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DOI:

[10.1016/j.psychres.2017.12.036](https://doi.org/10.1016/j.psychres.2017.12.036)

Document Version

Peer reviewed version

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Citation for published version (APA):

Young, S., González, R. A., Mullens, H., Mutch, L., Malet-Lambert, I., & Gudjonsson, G. (2017). Neurodevelopmental disorders in prison inmates: comorbidity and combined associations with psychiatric symptoms and behavioural disturbance. *Psychiatry Research*. <https://doi.org/10.1016/j.psychres.2017.12.036>

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Neurodevelopmental disorders in prison inmates:
comorbidity and combined associations with
psychiatric symptoms and behavioural disturbance

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PII: S0165-1781(16)31878-9
DOI: <https://doi.org/10.1016/j.psychres.2017.12.036>
Reference: PSY11072

To appear in: *Psychiatry Research*

Received date: 17 November 2016
Revised date: 4 December 2017
Accepted date: 14 December 2017

Cite this article as: Susan Young, Rafael A. González, Hannah Mullens, Laura Mutch, Isabella Malet-Lambert and Gisli H. Gudjonsson, Neurodevelopmental disorders in prison inmates: comorbidity and combined associations with psychiatric symptoms and behavioural disturbance, *Psychiatry Research*, <https://doi.org/10.1016/j.psychres.2017.12.036>

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Neurodevelopmental disorders in prison inmates: comorbidity and combined associations with psychiatric symptoms and behavioural disturbance

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Abstract

The identification and management of inmates with neurodevelopmental disorders (ND) has been insufficiently addressed in the literature. We estimated the proportion of cases with Attention deficit/hyperactivity disorder (ADHD), Autism spectrum disorder (ASD) and Intellectual disability (ID) in prison, their comorbidity, and associations with disruptive behaviours and with psychiatric symptoms. Further, we examined the role of coexisting ND on psychiatric symptoms and attitudes toward violence. All 390 male inmates underwent an assessment that included the Diagnostic Interview for ADHD in Adults 2.0, the Autism Quotient, the Learning Disability Screening Questionnaire, the Brief Symptom Inventory (BSI), and measures of disruptive behaviours and attitudes towards violence. The percentage of cases with ADHD, ASD and ID were 25%, 9% and 9%. Inmates with ADHD and those with ID had significantly higher levels of disruptive behaviours. The combined ADHD/ASD group had significantly higher scores on global severity symptoms than either ADHD or ASD only. Meanwhile, the combined ADHD/ID group had significantly higher scores of behavioural disturbance than the ADHD-only group. Our findings show the extent of ND in prison, their inter-relations and associations with further mental health problems. Vulnerabilities conferred by ND within the criminal justice system should be addressed via interventions and preventative strategies.

Keywords: Neurodevelopmental disorders; ADHD; Autism; Intellectual disability; prison

1. Introduction

Mental health disorders are overrepresented among incarcerated populations. Historically, mental health in prison has been neglected, with limited access to early intervention planning and services for those suffering from psychopathology. International guidelines indicate that treatment standards for prisoners should parallel those available for the population at large (United Nations, 1955). Although some progress has been achieved, and treatment pathways are in place for prison inmates with severe mental illness, such as psychosis (Jarrett et al., 2012; Shaw, 2009), personality disorders (Joseph and Benefield, 2012) and substance dependence (Department of Health, 2006), the identification and management efforts for inmates with neurodevelopmental disorders (ND) has received considerably less attention.

As classified in the most recent version of the DSM (American Psychiatric Association, 2013), ND include Attention Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), and Intellectual Disability (ID). ND are characterised by their early childhood onset, a certain degree of symptom overlap and that they frequently coexist. ADHD is a psychiatric disorder with childhood onset (<12), defined by symptoms of hyperactivity/impulsivity and inattentiveness, and it is highly heritable relative to other forms of psychiatric morbidity (American Psychiatric Association, 2013; Thapar et al., 2005). ADHD is the most prevalent amongst the ND, and is generally one of the most prevalent psychiatric disorders in children and adolescents, ranging from 5.9% to 7.1% in the United States (Willcutt, 2012), and 7.2% worldwide (Thomas et al., 2015). Amongst adults, clinically significant symptoms persist in 65% of cases (Kessler et al., 2006), and may affect as much as 2.8-5.3% of adults worldwide (Polanczyk et al., 2007; Simon et al., 2009).

ASD are defined by qualitative impairments in social communication and interactions (Charman, 2002), with a restricted range of interests and intentions, and stereotyped and repetitive patterns of behaviours (Camarata, 2014). The prevalence of ASD in the general population is estimated at about 1-1.5% (American Psychiatric Association, 2013), with a strong evidence of familial transmission (Constantino et al., 2013; Krumm et al., 2013; Sasson et al., 2013). ASD is often associated with lower IQ scores (Charman et al., 2011). Intellectual disability (ID) is a specific disorder that may be attributed to several causes, including Down's Syndrome, Fetal Alcohol Syndrome, malnutrition, and extreme social deprivation (American Psychiatric Association, 2013), amongst others. Evidence from Genome-wide association studies indicates a strong hereditary link to intelligence (Davies et al., 2011). Although specifying an age of onset may be challenging, current diagnostic criteria require the signs are present before 18 years. Recent diagnostic criteria for ID no longer require IQ to be below 70 and bestow more weight to the presence of function impairments. Its prevalence rate worldwide is estimated at 1% (Maulik et al., 2011).

Having clinically significant symptoms of ND represents an important disadvantage in a challenging environment such as the prison system (Hirvikoski and Blomqvist, 2015). Prison inmates with ND have an increased risk for feeling social disadvantage and exclusion (McCarthy et al., 2016). There is considerable evidence supporting an over-representation of youths and adults with ADHD in correctional services. Meta-analytic prevalence estimates indicate that 25% of adults in prison were classified as ADHD (Young et al., 2015a). ADHD is also a significant factor in prisoners' health as inmates with ADHD are at risk of increased psychiatric comorbidity (Young et al., 2015b) and poorer psychosocial adjustment to the prison environment (Young et al., 2011). For instance, inmates with ADHD in the criminal justice system (CJS) are found to have increased likelihood of engaging in critical incidents and events of behavioural disturbance (Gonzalez et al., 2016) and substance

misuse and high-risk behaviours within site (Gonzalez et al., 2015), whereby their prison tariff is likely to be extended.

Meanwhile, it is suspected that unrecognised cases of ASD in custody may be disproportionately high (McAdam, 2012), with prevalence rates across studies in Europe and in America ranging from 5% (Cheely et al., 2012) to 24% (Barendregt et al., 2015). A recent systematic review highlighted methodological inconsistencies across studies of ASD in prison, hence estimates may be unreliable (King and Murphy, 2014). Amongst these, these authors specifically allude to variability in methods for identifying ND diagnoses, the use of non-random samples, lack of consistency in the screening measures employed, and even in the terminologies used to describe autism spectrum conditions, with some studies using “ASD”, “Asperger” or “Pervasive developmental disorder”. Moreover, studies conducted amongst forensic psychiatry samples often yielded higher estimates, as these would have had considerably more mental health needs and comorbidity (King and Murphy, 2014).

In young offenders in custodial settings, Chitsabesan et al. (2006) estimated prevalence for ID at about 20%, whereas in a general sample of adult prisoners based on meta-analysis this was reported at 7% (Mottram, 2007). Most recent estimates suggest a prevalence of ID between 7-10% (Hellenbach et al., 2016), but methodological challenges make the calculation of ID prevalence difficult, with high rates of false positives and no measures of adaptive behaviours across studies (Fazel et al., 2008). The association between ID with offending is debated, whilst low IQ has been consistently associated with delinquency and violent crime (Lynam et al., 1993).

Several reasons may help explain an increase in the proportion of adults meeting criteria for a neurodevelopmental disorder amongst those incarcerated. Although different ND may share

pathways through which they increase risk for incarceration, distinct mechanisms have been proposed for each may be at play. For instance, lack of behavioural and emotional regulation (Gonzalez et al., 2016), increased impulsivity and risk taking behaviours may explain imprisonment and offending outcomes in ADHD. Meanwhile for ASD, lack of awareness of others' as normally described in Theory of Mind paradigms (Baron-Cohen, 2010), leading to lacking empathy in responses, poor social skills and vulnerabilities and risk for exploitation. Similarly for those with ID, vulnerabilities associated with lack of awareness of dangers and risk for grooming by others, together with lacking known protective effects that intelligence confers (Gonzalez et al., 2013) are potential mechanisms for ID.

Despite some advancement for individuals with ND in prisons, very few services for proper assessment and management are currently in place (Lewis et al., 2015). There is a pressing need for research on diagnosis, screening and co-occurrence of these disorders in a well-sampled prison population. Moreover, identifying important correlates with psychiatric comorbidity is a priority. Understanding links between ND and behavioural disturbance and attitudes toward violence is required, as their interactions with the CJS may occur through different pathways. For example, individuals with ASD may end up incarcerated through being victims of crime, or via communication difficulties, whereas individuals with ADHD may be incarcerated due to poor behavioural control.

In the present study we address the following questions: What is the proportion of cases with ADHD, ID, ASD and general ND in a well-characterised UK prison sample? What are the rates of co-occurrence between the different ND in the sample? What are the associations with disruptive behaviours in prison, attitudes toward violence and psychiatric symptoms? The additive effects of

combining coexisting individual ND on psychiatric symptoms and attitudes toward violence were further examined.

2. Method

2.1 Participants

This study recruited 392 male inmates using opportunity sampling – i.e. interviewing those who were simply available at the time when the study was carried out and fit the inclusion criteria. All participants were either serving a sentence or on remand at a correctional institution in Scotland, United Kingdom. Exclusion criteria included severe level of learning difficulty, a lack of fluency in the English language, and inmates being too mentally unwell to participate (as judged by the prison officers). Of the 392 recruited, two participants were excluded from this secondary analysis due to essential data missing in the Diagnostic Interview for ADHD in Adults 2.0 (DIVA 2.0). The final sample therefore consisted of 390 male inmates whom ranged in age from 18 to 50 years old ($\bar{x}=30.30$, $s.d.=8.35$). £20 was placed in the Common Good Fund in recognition of participation of each inmate.

2.2 Measures

2.2.1 The Autism Quotient (AQ) (Baron-Cohen et al., 2001)

The AQ is a widely used self-reported screening instrument of ASD. This measure has been validated (Baron-Cohen et al., 2001) and was designed to be brief and easy to administer.

Individuals are presented with 50 questions addressing key symptoms of ASD, including social communication difficulties ("I am often the last to understand the point of a joke"), social interaction difficulties ("I find it hard to make new friends"), repetitive obsessional interests ("I prefer to do things the same way over and over again"), sensory sensitivity ("I often notice small

sounds when others do not"), and social imagination difficulties ("I find it difficult to work out people's intentions"). Participants are asked to rate how much they personally agree with these statements using a 4-point Likert scale; 'Definitely Agree', 'Agree', 'Disagree' and 'Definitely Disagree'. The psychometric properties of the AQ have been reported between 0.74 – 0.84 (Broadbent et al., 2013; Hoekstra et al., 2008; Stevenson and Hart, 2017) in terms of reliability, and it has reported concurrent and construct validity across studies (Hoekstra et al., 2008; Lau et al., 2013; Stevenson and Hart, 2017).

For scoring purposes, answers can be dichotomised by combining those who represent agreement and disagreement options. One point is awarded for each response that is indicative of behaviours within the autistic spectrum. Total scores range from 0 to a maximum score of 50; with higher scores reflecting the presence of a greater number of autistic symptoms.

The screening cut-off value of 26 (Hoekstra et al., 2008) was applied for this research and inmates who scored past this cut-off were classified as likely having a general ASD. The cut-off value of 26 was selected to maximise power. In the present study, the proportion of those screening positive for the stricter autism cut-off value of 32 is 2.1%.

2.2.2 Diagnostic Interview for ADHD in Adults – 2.0 (DIVA 2.0)(Kooij, 2010)

All participants were interviewed using the DIVA 2.0 (Kooij, 2010). The DIVA 2.0 is a validated structured interview for ADHD in adulthood that allows assessing symptoms retrospectively as well as currently. The DIVA 2.0 is divided into categories of inattention (I/A), hyperactivity/impulsivity (H/I) and a section for impairment. For each of these areas, questions address current symptom presentation, and those present as a child (ages 5 to 12). Akin to the gold standard in clinical

practice - the CAADID - the DIVA 2.0 uses the symptoms of ADHD as described in DSM-IV (American Psychiatric Association, 2000). Adaptation to the current DSM-5 only required changing the age of symptom onset criterion. Participants are subsequently asked if problems with I/A and H/I have interfered with five different areas of their lives: work or education, relationships and family, social contacts, free time and hobbies and self-confidence/self-image. The DIVA 2.0 is very frequently used, and has been recently employed in clinical settings (Deberdt et al., 2015) and in police custody (Young et al., 2013).

Combining information gathered from the DIVA 2.0 allows for a diagnosis of ADHD to be made. Individuals aged 17 and older with 5 or more symptoms in the inattention domain plus 5 or more symptoms in the hyperactivity/impulsivity domain are categorised as having a combined presentation, whereas individuals reaching the threshold of 5 or more symptoms for either the inattentive or hyperactive/impulsive domain alone are categorised as predominantly inattentive or predominantly hyperactive/impulsive respectively. For the purposes of the study the ADHD classification grouped the primary inattentive, primary impulsive and combined types into the ADHD group, and those who not pass the diagnostic threshold as the non-ADHD group.

2.2.3 Learning Disability Screening Questionnaire (LDSQ) (McKenzie et al., 2012; McKenzie et al., 2015).

The LDSQ questionnaire rates an individual based on seven items that examine intellectual skills (e.g. "can the person read and write") and functional skills (e.g. "can the person live independently"). A higher score (range 0 to 7) indicates lower likelihood of intellectual disability. Scores are converted to a percentage score to account for non-applicability or non-responses, and are then compared with a percentage cut-off, as described in the manual. The LDSQ has been

reported to have good convergent validity when compared with Wechsler IQ scores (McKenzie et al., 2015), with over 80% specificity and sensitivity, and has been validated for use in forensic settings where it is also found to have acceptable psychometric properties (McKenzie et al., 2012).

2.2.4 Brief Symptom Inventory (BSI)

The Brief Symptom Inventory (BSI) is a brief psychological self-report scale (Derogatis and Melisaratos, 1983; Valera et al., 2015). The BSI was developed based on its parent instrument, the SCL-90-R, and both test-retest and internal consistency reliabilities are shown to be very good for its primary symptom dimensions. The BSI has 9 subscales (Somatization, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, Phobic anxiety, Paranoid ideation and Psychoticism), and 3 composite measures (Global Severity Index, Positive Symptom Distress Index, and Positive Symptom Total). Reliability and validity of the Brief Symptom Inventory have been readily documented.

2.2.5 Disruptive Behavioural Social Problems (Young et al., 2003)

The DBSP measure is an informant-rated 14-item questionnaire that investigates the levels of disruptive behaviour and social problems displayed by an individual over a set time-frame. The measure provides three scores: a total score, a disruptive behaviour score, and a social/psychological problems score. A higher score on each indicates a larger degree of problems. The internal consistency for both the disruptive behaviour and social/psychological problem scales are high, with alphas of 0.92 and 0.84 respectively (Young et al., 2003). Informants, whom in this study consisted of prison officers, are asked to answer questions using a 7-point rating scale to display agreement, in which 1="Not at all" and 7="Very Much So". For the purposes of this study, prison officers were asked to consider inmates' behaviour over the past 4 weeks. Questions that

load onto the disruptive behaviour score include "Has the person sought attention from staff?", whilst questions contributing to the social/psychological problems score include "Have you found it easy to establish good rapport with this person?".

2.2.6 Maudsley Violence Questionnaire (MVQ)

The Maudsley Violence Questionnaire (MVQ) (Walker, 2005) is a 56-item true/false questionnaire with a score range of 0-56. The MVQ examines cognitive style in relation to violence attitudes and is designed for use across a spectrum of violent offenders and non-violent individuals. The MVQ is the only measure of violent thoughts that has been factor analysed using a large, normally distributed sample (Walker, 2005; Walker and Bowes, 2013). Following factor analysis the 56 items can be stratified into two factors: 1) *Machismo* – endorsing stereotypical expectations of men as strong and tough (42 items), and 2) *Acceptance* – accepting and enjoying violent behaviour (14 items). Higher scores on these subscales indicate higher frequency of each specific trait.

2.3 Procedure

The current study collected data over an 18-month period between 2011– 2013, and adopts a cross-sectional design. Potential participants indicated interest in participation to the research team, via the prison staff. Recruitment was supplemented by posters and flyers placed on ward notice boards and at reception, and potential participants also indicated interest to the research team via prison staff. A member of the research team met with the participant for the initial meeting and an information sheet was provided for the individual to read. It was reinforced that participation would be confidential and on a voluntary basis, that they had the option to withdraw at any stage without having to provide an explanation, and that there were no expected risks from participation.

The procedure of the original study was reviewed and ethically approved by the Scottish Prison Service Research Access and Ethics Committee (No. 7/13/10/10). Further details of the study procedures have been published elsewhere (Young et al., 2016).

2.4 Statistical Analysis

Frequencies were reported for all categorical variables, and means with their standard deviations for continuous descriptive variables.

In order to establish independence in the proportions of the observations of all binary and categorical variables we used Chi-square (χ^2) tests. To examine potential differences in the mean of demographic or scale scores we used student *t*-tests. Adjusted linear regression models were fitted using ADHD, ASD and ID as the exposures on BSI symptoms as outcomes. Additivity between the ND was examined by creating combined (2*2) categories of the different combinations of ND, regressing the categories on DBSP, BSI and MVQ scores, and then contrasting their estimated parameters. All analyses were performed using Stata version 13 (StataCorp., 2013).

3. Results

3.1 Prevalence and comorbidities

ADHD was assessed via clinical diagnostic interview. ASD and ID were each examined using validated screening tools. The percentage of inmates in the sample who met criteria for any ND was 33% (Table 1). The proportions in this sample were 24.6% for ADHD ($n=96$), 8.5% ($n=33$) for ASD and 9% ($n=35$) for ID. Amongst those with ADHD, 21.9% ($n=21$) also screened positive for ASD ($p < 0.001$), and 14.6% screened positive for ID ($p < 0.05$). Only 5 inmates screened positive for ASD and

ID (not significant). Approximately 63% with ASD, and 40% of inmates with ID, met criteria for ADHD, respectively.

-Insert Table 1 here-

3.2 Behavioural disturbance and attitudes toward violence

Table 2 shows the associations between the different ND (ADHD, ASD, ID) evaluated in the study with respect to disruptive behaviours (DBSP) and attitudes toward violence (MVQ). Participants with ADHD had significantly higher scores on the disruptive behaviours, but not on the social/psychological functioning dimension of the DBSP scale, compared to those without ADHD. Inmates with ID had significantly higher scores on both DBSP subscales compared to those without ID. Those with ASD did not have higher scores on either, compared to those without ASD.

Both ADHD and ID had significantly higher scores on *machismo* and *acceptance of violence* attitudes of the MVQ, compared to those who did not screen positive for ADHD and ID, respectively. Those with ASD only displayed significantly higher scores on the *machismo* subscale compared to those inmates without ASD.

-Insert Table 2 here-

3.3 ND and psychiatric symptoms (BSI)

Primary Axis I symptom categories measured by the BSI were contrasted by the different types of ND. All clinical symptom means were significantly higher in the ADHD and ASD groups compared with those without these disorders. Those with ID had significantly higher scores on the Interpersonal-sensitivity and Paranoid ideation BSI subscales. After fitting multivariate models

including all three ND and every other BSI subscale, only the Obsession-Compulsion and the Psychotic symptom scales were associated with ADHD. Only Interpersonal-sensitivity was associated with ID and ASD in the multivariate model (Table 3).

-Insert Table 3 here-

3.4 Additive effects of ND

We contrasted groups of combined/co-occurring ND with those of individual ADHD, ASD or ID on composite psychiatric symptoms (BSI), disruptive behaviours (DBSP) and on attitudes toward violence (MVQ). For these analyses, we selected the ND categories based on whether they had been significantly associated in our previous univariate analyses; therefore we separately examined the joint contributions of ADHD with ASD (ADHD/ASD) and with ID (ADHD/ID). The combined ADHD/ASD group had significantly higher scores on global severity symptoms and higher positive endorsement of symptoms (BSI), than either ADHD or ASD. The combined ADHD/ASD had lesser scores of machismo and acceptance of violence attitudes (MVQ) than the ADHD-only group. Meanwhile, the combined ADHD/ID group had significantly higher scores of behavioural disturbance and acceptance of violence than the ADHD-only group (Table 4).

-Insert Table 4 here-

4. Discussion

Prevalence and associations between the different neurodevelopmental disorders (ND) have been documented in the community and in clinical samples. These are suspected to be over-represented in correctional services. The associations between ND and institutional behavioural and psychiatric correlates remain understudied and poorly understood. In the

present study we set out to examine the proportion of cases with ADHD, ID, ASD and general ND among UK prison inmates, and their rates of co-existence. Furthermore, we estimated associations with disruptive behaviours in prison, attitudes toward violence and with psychiatric symptoms, and whether comorbidity between the different ND conferred additional burden in the examined outcomes.

Our findings show a high proportion (diagnostic for ADHD, screen-based for ASD and ID) of ND: ADHD 25%, ASD 9% and ID 9%. The combined proportion for all ND was 33%. Among this sample of inmates, ND demonstrate to be significantly co-occurring with ADHD. For instance, 63% of all who screened positive for ASD and 40% of those with ID, met criteria for ADHD. Estimates of the different ND in the present sample are disproportionately higher than most population estimates. A recent prison study reported similar estimates based on a UK correctional sample. Their study identified 36% prisoners who screened positive for one or more type of ND (McCarthy et al., 2016). However in our larger sample we also employed full diagnostic criteria for ADHD. Meanwhile, with the caveat that studies addressing ASD in prison have all sorts of methodological differences and limitations, our present estimate of 9% falls within recent estimates reported in the literature on prisoners. For instance, Billstedt et al. (2017) reported ASD rates at 10%, Barendregt et al. (2015) at the higher end with 24%, whilst Cheely et al. (2012) at about 5%. We purposefully employed a lower threshold for ASD screening recommended by its authors (Baron-Cohen et al., 2001) in order to attain maximum power to detect effects, and found a rate considerably higher than population (1%) and prison estimates.

Our reported association between ADHD and ASD is consistent with the conceptual developmental link between them. For instance, a Latent Class Analysis study provided

evidence that autism symptoms are present in ADHD and may indicate index subtypes of ADHD (Mulligan et al., 2009). They also reported that ADHD represents a familial trait associated with increased neurodevelopmental and oppositional/conduct disorders. Meanwhile, the finding that ASD and ID were not associated in our own sample was unexpected and runs counter to estimates of this comorbidity between 20-30% (Underwood et al., 2013). Only five inmates screened positive for both ASD and ID strongly implying there may have been insufficient power to detect true effects, and the presence of false negatives.

Individuals with both ADHD and ASD had significantly higher scores on all psychiatric symptom subscales. These results parallel patterns of high comorbidity amongst prison inmates with ADHD (Young et al., 2015b) and individuals in the general population (Biederman et al., 2006). ASD were highly comorbid with ADHD, and our findings show that coexistence conferred additive vulnerability for suffering general psychiatric symptoms. This represents a novel and remarkable finding amongst inmates, whilst also consistent with recent reports of poorer mental health outcomes and distress for those with comorbid ADHD and ASD, who demonstrated persistent psychiatric symptoms after follow-up (Simonoff et al., 2013).

Meanwhile, adjusting models for all symptoms combined allow to examine direct associations and highlight those that are most likely to be of clinical significance. Obsessive/compulsive symptoms had the more robust association with ADHD. This association is likely to be explained by core anxiety, which underlies Obsessive-Compulsive Disorder and is highly comorbid with ADHD. Moreover, recent studies show evidence of shared variance and common neurobiological findings between ADHD and compulsive behaviours (Brown et al., 2014). Meanwhile, observed associations

with psychotic symptoms warrant further investigation and, given the prison context and the all-male sample, may suggest links with personality pathology, including paranoid and antisocial.

Inmates with ADHD in this sample were also significantly more likely to endorse positive attitudes towards violence. Additionally, scores for those with coexisting ADHD/ID showed additivity in relation to behavioural disturbance and violent attitudes. There are several reports on the role of low IQ and ID in association with violence and behavioural problems (Moffitt et al. 2004), and in our sample ID seems to combine with ADHD for an increased effect size. Meanwhile, our results show evidence of *lesser* attitudes toward violence in offenders with both ADHD/ASD. Previous research has indicated ADHD is associated with critical incidents (Young et al., 2009), attitudes toward violence (Warnock-Parkes et al., 2008) and violence perpetration (Gonzalez et al., 2016), whereas for ASD this is less known and understudied.

4.1 Limitations

The findings of the study may not be generalizable beyond the prison population. Besides ADHD, proportions of the other ND were derived from screening instruments. It is likely that these screens resulted in a number of false positives, a problem with self-report questionnaires in general. For instance, the AQ is not designed to be diagnostic, but aims to identify individuals that present with high levels of autistic traits and for whom further in-depth investigations should be made. Although designed based on a strong conceptual theory of autism, and it is recommended in the UK NICE guidelines (NICE, 2014), some have cast doubt on its validity (Ashwood et al., 2016). An ADHD screen, by contrast, has been empirically derived for an offender population, which is likely to prove useful to screen for the condition in this setting (Ashwood et al., 2016). Age is inversely associated with age in the present sample and may have played a role in associations with other ND

or correlates. Although statistically significant, some of the effect sizes derived from our analyses on attitudes toward violence and behavioural disturbance had relatively small effect sizes (~ 0.30) and would benefit from replication in further studies. Methodological inconsistencies across studies of ND in prison have been highlighted (King and Murphy, 2014). A general disadvantage of most studies was their samples being too small. In the present study we based our findings on a well-sampled prison study, used diagnostic interviews by trained staff for DIVA 2.0 and accounted for comorbidity with other common mental health disorders. Lastly, the cross-sectional nature of the design limits any conclusions regarding causality between ND and all outcomes studied.

4.2 Conclusions and implications

Our findings show the extent of ND in prison, their inter-relations and associations with further mental health problems. These confirmed previous findings from community samples of high comorbidity between these disorders. Our findings revealed increased risk for psychiatric vulnerability when ADHD and ASD co-occur, whilst a combination of ADHD/ID increases the likelihood for behavioural disturbance and violent attitudes. Vulnerabilities conferred by ADHD in the criminal justice system should be addressed via interventions and preventative strategies. There is a pressing need for resources to be in place and for staff to be trained in the management and identification of prison inmates with ND in correctional services.

Acknowledgements

We are grateful to the support of the Scottish Prison Service for their support of the study. This study was supported by a grant from Shire Pharmaceutical Development Limited. Shire Pharmaceutical Development Ltd. had no role in the design and conduct of the study; collection,

management, analysis, and interpretation of the data; or on the preparation, review, or approval of the manuscript, and the decision to submit the manuscript for publication.

The research was supported by the National Institute for Health Research (NIHR) Imperial Biomedical Research Centre. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

Declaration of interest

SY and GHG have received honoraria for consultancy, travel, educational talks and/or research from Janssen, Eli Lilly, Shire, Novartis, HB Pharma, Flynn Pharma and/or Shire. Other authors have no conflicts of interest.

Table 1. Proportion and co-occurrence of neurodevelopmental disorders (ND) in prison: ADHD, ASD and ID ($N = 387$)

	Neurodevelopmental disorder ($n = 128, 32.9\%$)		
	ADHD ($n \%$)	ASD ($n \%$)	ID ($n \%$)
ND	96 (24.6)	33 (8.5)	35 (9.0)
ASD†	21 (63.6)***	-	5 (15.2)
ID†	14 (40.0)*	5 (14.3)	-
ADHD†	-	21 (21.9)***	14 (14.6)*

Abbreviations: ND – Neurodevelopmental disorders, ADHD – Attention deficit / hyperactivity disorder, ASD – Autism Spectrum Disorder, ID – Intellectual disability

†All row percentages

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2. Contrasts by neurodevelopmental disorders on the DBSP scale and on the MVQ

DBSP- Disruptive behaviour				DBSP - Social/psychological functioning			
	No ND	Yes ND			No ND	Yes ND	
ND	Mean (sd)	Mean (sd)	<i>t</i>	<i>ES (d)</i>	Mean (sd)	Mean (sd)	<i>t</i>
ADHD	13.6 (0.4)	17.5 (1.0)	-4.1***	0.49	23.1 (0.4)	22.8 (0.6)	0.38
ASD	14.4 (0.4)	16.2 (1.3)	-1.18	0.21	23.0 (0.4)	23.4 (1.1)	-0.30
ID	14.3 (0.4)	17.2 (1.7)	-2.06*	0.36	22.9 (0.4)	25.0 (1.1)	-1.76*
	MVQ - Machismo				MVQ - Acceptance		
ND	No ND	Yes ND	<i>t</i>	<i>ES (d)</i>	No ND	Yes ND	<i>t</i>
ADHD	14.4 (0.4)	17.8 (0.8)	-3.9***	0.46	4.6 (0.2)	5.4 (0.3)	-2.2*
ASD	15.0 (0.4)	17.6 (1.4)	-1.88*	0.34	4.7 (0.2)	5.7 (0.5)	-1.6
ID	14.9 (0.4)	18.0 (1.3)	-2.27*	0.40	4.7 (0.2)	6.0 (0.6)	-2.3*

Abbreviations: DBSP – Disruptive Behaviour and Social Problems, MVQ – Maudsley Violence Questionnaire, ND – Neurodevelopmental disorders, ADHD – Attention deficit / hyperactivity disorder, ASD – Autism Spectrum Disorder, ID – Intellectual disability, ES – Effect-size.

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 3. Contrasts by neurodevelopmental disorders on the Brief Symptom Inventory

Mean contrasts										Adjusted models													
ADHD										ASD			ID			ADHD		ASD		ID			
Yes		No		t		Yes		No		t		Yes		No		t		Coef.		Coef.		Coef.	
M (sd)		M (sd)				M (sd)		M (sd)				M (sd)		M (sd)									
Brief Symptom Inventory																							
Somatization				63.7 (1.3)		55.6 (0.7)		-5.4***		69.2 (1.4)		56.5 (0.7)		-5.4***		59.5 (2.4)		57.4 (0.7)		-0.9		-	
Obsession-compulsion				68.2 (1.2)		54.7 (0.8)		-8.9***		73.2 (1.6)		56.6 (0.7)		-6.8***		61.4 (2.7)		57.7 (0.7)		-1.5		-	
Interpersonal sensitivity				61.2 (1.3)		53.9 (0.7)		-5.2***		71.2 (1.4)		54.3 (0.6)		-8.1***		59.9 (2.1)		55.3 (0.7)		-2.1*		2.33*	
Depression				66.6 (1.2)		58.5 (0.7)		-5.6***		73.1 (1.5)		59.3 (0.7)		-6.3***		61.6 (2.1)		60.4 (0.7)		-0.5		-	
Anxiety				66.4 (1.4)		55.8 (0.8)		-6.5***		73.7 (1.7)		57.0 (0.8)		-6.7***		61.3 (2.6)		58.1 (0.8)		-1.2		-	
Hostility				64.0 (1.1)		54.2 (0.8)		-6.7***		68.2 (1.8)		55.6 (0.7)		-5.5***		61.5 (2.4)		56.2 (0.7)		-2.3		-	
Phobic anxiety				62.5 (1.3)		54.7 (0.6)		-5.7***		69.5 (1.9)		55.5 (0.6)		-6.8***		58.8 (2.2)		56.5 (0.6)		-1.1		-	
Paranoid ideation				67.2 (1.1)		59.0 (0.7)		-6.0***		73.1 (1.3)		59.9 (0.6)		-6.2***		65.3 (1.9)		60.6 (0.6)		-2.2*		1.90	
Psychoticism				69.4 (1.1)		60.3 (0.7)		-6.6***		74.5 (1.4)		61.5 (0.6)		-6.0***		63.4 (2.1)		62.5 (0.7)		-0.4		-	
Global Severity Index				70.5 (1.1)		59.0 (0.8)		-7.6***		76.3 (1.1)		60.5 (0.7)		-6.7***		64.9 (2.3)		61.6 (0.7)		-1.4		-	
Positive Symptom Total				67.5 (1.1)		56.4 (0.8)		-7.6***		73.2 (1.1)		57.8 (0.7)		-6.7***		61.6 (2.3)		58.9 (0.7)		-1.1		-	
Abbreviations: DBSP – Disruptive Behaviour and Social Problems, MVQ – Maudsley Violence Questionnaire, ND – Neurodevelopmental disorders, ADHD – Attention deficit / hyperactivity disorder, ASD – Autism Spectrum Disorder, ID – Intellectual disability.																							
*p<0.05, **p<0.01, ***p<0.001																							

Abbreviations: DBSP – Disruptive Behaviour and Social Problems, MVQ – Maudsley Violence Questionnaire, ND – Neurodevelopmental disorders, ADHD – Attention deficit / hyperactivity disorder, ASD – Autism Spectrum Disorder, ID – Intellectual disability.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4. Contrast between those with ADHD comorbid with other ND, against those without comorbid ND on response variable scores

ADHD + ASD ^a					
	ADHD only N= 75, 19.2%	ASD only N= 12, 3.1%	ADHD/ASD N= 21, 5.4%	(ADHD/ASD – ADHD) ^c	
Response variables	Coef.	Coef.	Coef.	Coef.	
DBSP - DB	3.72***	-0.49	4.20*	0.48	
DBS - S/PP	-0.38	0.74	0.05	0.42	
MVQ Machismo	3.66***	3.54	3.27	-0.39	
MVQ Accept	1.01*	2.14*	0.57	-0.44	
BSI - GSI	9.9***	14.7***	19.7***	9.8**	
BSI - PST	9.9***	16.4***	18.1***	8.2**	
ADHD + ID ^b					
	ADHD only N= 82, 21.1%	ID only N= 21, 5.4%	ADHD/ID N= 14, 3.6%	(ADHD/ID – ADHD) ^d	
Response variables	Coef.	Coef.	Coef.	Coef.	
DBSP - DB	2.97**	0.09	8.9***	5.9*	
DBS - S/PP	-0.57	2.00	2.00	2.6	
MVQ Machismo	2.97**	1.59	6.99**	4.01	
MVQ Accept	0.46	0.27	3.12***	2.67**	
BSI - GSI	11.0***	0.29	14.2***	3.19	
BSI - PST	10.6***	-0.42	13.4***	2.8	
Abbreviations: DBSP – Disruptive Behaviour and Social Problems, MVQ – Maudsley Violence Questionnaire, ND – Neurodevelopmental disorders, ADHD – Attention deficit / hyperactivity disorder, ASD – Autism Spectrum Disorder, ID – Intellectual disability.					
^a Reference group for analyses is “Neither ADHD nor ASD”					
^b Reference group for analyses is “Neither ADHD nor ID”					
^c Contrast between combined ADHD/ASD and ADHD-only					
^d Contrast between combined ADHD/ID and ADHD-only					
* $p<0.05$, ** $p<0.01$, *** $p<0.001$					

- American Psychiatric Association, 2000. Diagnostic and statistical manual of mental disorders, 4th ed., text revision, Author, Washington, DC.
- American Psychiatric Association, 2013. Diagnostic and statistical manual of mental disorders, 5th ed. Author, Washington, DC.
- Ashwood, K.L., Gillan, N., Horder, J., Hayward, H., Woodhouse, E., McEwen, F.S., et al. 2016. Predicting the diagnosis of autism in adults using the Autism-Spectrum Quotient (AQ) questionnaire. *Psychol Med* 46 (12), 2595-2604.
- Barendregt, C.S., Van der Laan, A.M., Bongers, I.L., Van Nieuwenhuizen, C., 2015. Adolescents in secure residential care: the role of active and passive coping on general well-being and self-esteem. *Eur Child Adolesc Psychiatry* 24 (7), 845-854.
- Baron-Cohen, S., 2010. Empathizing, systemizing, and the extreme male brain theory of autism. *Prog Brain Res* 186, 167-175.
- Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., Clubley, E., 2001. The autism-spectrum quotient (AQ): evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *J Autism Dev Disord* 31 (1), 5-17.
- Biederman, J., Monuteaux, M.C., Mick, E., Spencer, T., Wilens, T.E., Silva, J.M., et al. 2006. Young adult outcome of attention deficit hyperactivity disorder: a controlled 10-year follow-up study. *Psychol Med* 36 (2), 167-179.
- Billstedt, E., Anckarsater, H., Wallinius, M., Hofvander, B., 2017. Neurodevelopmental disorders in young violent offenders: Overlap and background characteristics. *Psychiatry Res* 252, 234-241.
- Broadbent, J., Galic, I., Stokes, M.A., 2013. Validation of autism spectrum quotient adult version in an Australian sample. *Autism Res Treat* 2013, 984205.
- Brown, F.C., Katz, L.J., Roth, R.M., Beers, S.R., 2014. The relationship of self-reported subclinical obsessive-compulsive symptoms and impulsivity among adults with AD/HD. *Psychiatry Res* 216 (1), 131-136.
- Camarata, S., 2014. Validity of early identification and early intervention in autism spectrum disorders: future directions. *Int J Speech Lang Pathol* 16 (1), 61-68.
- Charman, T., 2002. The prevalence of autism spectrum disorders. Recent evidence and future challenges. *Eur Child Adolesc Psychiatry* 11 (6), 249-256.
- Charman, T., Pickles, A., Simonoff, E., Chandler, S., Loucas, T., Baird, G., 2011. IQ in children with autism spectrum disorders: data from the Special Needs and Autism Project (SNAP). *Psychol Med* 41 (3), 619-627.
- Cheely, C.A., Carpenter, L.A., Letourneau, E.J., Nicholas, J.S., Charles, J., King, L.B., 2012. The prevalence of youth with autism spectrum disorders in the criminal justice system. *J Autism Dev Disord* 42 (9), 1856-1862.
- Chitsabesan, P., Kroll, L., Bailey, S., Kenning, C., Sneider, S., MacDonald, W., et al. 2006. Mental health needs of young offenders in custody and in the community. *Br J Psychiatry* 188, 534-540.
- Constantino, J.N., Todorov, A., Hilton, C., Law, P., Zhang, Y., Molloy, E., et al. 2013. Autism recurrence in half siblings: strong support for genetic mechanisms of transmission in ASD. *Mol Psychiatry* 18 (2), 137-138.
- Davies, G., Tenesa, A., Payton, A., Yang, J., Harris, S.E., Liewald, D., et al. 2011. Genome-wide association studies establish that human intelligence is highly heritable and polygenic. *Mol Psychiatry* 16 (10), 996-1005.
- Deberdt, W., Thome, J., Lebecq, J., Kraemer, S., Fregenal, I., Ramos-Quiroga, J.A., et al. 2015. Prevalence of ADHD in nonpsychotic adult psychiatric care (ADPSYC): A multinational cross-sectional study in Europe. *BMC Psychiatry* 15 (1), 242.
- Department of Health, 2006. Clinical Management of Drug Dependence in the Adult Prison Setting. file:///Users/rafaelgonzalez/Downloads/UK21_management%20in%20prison%20setting.pdf (Accessed 9 November 2015).

- Derogatis, L.R., Melisaratos, N., 1983. The Brief Symptom Inventory: an introductory report. *Psychol Med* 13 (3), 595-605.
- Fazel, S., Xenitidis, K., Powell, J., 2008. The prevalence of intellectual disabilities among 12,000 prisoners - a systematic review. *Int J Law Psychiatry* 31 (4), 369-373.
- Gonzalez, R.A., Gudjonsson, G.H., Wells, J., Young, S., 2016. The Role of Emotional Distress and ADHD on Institutional Behavioral Disturbance and Recidivism Among Offenders. *J Atten Disord* 20 (4), 368-378.
- Gonzalez, R.A., Velez-Pastrana, M.C., Ruiz Varcargel, J.J., Levin, F.R., Albizu-Garcia, C.E., 2015. Childhood ADHD symptoms are associated with lifetime and current illicit substance-use disorders and in-site health risk behaviors in a representative sample of Latino prison inmates. *J Atten Disord* 19 (4), 301-312.
- Hellenbach, M., Karatzias, T., Brown, M., 2016. Intellectual disabilities among prisoners: prevalence and mental and physical health comorbidities. *J Appl Res Intellect Disabil.*, electronic publication 18 January; doi: 10.1111/jat.127234.
- Hirvikoski, T., Blomqvist, M., 2015. High self-perceived stress and poor coping in intellectually able adults with autism spectrum disorder. *Autism* 19 (6), 752-757.
- Hoekstra, R.A., Bartels, M., Cath, D.C., Boomsma, D.I., 2008. Factor structure, reliability and criterion validity of the Autism-Spectrum Quotient (AQ): a study in Dutch population and patient groups. *J Autism Dev Disord* 38 (8), 1555-1566.
- Jarrett, M., Craig, T., Parrott, J., Forrester, A., Winton-Brown, T., Maguire, H., et al. 2012. Identifying men at ultra high risk of psychosis in a prison population. *Schizophr Res* 136 (1-3), 1-6.
- Joseph, N., Benefield, N., 2012. A joint offender personality disorder pathway strategy: an outline summary. *Crim Behav Ment Health* 22 (3), 210-217.
- Kessler, R.C., Adler, L., Barkley, R., Biederman, J., Conners, C.K., Demler, O., et al. 2006. The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *American Journal of Psychiatry* 163 (4), 716-723.
- King, C., Murphy, G.H., 2014. A systematic review of people with autism spectrum disorder and the criminal justice system. *J Autism Dev Disord* 44 (11), 2717-2733.
- Kooij, J.J.S., 2010. Diagnostic Interview for ADHD in Adults 2.0 (DIVA 2.0), Adult ADHD: Diagnostic assessment and treatment. Pearson Assessment and Information BV: Amsterdam, ND.
- Krumm, N., O'Roak, B.J., Karakoc, E., Mohajer, K., Nelson, B., Vives, L., et al. 2013. Transmission disequilibrium of small CNVs in simplex autism. *Am J Hum Genet* 93 (4), 595-606.
- Lau, W.Y., Kelly, A.B., Peterson, C.C., 2013. Further evidence on the factorial structure of the Autism Spectrum Quotient (AQ) for adults with and without a clinical diagnosis of autism. *J Autism Dev Disord* 43 (12), 2807-2815.
- Lewis, A., Pritchett, R., Hughes, C., Turner, K., 2015. Development and implementation of autism standards for prisons. *Journal of intellectual disabilities and offending behaviour* 6 (2), 68-80.
- Lynam, D., Moffitt, T., Stouthamer-Loeber, M., 1993. Explaining the relation between IQ and delinquency: class, race, test motivation, school failure, or self-control? *J Abnorm Psychol* 102 (2), 187-196.
- Maulik, P.K., Mascarenhas, M.N., Mathers, C.D., Dua, T., Saxena, S., 2011. Prevalence of intellectual disability: a meta-analysis of population-based studies. *Res Dev Disabil* 32 (2), 419-436.
- McAdam, P., 2012. Knowledge and understanding of the autism spectrum amongst prison staff. *Prison Service Journal* 202, 26-30.
- McCarthy, J., Chaplin, E., Underwood, L., Forrester, A., Hayward, H., Sabet, J., et al. 2016. Characteristics of prisoners with neurodevelopmental disorders and difficulties. *J Intellect Disabil Res* 60 (3), 201-206.
- McKenzie, K., Michie, A., Murray, A., Hales, C., 2012. Screening for offenders with an intellectual disability: the validity of the Learning Disability Screening Questionnaire. *Res Dev Disabil* 33 (3), 791-795.
- McKenzie, K., Sharples, P., Murray, A.L., 2015. Validating the Learning Disability Screening Questionnaire against the Wechsler Adult Intelligence Scale, Fourth Edition. *Intellect Dev Disabil* 53 (4), 301-307.

- Mulligan, A., Anney, R.J., O'Regan, M., Chen, W., Butler, L., Fitzgerald, M., et al. 2009. Autism symptoms in Attention-Deficit/Hyperactivity Disorder: a familial trait which correlates with conduct, oppositional defiant, language and motor disorders. *J Autism Dev Disord* 39 (2), 197-209.
- National Institute for Health and Clinical Excellence (NICE), 2014. Autistic spectrum disorder in adults. <https://www.nice.org.uk/guidance/cg142>: London. (Accessed 9 November 2015).
- Polanczyk, G., de Lima, M.S., Horta, B.L., Biederman, J., Rohde, L.A., 2007. The worldwide prevalence of ADHD: a systematic review and meta-regression analysis. *American Journal of Psychiatry* 164 (6), 942-948.
- Sasson, N.J., Lam, K.S., Parlier, M., Daniels, J.L., Piven, J., 2013. Autism and the broad autism phenotype: familial patterns and intergenerational transmission. *J Neurodev Disord* 5 (1), 11.
- Shaw, J., 2009. A National Evaluation of Prison Mental Health In-reach Services. Report for the National Institute for Health Research. <http://www.ohrn.nhs.uk/resource/Research/Inreach.pdf> (Accessed 9 November 2015).
- Simon, V., Czobor, P., Balint, S., Meszaros, A., Bitter, I., 2009. Prevalence and correlates of adult attention-deficit hyperactivity disorder: meta-analysis. *British Journal of Psychiatry* 194 (3), 204-211.
- Simonoff, E., Jones, C.R., Baird, G., Pickles, A., Happe, F., Charman, T., 2013. The persistence and stability of psychiatric problems in adolescents with autism spectrum disorders. *J Child Psychol Psychiatry* 54 (2), 186-194.
- StataCorp., 2013. Stata Statistical Software: Release 13, StataCorp LP, College Station, TX.
- Stevenson, J.L., Hart, K.R., 2017. Psychometric properties of the Autism-Spectrum Quotient for assessing low and high levels of autistic traits in college students. *J Autism Dev Disord* 47 (6), 1838-1853.
- Thapar, A., O'Donovan, M., Owen, M.J., 2005. The genetics of attention deficit hyperactivity disorder. *Hum Mol Genet* 14 Spec No. 2, R275-282.
- Thomas, R., Sanders, S., Doust, J., Beller, E., Glasziou, P., 2015. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 135 (4), e994-1001.
- Underwood, L., Forrester, A., Chaplin, E., McCarthy, J., 2013. Prisoners with neurodevelopmental disorders. *Journal of intellectual disabilities and offending behaviour* 4 (1-2), 17-23.
- United Nations, 1955. Standard Minimum Rules for the Treatment of Prisoners. Accessed 9 November 2015 at: <http://www.refworld.org/docid/3ae6b36e8>.
- Valera, P., Fullilove, R., Cali, S., Nunes, E., Chiongbian, V., Clark, W., et al. 2015. The Psychometric Properties of the Brief Symptom Inventory in Men under Criminal Justice Involvement: Implications for Forensic Social Workers in Practice Settings. *Br J Soc Work* 45 (7), 2210-2223.
- Walker, J., 2005. The Maudsley Violence Questionnaire: initial validation and reliability. *Personality and Individual Differences* 38, 187-201.
- Walker, J., Bowes, N., 2013. The evaluation of violent thinking in adult offenders and non-offenders using the Maudsley Violence Questionnaire. *Crim Behav Ment Health* 23 (2), 113-123.
- Warnock-Parkes, E., Gudjonsson, G., Walker, J., 2008. The relationship between the Maudsley Violence Questionnaire and official recordings of violence in mentally disordered offenders. *Personality and Individual Differences* 44, 833-841.
- Willcutt, E.G., 2012. The prevalence of DSM-IV attention-deficit/hyperactivity disorder: a meta-analytic review. *Neurotherapeutics* 9 (3), 490-499.
- Young, S., Gonzalez, R.A., Mutch, L., Mallet-Lambert, I., O'Rourke, L., Hickey, N., et al. 2016. Diagnostic accuracy of a brief screening tool for attention deficit hyperactivity disorder in UK prison inmates. *Psychol Med*, 1-10.
- Young, S., Goodwin, E.J., Sedgwick, O., Gudjonsson, G.H., 2013. The effectiveness of police custody assessments in identifying suspects with intellectual disabilities and attention deficit hyperactivity disorder. *BMC Medicine* 11, 248.
- Young, S., Gudjonsson, G.H., Wells, J., Asherson, P., Theobald, D., Oliver, B., et al. 2009. Attention deficit hyperactivity disorder and critical incidents in a Scottish prison population. *Personality and Individual Differences* 46, 265-269.

- Young, S., Moss, D., Sedgwick, O., Fridman, M., Hodgkins, P., 2015a. A meta-analysis of the prevalence of attention deficit hyperactivity disorder in incarcerated populations. *Psychol Med* 45 (2), 247-258.
- Young, S., Sedgwick, O., Fridman, M., Gudjonsson, G., Hodgkins, P., Lantigua, M., et al. 2015b. Co-morbid psychiatric disorders among incarcerated ADHD populations: a meta-analysis. *Psychol Med* 45 (12), 2499-2510.
- Young, S., Wells, J., Gudjonsson, G.H., 2011. Predictors of offending among prisoners: the role of attention-deficit hyperactivity disorder and substance use. *J Psychopharmacol* 25 (11), 1524-1532.

Highlights

- There were exceedingly high prevalence rates for ADHD (25%), ASD (9%) and ID (9%), and all neurodevelopmental disorders combined (32%) in prison.
- 63% of all who screened positive for ASD, and 40% of those with ID also met diagnostic criteria for ADHD
- Inmates with combined ADHD/ASD had a significantly higher severity profile of psychiatric symptoms than either ADHD or ASD-only
- Those with combined ADHD/ID had significantly higher levels of behavioural disturbance in prison