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† The MRC AIMS Consortium is a UK collaboration of autism research centers in the UK including the Institute of Psychiatry, London; the Autism Research Centre, University of Cambridge; and the Autism Research Group, University of Oxford. It is funded by the MRC UK and headed by the Section of Brain Maturation, Institute of Psychiatry. The Consortium members are (in alphabetical order) Bailey AJ, Baron-Cohen S, Bolton PF, Bullmore ET, Carrington S, Chakrabarti B, Daly EM, Deoni SC, Ecker C, Happé F, Henty J, Jezzard P, Johnston P, Jones DK, Lombardo M, Madden A, Mullins D, Murphy C, Murphy DG, Pasco G, Sadek S, Spain D, Steward R, Suckling J, Wheelwright S, and Williams SC.

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Running title: 'OCD in adults with ASD'

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Funding was provided by the Medical Research Council (MRC, UK) and the MRC, UK Autism Imaging Study (AIMS) network (G0400061/69344; D.G.M., principal investigator), the National Institute for Health Research Biomedical Research Centre for Mental Health at

King's College London, Institute of Psychiatry and South London and Maudsley National Health Service (NHS) Foundation Trust.

Debbie Spain is funded by a National Institute for Health Research (NIHR) Clinical Doctoral Research Fellowship (CDRF - 2012 - 03 - 059). The review presents independent research funded by the NIHR. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

Lay abstract

Little is known about how obsessive-compulsive disorder (OCD) manifests in individuals who have autism spectrum disorder (ASD). It is also unknown whether self-report questionnaires are useful in measuring OCD in ASD. The first aim of the study was to describe the types of obsessive and compulsive symptoms of adults with (i) ASD, (ii) OCD, and (iii) ASD + OCD using the Obsessive Compulsive Inventory – Revised (OCI-R). The second aim was to assess the utility of the OCI-R as a screening measure for OCD in a high-functioning adult ASD sample. To assess this, individuals with ASD (n=171), OCD (n=108), ASD+OCD (n=54) and control participants (n=92) completed the OCI-R. Results showed that individuals with ASD + OCD reported significantly higher levels of obsessive-compulsive symptoms than those with ASD alone. OCD symptoms were not significantly associated with core childhood or present state ASD repetitive behaviours. Analysis suggested that the OCI-R discriminated well between those with ASD + OCD and those with ASD alone, and fairly well between those with ASD without OCD and those with OCD alone. These results suggest that OCD manifests separately from ASD and is characterised by a different profile of repetitive thoughts and behaviours. The OCI-R showed good psychometric properties and corresponded well with clinician diagnosis of OCD and appears to be useful as a screening tool in the ASD adult population.

Abstract

Background: Little is known about the symptom profile of obsessive-compulsive disorder (OCD) in individuals who have autism spectrum disorders (ASD). It is also unknown whether self-report questionnaires are useful in measuring OCD in ASD.

Aims: To describe the symptom profiles of adults with ASD, OCD, and ASD+OCD using the Obsessive Compulsive Inventory – Revised (OCI-R), and to assess the utility of the OCI-R as a screening measure in a high-functioning adult ASD sample.

Method: Individuals with ASD (n=171), OCD (n=108), ASD+OCD (n=54) and control participants (n=92) completed the OCI-R.

Results: Individuals with ASD+OCD reported significantly higher levels of obsessive-compulsive symptoms than those with ASD alone. OCD symptoms were not significantly correlated with core ASD repetitive behaviours as measured on the ADI-R or ADOS-G. The OCI-R showed good psychometric properties and corresponded well with clinician diagnosis of OCD. ROC analysis suggested cut-offs for OCI-R Total and Checking scores that discriminated well between ASD + versus –OCD, and fairly well between ASD-alone and OCD-alone.

Conclusions: OCD manifests separately from ASD and is characterised by a different profile of repetitive thoughts and behaviours. The OCI-R appears to be useful as a screening tool in the ASD adult population.

Keywords: Autism spectrum disorder, Adults, Obsessive Compulsive Disorder, Obsessive-Compulsive Inventory – Revised, Hoarding, Self-report questionnaire

Introduction

Adults with autism-spectrum disorders (ASD) experience high levels of co-morbid psychiatric problems, yet rates of diagnosis and treatment of these conditions is very low (Hofvander et al., 2009). While this is in part due to a lack of specialist services for the adult ASD population, it also reflects the difficulty in distinguishing core ASD symptomatology from additional psychiatric problems. This challenge may be most acute in the assessment and diagnosis of Obsessive-Compulsive Disorder (OCD), which is often co-morbid with ASD (Russell et al., 2005; White et al., 2009). As both conditions are partly characterised by repetitive thoughts and actions, establishing which behaviours are attributable to ASD and which warrant an additional

diagnosis of OCD is far from straightforward. Difficulties with assessment of co-morbid OCD symptoms may also be compounded by impairments characteristic of ASD, such as deficits in communication and insight, and high rates of alexithymia (i.e. impairment in identifying and describing one's emotions) (Bird & Cook, 2013; Davis et al., 2008). However, it is important to understand how OCD manifests in this group and to identify at-risk individuals, given that both OCD and ASD result in high levels of distress and burden, and significant economic costs (Cadman et al., 2012; Doesburg et al., 1997; DuPont et al., 1995; Knapp et al., 2009; Magliano et al., 1996; Torres et al., 2006). Importantly, there is evidence that OCD is treatable in high-functioning adults with ASD (Russell et al., 2013).

Two studies have used a clinician-administered OCD measure (the Yale Brown Obsessive Compulsive Scale; Y-BOCS) (Goodman et al., 1989) to compare the types of OC symptoms experienced by adults with ASD to those found in typically-developing adults with a primary diagnosis of OCD (Mcdougle et al., 1995; Russell et al., 2005). Mcdougle et al. (1995) reported that adults with OCD were more likely to show aggressive and symmetry obsessions, and compulsions related to counting, whereas individuals with ASD were more likely to display compulsions related to hoarding, or touching and tapping. However, IQ may have been a confound; many of the participants in the study were non-verbal and carer reports were relied upon. Additionally, the ego dystonic criteria was suspended. In Russell et al.'s study (2005) adults with OCD displayed greater total frequencies of obsessions and compulsions compared to a high-functioning ASD group, including significantly higher frequencies of somatic obsessions and repeating and checking compulsions. Comparison between participants with OCD and ASD+OCD showed a higher frequency of somatic obsessions in the OCD group and sexual obsessions in the ASD+OCD group. In addition, approximately 25% of the group (n=40) with ASD met criteria for co-morbid OCD and 39% (n=15) reported significant interference and distress as a result of anxiety-based obsessions and compulsions.

Studies comparing children with ASD and OCD using the CY-BOCS (child version of the Y-BOCS) have shown a broadly similar pattern of findings, with children with OCD showing higher frequencies of obsessions and compulsions and greater symptom severity than children with ASD (Ruta et al., 2010; Zandt et al., 2007). Ruta et al. (2010) reported similar findings to Mcdougle et al. (1995), with children with OCD showing higher frequencies of contamination and checking compulsions, and children with ASD showing a trend towards higher levels of hoarding obsessions, and hoarding and ordering compulsions. In contrast, Zandt and colleagues (2007) reported that the only difference between the ASD and OCD groups was a greater frequency of routines and rituals in the OCD group. Differences in these study findings may be attributable to sample sizes, in particular a lack of power to detect differences in the study by Zandt and colleagues (Zandt et al., 2007).

While clinician-administered instruments are important assessment tools, they often require extensive training and can be time-consuming. Self-report measures are routinely used in clinical practice as they can offer rapid screening, and provide a valuable means of measuring change and outcomes, for example during a course of psychological treatment. However, because of the difficulties that individuals with ASD can have in describing their internal states, it is not known whether self-report measures are effective in identifying OCD in this group. For example, Mazefesky and colleagues (2011) reported the poor performance of a self-report measure to identify OCD in children with ASD; but other studies have shown strong correlations between parent and child self-reports of anxiety and depression in ASD (Blakeley-Smith et al., 2012;; Ozsivadjian et al., 2013; Storch et al., 2012). A separate study with adults also found that individuals with high-functioning autism are able to self-report symptoms of alexithymia, suggesting that high-functioning adults may be able to report symptoms more reliably than children (Berthoz & Hill, 2005).

In summary, it is important to ascertain whether self-report measures may be effective screening tools to identify OCD in ASD. The present study therefore used a well-validated self-

report measure, the Obsessive Compulsive Inventory – Revised (OCI-R) (Foa et al., 2002), to measure OCD symptoms in an adult ASD sample. The aims of the study were three-fold: (i) to compare the symptom profiles of adults with ASD, OCD, ASD+OCD and a control group using the OCI-R, (ii) to assess the psychometric properties of the OCI-R in an ASD sample, and (iii) to examine the utility of the OCI-R as a screening measure by exploring how accurately it corresponds to clinician diagnosis.

Method

Sample and study design

The study used an observational design using a self-report questionnaire. Participants included (i) 171 adults with ASD and no clinical diagnosis of OCD (ASD-), (ii) 54 adults with ASD and (clinician diagnosed) co-morbid OCD (ASD+OCD), (iii) 108 adults with OCD and no known ASD diagnosis, and (iv) 92 non-clinical controls. Anonymised data were obtained from four different sources: (i) the Adult Autism (Behavioural Genetics) Service, a specialist outpatient clinic in South London diagnosing neurodevelopmental disorders in adults, (ii) the Autism Imaging Multicentre Study (AIMS) (Ecker et al., 2010), (iii) a randomised controlled trial of CBT for comorbid OCD in high-functioning autism (Russell et al., 2013), and (iv) various studies on OCD conducted at the Institute of Psychiatry, King's College London. Ethical approvals and informed consent were obtained for the respective studies.

Procedure

Participants completed the OCI-R as part of a standard clinical or research assessment which comprised obtaining diagnostic, clinical and demographic information. Participants completed the OCI-R independently, but were able to ask questions of the clinician or researcher if required. IQ measurement was a routine component of evaluation for the control and ASD groups (i-iii). No IQ data were available for the OCD group (iv); however, all participants in

this group were adults of working age with no known intellectual disability or developmental disorder.

The control group were screened for ASD using the Autism Quotient (AQ) (Baron-Cohen et al., 2001). Participants were excluded if they scored 32 or more on the AQ, if they had a psychiatric diagnosis, or if they had a verbal IQ<70.

Diagnoses of ASD and OCD were established by standardised diagnostic evaluation (either via the Mini-International Neuropsychiatric Interview and/or ICD-10 clinical research criteria) (Sheehan et al., 1998; WHO, 2004), by a multi-disciplinary team comprised of psychiatrists, nurse specialists, psychology graduates, and (post)doctoral clinical-researchers experienced in working with adults with ASD and OCD. Where possible ASD diagnostic information was supplemented with the Autism Diagnostic Interview - revised (ADI-R) (Lord et al., 1994) or the Autism Diagnostic Observation Schedule - Generic (ADOS-G) (Lord et al., 2000) when parental informants were not available. Participants were included in the ASD- or ASD+OCD groups if they had a diagnosis of Asperger's syndrome or childhood autism with no intellectual disability ('high-functioning autism'). To reduce the heterogeneity of the ASD sample, participants were excluded if they had a diagnosis of atypical autism or pervasive developmental disorder – not otherwise specified (PDD-NOS) as these two groups may have minimal or absent symptoms in the Repetitive Behaviours domain. Participants were also excluded if they had psychosis, or if they had a verbal IQ<70.

Measures

The type, severity and frequency of obsessive and compulsive symptoms were investigated using the Obsessive Compulsive Inventory-Revised (OCI-R) (Foa et al., 2002). The OCI-R is a self-report measure consisting of 18 questions rated on a 5-point Likert scale. It rates the level of distress caused by various symptoms over the past month. The measure includes items such

as “I repeatedly check gas and water taps and light switches after turning them off”. A total score (ranging from 0-72) is calculated by summing the scores for each item. The OCI-R has 6 subscales in line with epidemiological studies of the main OC symptom dimensions, i.e. Hoarding, Checking, Ordering, Obsessing, Washing and Neutralising. The OCI-R has been validated in OCD and anxiety samples (Abramowitz & Deacon, 2006; Foa et al., 2002; Huppert et al., 2007) and a non-clinical sample (Hajcak et al., 2004). Whilst the OCI-R was not designed as a diagnostic measure, Foa et al. (2002) suggest a total OCI-R score of 21 as the optimal cut-off for distinguishing patients with OCD from non-anxious controls, and 18 for distinguishing those with OCD from anxious controls.

Verbal IQ was assessed by trained psychology graduates using either the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III) (Wechsler, 1981) or the Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999). Verbal IQ scores were available for 81 of the control group (90%), 144 of the ASD- group (84%) and 35 of the ASD+OCD group (65%). Of those tested for verbal IQ, 81 (31%) were tested using the WAIS and 179 (69%) using the WASI.

Statistical analysis

Kolmogorov–Smirnov tests revealed that scores on most of the measures were not normally distributed; non-parametric tests were therefore used where appropriate. First descriptive statistics were calculated for the four groups and differences between the groups were explored. Second, Kruskal-Wallis tests followed by post-hoc Mann-Witney tests were used to compare the symptom profiles of the four groups. Third, the psychometric properties of the OCI-R were examined in the combined sample of the ASD- and ASD+OCD groups (n=232). Cronbach’s *alpha* and Spearman’s *rho* were calculated to assess inter-correlations, and confirmatory factor analysis (CFA) was used to test the hypothesised 6-factor structure of the OCI-R. Finally, to examine the diagnostic utility of the OCI-R in distinguishing patients clinically diagnosed with ASD+OCD from patients with ASD only, a receiver operating characteristic (ROC) analysis

was conducted. The ROC analysis was conducted using Stata 12; CFA was performed using AMOS 20.0; all other tests were conducting using SPSS 20.0. To control for multiple comparisons the significance level for the Mann-Witney tests was set at 0.01. Significance level for all other tests was set at 0.05.

Results

Demographic characteristics

Table I about here

The demographic characteristics of the sample are shown in Table I. There was a significant difference between the groups in verbal IQ ($F_{(2, 259)}$=3.78, p=.02), with the ASD+OCD group having a significantly higher mean IQ than the control group (p=.02). There was a significant age difference between the groups ($F_{(3, 411)}$=32.84, p<.001), with the OCD group being significantly older than all the other groups (p<.001). There were also significant differences in the gender balance of the groups ($\chi_{(2)}$=63.85, p<.001), with the OCD group containing significantly more females than the other groups.

Due to these group differences in gender, Mann-Witney tests were run to compare the OCI-R scores of males and females within each group; however the only significant difference in scores was on the *Ordering* subscale for the OCD group (males mean=4.38, s.d.=3.71; females mean=6.02, s.d.=3.85; U=1081.50, p=.02). Similarly, due to significant age differences between groups, analyses were also re-run using an age-matched subset of the four groups. No differences were found in the significance or direction of any comparisons.

Table II about here

Diagnostic information

ADI-R scores were available for 145 of the ASD- group (85%) and 40 of the ASD+OCD group (74%). ADOS-G scores were available for 127 of the ASD- group (74%) and 31 of the ASD+OCD group (57%) (See Table II). There were significant differences between the two groups: the ASD- group showed significantly higher ADI-R (childhood) communication scores ($T_{(77.39)}$=2.27, p=.03) whilst the ASD+OCD group showed significantly higher ADOS-G current communication scores ($T_{(156)}$=-3.43, p=.001). There were no significant differences between the ASD+OCD and ASD- groups on the ADI-R restricted, repetitive and stereotyped interests domain (RRSI) or the ADOS stereotyped behaviours and restricted interests domain (SBRI), suggesting that the groups did not differ in terms of current or developmental levels of ASD-related repetitive behaviours. There was also no significant correlation between total OCI-R scores and the ADI-R RRSI or ADOS-G SBRI domain scores (all r<0.15) in either the ASD- or ASD+OCD groups.

Symptom profiles

There were significant differences in OCI-R scores between the groups ($H_{(3)}$=137.12, p<0.001) (see Figure I). The ASD+OCD group had a significantly higher mean total score than the OCD group (p=.03), which in turn had a significantly higher mean total score than the ASD- group (p<.001). The control group had a significantly lower mean total score than all the clinical groups (p<.001), There was no significant difference between the ASD+OCD group and the OCD group in mean total OCI-R score (p=.03).

Figure I about here

Significant differences between the groups were found for all six subscales of the OCI-R (see Figure II) (Hoarding $H_{(3)}$=51.89; Checking $H_{(3)}$=74.96; Ordering $H_{(3)}$=84.35; Neutralising $H_{(3)}$=46.70; Washing $H_{(3)}$=63.12; and Obsessing $H_{(3)}$=114.82, p<.001 for all). The results of the post-hoc analysis are shown in Table III.

Figure II about here

Table III about here

The ASD- group had significantly higher rates of Hoarding than the OCD group, but comparable levels of Ordering symptoms. In contrast the ASD+OCD group had significantly higher rates of both Hoarding and Ordering than the OCD group, and significantly higher rates of Checking, Ordering and Obsessing than the ASD- group. There were no significant differences between the OCD and ASD+OCD group in total score or Checking, Washing, Neutralising or Obsessing.

Psychometric properties of the OCI-R

The psychometric properties of the OCI-R were examined in the whole ASD sample (n=225; from here on referred to as the 'combined ASD sample'). The OCI-R total scale demonstrated excellent internal consistency (α=0.92) indicating that the individual items are measuring the same construct. The Hoarding (α=0.79), Checking (α=0.85), Ordering (α=0.91), Neutralising (α=0.80), Washing (α=0.79) and Obsessing (α=0.85) subscales all demonstrated acceptable internal consistency.

Correlations between the subscales were calculated using Spearman's r. Correlations for the combined ASD sample were moderate (0.32-0.59) implying that, while related, the subscales do measure different aspects of OCD (Table IV).

Table IV about here

A confirmatory factor analysis was undertaken to test the hypothesised 6 factor structure of the OCI-R in the combined ASD sample. The latent factors were allowed to covary, while the errors were not. Following Foa et al. (Foa et al., 2002), the 6 factor structure was confirmed using

criteria proposed by Hu and Bentler (Hu & Bentler, 1999). The model had a significant chi-square ($\chi^2_{(120)}$=237.08, p<.001), a goodness of fit index (GFI) of 0.89, a comparative fit index (CFI) of .95, a standardised root mean square residual (SRMR) of 0.06, and a root mean square error of approximation (RMSEA) of 0.07. All of these statistics, apart from chi-square, indicate a good fit, implying that the 6 factor structure observed with other populations also holds in this ASD sample. By comparison, a one-factor model showed a poor fit ($\chi^2_{(135)}$=909.23, p<.001; GFI= 0.66; CFI=0.65; SRMR=0.10; RMSEA=0.16).

Calculation of an OCI-R cut-off score for the ASD group

Following Abramowitz and Deacon (Abramowitz & Deacon, 2006), ROC analyses were run for both OCI-R total score and the 6 OCI-R subscales to investigate which best discriminated the ASD- group from the ASD+OCD group. The highest area under the curve (AUC) values were exhibited by the total OCI-R scale (0.71; Figure III) and the Ordering subscale (0.70). These values indicate that the OCI-R has good discriminative power in this population. The AUC values for the other subscales demonstrated moderate to good discriminative power (Hoarding = 0.56; Checking = 0.69; Neutralising = 0.61; Washing = 0.61; Obsessing = 0.63),

Figure III about here

Table V shows the sensitivity and specificity rates for different cut-off values on the OCI-R total scale. An optimal OCI-R total cut-off score of 29 was found for both sensitivity and specificity. This resulted in the correct classification of 37 out of 54 of ASD+OCD (69%), and 120 out of 171 of ASD- (70%). Table VI shows the sensitivity and specificity rates for the six subscales at the optimal selected cut-off. Of these, the Checking subscale showed the strongest discriminative properties with a cut-off score of 5 giving a correct classification of 38 out of 54 of ASD+OCD (70%), and 109 out of 171 of ASD- (64%).

In order to try to assess how effectively the OCI-R discriminated between ASD and OCD presentations, an additional ROC analysis was run comparing the ASD- and OCD groups. Results showed that the measure was moderately effective, with AUC values ranging from 0.64 (Checking and Obsessing) to 0.37 (Hoarding).

Table V about here

Table VI about here

Discussion

We report, for the first time, the utility of a self-report measure of OCD symptoms in a large sample of adults with ASD. Our aims were threefold: (i) to compare the symptom profiles of adults with ASD, OCD, ASD+OCD and a control group using the OCI-R, (ii) to assess the psychometric properties of the OCI-R in an ASD sample, and (iii) to examine the utility of the OCI-R as a screening measure by exploring how accurately it corresponds to clinician diagnosis.

First, we compared the types of self-reported repetitive thoughts and behaviours displayed by adults clinically diagnosed with ASD alone, ASD+OCD, and OCD alone. Our results suggest that ASD+OCD individuals have significantly higher levels of checking, ordering and obsessing than individuals with ASD alone. This is consistent with the results of an earlier study of typically-developing individuals which showed that the largest differences between OCD and control subjects were on the obsessing and checking subscales of the OCI-R (Foa et al. 2002). This implies that the symptom profile of OCD in ASD shares similarities with the non-ASD population.

We also found that ASD+OCD individuals show significantly higher levels of ordering and hoarding than individuals with OCD alone. Hoarding was notable also in ASD without OCD-. These results are consistent with recent work by Pertusa and colleagues (Pertusa et al., 2012) who reported a high frequency of hoarding symptoms in individuals with ASD. This is also consistent with the findings of an earlier study of a mixed ability sample of adults with ASD (Mcdougle et al., 1995) and a study of children with ASD (Ruta et al., 2010), but not a study of high-functioning adults using the Y-BOCS (Russell et al., 2005) which found that sexual obsessions were the symptom dimension differentiating ASD+OCD from adults with a primary diagnosis of OCD. Since the OCI-R does not contain a subscale specifically assessing sexual obsessions, comparison to the present study is limited.

We found no significant correlations between total OCI-R score and scores on the ADI-R or ADOS-G repetitive behaviour and restricted interest domains. This is in contrast to a possible explanation of the ASD-OCD overlap construing apparent OCD symptoms in ASD groups as merely reflecting ASD-typical repetitive behaviour and special interests (Baron-Cohen, 1989). Instead, our data suggest that obsessive and compulsive symptoms do represent a distinct construct to the rituals and repetitive behaviours characteristic of ASD, and in the current large sample are not necessarily associated with the severity of childhood or present state core ASD impairments (Kerns & Kendall, 2012).

Second, we sought to assess the psychometric properties of the OCI-R in an adult ASD sample. Internal consistency was good and factor analysis supported the 6 factor structure previously reported in OCD clinical samples (Abramowitz & Deacon, 2006; Foa et al., 2002; Huppert et al., 2007) and a non-clinical sample (Hajcak et al., 2004). There might be concern about the use of self-report instruments in a clinical group such as ASD, where impairments in self-awareness and insight have been reported (Davis et al., 2008). However, our results suggest that the OCI-R self-report measure operates very similarly in those with ASD compared to those with OCD

or no disorder. Hence we suggest that the OCI-R can be used as a reliable self-report screening tool for those with ASD.

Finally, we explored how effectively the OCI-R discriminated between ASD+OCD and ASD-. ROC analysis suggested that a cut off OCI-R total score of 29 best discriminated between the two groups (correctly classifying 69% of ASD+OCD and 70% of ASD- individuals respectively). The performance of the OCI-R in this sample is comparable to that demonstrated by Foa and colleagues (Foa et al., 2002) in the original validation of the measure (OCD versus non-anxious controls: sensitivity=65.6%, specificity=63.9% at a cut-off of 21; OCD versus anxious controls: sensitivity=74.0%, specificity=75.2% at a cut-off of 18). This suggests that self-reported symptoms using the OCI-R correspond accurately to clinician diagnosis, but that due to the high levels of repetitive behaviours in ASD a higher cut-off score should be used than with other populations (Abramowitz & Deacon, 2006).

Our study has some limitations. First, only one self-report measure of OCD was used. While participants were diagnosed by experienced clinicians using ICD-10 research criteria, inclusion of an informant or standardised clinician-administered measure of OCD symptoms (e.g. the Y-BOCS) would have provided additional corroboration of diagnosis, and facilitated in depth assessment of characteristics such as obsessional thoughts and images. It is acknowledged that people with ASD may have difficulties with separating out OCD traits from ASD characteristics. Second, we did not formally assess for ASD in the OCD group; given the potential high rates of co-morbidity, it is possible that some participants with OCD may have had undiagnosed ASD. However, undiagnosed ASD in the OCD group could not account for the current pattern of results, and would only have diluted group differences. Third, as in previous studies assessing the validity of the OCI-R, IQ data were not available for the OCD group. Again, possible group differences in IQ are unlikely to have driven the findings reported here; within the ASD group there was a weak relationship between IQ and OCI-R scores. Fourth, only participants with a diagnosis of Asperger's syndrome or high-functioning autism

were included, which may limit the generalisability of results to individuals who have broader autism spectrum conditions. However, this limitation should be balanced against the strength of having a more homogeneous group and the opportunity to consider the association between scores on an OCD symptom measure and scores on all domains of ASD characteristics, including repetitive behaviours. Finally, there were differences in the gender and age compositions of the groups. Previous research has found some differences in the types of OCD symptoms reported by males and females (Bogetto et al., 1999), however, in our sample the only gender differences were in the OCD group on the Ordering subscale. Also, whilst our results indicated a small correlation between age and total OCI-R score, further analysis with an age-matched subset showed no differences in the significance or direction of any of the between-group comparisons from the whole groups.

While our findings may only be directly relevant to individuals with ASD without intellectual disability, there are a number of clinical implications. Our findings confirm the results of previous studies, which show that many people with ASD also have OC symptoms, and that these occur independently of the repetitive behaviours characteristic of the core disorder. We also found that the symptom profile of OCD in ASD shared similarities with the non-ASD population. This is important, as one could (wrongly) assume that OC symptoms are part of ASD or very different in ASD, and hence fail to assess or treat these important and debilitating difficulties. Our findings suggest that high-functioning adults with ASD can self-report OC symptoms using the OCI-R and that this can act as a useful screen for later diagnostic evaluation comprising objective clinician-administered assessments. This also implies that the OCI-R could be used as an outcome measure for treatment interventions for high-functioning individuals with ASD.

There are several implications for future research. First, the aetiology of OCD in ASD is poorly understood. While it seems plausible that these co-morbid symptoms are attributable to a combination of genetic and environmental factors, further research is needed to explore causal

and maintaining mechanisms for OCD in ASD: Such research should include investigation of a range of neurocognitive and/or neurobiological factors associated with ASD that might serve to precipitate or perpetuate OC symptoms. These might include difficulties tolerating uncertainty, a tendency toward concrete thinking styles, preferences for local vs. global processing of information, and developmental abnormalities in neural systems (e.g. cortico-striatal pathways) implicated in both ASD and OCD. Bivariate twin analyses have been helpful in differentiating genetic and phenotypic sources of overlap between ASD and other commonly-associated disorders (e.g. ADHD, anxiety) (Hallett et al., 2012) and might prove useful to investigate comorbid OCD and ASD. Second, to further explore the validity of the OCI-R in this population, self-reported symptoms of OC should be compared with informant-reports (e.g. via a clinician-administered measure). Third, the overlap between self-reported hoarding and ordering behaviours in ASD and OCD warrants further investigation, to aid with delineating between disorders, and to inform robust methods of assessment methods. Finally, longitudinal studies are needed in order to determine the developmental trajectory and prognosis of OCD in this clinical population.

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