior Research Administrator: Kirsty Theron  
Telephone Number: NA  
E-Mail: [Kirsty.theron@ggc.scot.nhs.uk](mailto:Kirsty.theron@ggc.scot.nhs.uk)  
Website: <https://www.nhsggc.org.uk/about-us/professional-support-sites/research-innovation>

25/05/2022

Dr Leighanne Love

### NHS GG&C Board Approval

Dear Dr L Love

<b>Study Title:</b>	The impact of head injury and neurodevelopmental disorders on frequency of offending and violent offences in young people
<b>Principal Investigator:</b>	Dr Leighanne Love
<b>GG&amp;C HB site</b>	West Glasgow Ambulatory Care Hospital (Forensic CAMHS)
<b>Sponsor</b>	NHS Greater Glasgow and Clyde
<b>R&amp;I reference:</b>	GN22NE155P
<b>REC reference:</b>	22/NW/0156
<b>Protocol no: (including version and date)</b>	Version 7.0 (21.04.2022)

I am pleased to confirm that Greater Glasgow & Clyde Health Board is now able to grant **Approval** for the above study.

#### Conditions of Approval

1. **For Clinical Trials** as defined by the Medicines for Human Use Clinical Trial Regulations, 2004
  - a. During the life span of the study GGHB requires the following information relating to this site
    - i. Notification of any potential serious breaches.
    - ii. Notification of any regulatory inspections.

It is your responsibility to ensure that all staff involved in the study at this site have the appropriate GCP training according to the GGHB GCP policy ([www.nhsggc.org.uk/content/default.asp?page=s1411](http://www.nhsggc.org.uk/content/default.asp?page=s1411)), evidence of such training to be filed in the site file. Researchers must follow NHS GG&C local policies, including incident reporting.

2. **For all studies** the following information is required during their lifespan.
  - a. First study participant should be recruited within 30 days of approval date.
  - b. Recruitment Numbers on a monthly basis
  - c. Any change to local research team staff should be notified to R&I team
  - d. Any amendments – Substantial or Non Substantial
  - e. Notification of Trial/study end including final recruitment figures
  - f. Final Report & Copies of Publications/Abstracts
  - g. You must work in accordance with the current NHS GG&C COVID19 guidelines and principles.

**Please add this approval to your study file as this letter may be subject to audit and monitoring.**



Your personal information will be held on a secure national web-based NHS database.  
I wish you every success with this research study

Yours sincerely,

**Kirsty Theron**  
**Senior Research Administrator**

**Cc: R Ballantine, Prof H McLeod, C Sardar Montgomery**



Appendix 3.1. Major Research Project Proposal (rescue)

<https://osf.io/nezfg/files/osfstorage/62e261221bb7a576e71f38a9>

Appendix 3.2. Major Research Project Proposal (abandoned)

<https://osf.io/nezfg/files/osfstorage/62e261a4f66a9470a5230489>