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Title : Elevated levels of hoarding in ADHD: a special link with inattention

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Abstract

Background: Hoarding Disorder (HD) is under recognised and under-treated. Though HD develops by early adulthood, patients present only later in life, resulting in research based largely on samples of predominantly older females. Previously linked to Obsessive Compulsive Disorder (OCD), individuals with HD often have high inattention levels reminiscent of Attention Deficit/ Hyperactivity Disorder (ADHD). Here, we investigated HD in adults with ADHD.

Methods: Patients in an ADHD clinic (n=88) reported on ADHD-, and OCD-related symptoms. Patients were compared to age, gender and education matched controls (n=90). Findings were compared to those in an independent online UK sample (n=220).

Results: Clinically significant hoarding symptoms were found in ~20% versus 2% of ADHD and control groups, respectively, with hoarders being on average in their thirties and balanced gender-wise. Greater hoarding severity was noted even in non-hoarding ADHD patients compared with controls ($d=0.89$). Inattention was the only significant statistical predictor of hoarding severity in ADHD patients. Similarly, inattention, alongside depression and anxiety were the greatest predictors of hoarding in the independent sample where 3.2% were identified as hoarders.

Conclusion: Adult ADHD patients had a high frequency of hoarding symptoms, which were specifically linked to inattention. HD should be routinely assessed in ADHD patients, as they do not typically disclose associated difficulties, despite these potentially leading to impaired everyday functioning. Research in HD should investigate ADHD patients, who are younger and with a greater prevalence of males than typical HD samples.

Key words: Attention Deficit/Hyperactivity disorder; Hoarding Disorder; executive function; inattention; Obsessive Compulsive Disorder

Introduction

Individuals with Hoarding disorder (HD) suffer from excessive clutter, difficulties discarding and often excessive accumulation, causing clinically significant distress or impairment in social and occupational functioning (Frost & Hartl, 1996). Historically, hoarding symptoms were believed to characterise some Obsessive Compulsive Disorder (OCD) patients (Saxena, 2008). However, the majority of individuals with HD do not demonstrate the key features of OCD: obsessions or time-consuming compulsions (Frost et al., 2011). Consequently, since 2013 HD has been considered a distinct condition with unique phenomenological, psychological and neurobiological characteristics (American Psychiatric Association, 2013). HD appears chronic with symptoms typically arising by late adolescence and steadily worsening over time, leading to significant distress and impact on daily functioning by age 40 (Dozier et al., 2016; Grisham et al., 2006; Zaboski et al., 2019). Prevalence of HD is estimated to be 2.5%, with similar rates for males and females (Postlethwaite et al., 2019). Notably, individuals with HD frequently have poor insight regarding their condition, and consequently are less likely to seek help or treatment (Frost et al., 2010; Grisham et al., 2005).

The bulk of research on hoarding has drawn on OCD patients, given its status prior to DSM-5 (American Psychiatric Association, 2013). More recently, much of what is known about HD *per se* and its treatment is derived from individuals who self-identify as hoarders. These samples are predominantly female (Frost et al., 2011; Woody et al., 2020), suggesting insight may be especially poor in males. Moreover, the average age of HD participants in research and treatment studies is mid-50's or older (Tolin et al., 2015; Woody et al., 2014). There have been some studies on community samples, where participants are identified via housing, fire and public health agencies (Bratiotis et al., 2011). These samples are gender balanced but the average age is even older (Woody et al., 2020). Taken together, this suggests

that individuals, and particularly males who suffer from clinically significant levels of hoarding already by their mid-30's do not seek help until decades later, if at all.

Despite the historic association between HD and OCD, research and clinical impression has pointed to a link between HD and Attention Deficit/Hyperactivity Disorder (ADHD). ADHD is a neurodevelopmental disorder marked by persistent problems due to inattention and impulsivity, with over half of sufferers experiencing significant functional difficulties into adulthood (American Psychiatric Association, 2013). Similarly to individuals with ADHD, those with hoarding have difficulties with information processing and executive functioning (Morein-Zamir et al., 2014; Woody et al., 2014). The link was noted in OCD patients, where those with hoarding were more likely to have ADHD, particularly the inattentive subtype (Frost et al., 2011; Sheppard et al., 2010). The association was also found in HD, with higher levels of inattentive symptoms and elevated ADHD comorbidity rates when compared to controls or OCD patients (Frost et al., 2011; Hall et al., 2013; Hartl et al., 2005; Tolin & Villavicencio, 2011). A link between hoarding and impulsivity/hyperactivity symptoms has also been proposed, with HD patients endorsing more acquisition-related impulse control problems (Frost et al., 2011). However, this association has proven more inconsistent with positive findings in undergraduate samples (Timpano et al., 2013) and some patient studies (Hall et al., 2013; Hartl et al., 2005), but not others (Sheppard et al., 2010; Tolin & Villavicencio, 2011). The link between hoarding and ADHD more generally has not been supported in non-patient samples. Namely, in a twin registry and an undergraduate student sample (Ivanov et al., 2013; Woerner et al., 2017), though importantly these studies did not distinguish between inattention and impulsivity/hyperactivity, assessing them jointly.

To fully understand the association between hoarding and ADHD it is also necessary to investigate hoarding in ADHD populations, not least as ADHD appears to be more prevalent than HD with estimates of 5.3% in children and adolescents (Polanczyk et al.,

2007) and 2.5-3.5% in adults (Matte et al., 2015; Simon et al., 2009). A study in youths diagnosed with ADHD highlighted parents endorsing a relatively high frequency of clinically significant hoarding (29%), with inattention and hyperactivity/impulsivity as independently predicting hoarding features (Hacker et al., 2016). Additionally, an epidemiological study found hoarding symptoms were more common in individuals retrospectively reporting childhood ADHD inattention (but not hyperactivity) relative to those not reporting childhood ADHD (Fullana et al., 2013).

Consideration of the link between hoarding and ADHD exists amongst hoarding specialists, but not amongst adult ADHD clinical and scientific specialists (Faraone, Asherson, Banaschewski, Biederman, Buitelaar, et al., 2015; Posner et al., 2020). A fuller understanding of hoarding in adult ADHD is important for several reasons. Firstly, determining whether there is indeed a higher prevalence will shed light on the presumed link between ADHD and hoarding from a different cohort, which has been largely overlooked to date. Moreover, hoarding in ADHD may demonstrate unique clinical characteristics. Uncovering hoarding across the full life span and early to middle-adulthood is key as this is when everyday difficulties due to hoarding gradually amass to impairing levels. Discovery of elevated hoarding behaviours in this younger cohort may also promote earlier identification and intervention.

To address the knowledge gap, this study assessed patients at an adult ADHD clinic. In this well-characterised sample we aimed to assess the frequency, severity and nature of hoarding symptoms in relation to ADHD, in addition to OC-related traits, mood and anxiety. We also explored differences in clinical characteristics between those with clinically significant hoarding relative to non-hoarding patients. Given the inconsistencies in the literature, we examined statistically whether inattention and impulsivity/hyperactivity uniquely contributed to hoarding. We also compared the findings in the ADHD sample with a

control group matched for age, gender and education. An independent community sample allowed us to verify whether key findings replicated when a more dimensional approach to hoarding and ADHD behaviours was adopted (Morein-Zamir et al., 2020).

Methods

Participants

ADHD patients were recruited from the NHS Cambridge and Peterborough Foundation Trust Adult ADHD clinic. Diagnosis of ADHD according to DSM-5 (American Psychiatric Association, 2013) was based on a full clinical interview with the patient and an informant who had known the patients since childhood, by a clinical professional with extensive expertise in ADHD assessment. Clinical assessment also included Barkley Adult ADHD Rating Scales, self- and informant-report of childhood and adulthood symptoms (BAARS; (Barkley, 2011)). Control participants were recruited via advertisements in the local community. Screening verified controls did not meet diagnostic threshold for ADHD and included a previously validated brief ADHD screener (Kessler et al., 2005; Ustun et al., 2017) in addition to the MINI (Sheehan et al., 1998). Exclusion criteria for controls included current or former diagnosis of ADHD, or probable ADHD on the screener. Exclusion criteria for all participants included severe neurological deficits. Patients were contacted by mail and in clinic to participate in a study about “Accumulation behaviours in ADHD”, with a 32% response rate. For the independent UK online cohort (recruited via prolific.co.uk) there were no exclusion criteria, with the provision that the sample be 50% female.

Measures

ADHD and impulsivity

The Adult ADHD Self-Report Scale (ASRS; (Kessler et al., 2005)) is derived from symptoms of ADHD and contains the 18 symptoms of inattention, hyperactivity and impulsivity according to DSM-IV (American Psychiatric Association, 2000, 2013). Symptom severity is reported on a 5-point scale (ranging from never to very often). ASRS scores have shown good reliability and validity in clinical and general populations (Brevik et al., 2020). Subscale and total scores in current samples demonstrated high internal consistency (Cronbach α values 0.81-0.95). For ADHD patients, the BAARS-IV self-report was available, which includes 27 items describing behaviour over the past 6 months, with subscales for inattention, hyperactivity, impulsivity and sluggish cognitive tempo. Participants respond using a 4-point scale ranging from sometimes to very often. The scale has demonstrated good internal consistency and reliability with good internal consistencies in the present sample (subscale α values 0.80-0.92). The widely used Barret Impulsivity Scale-11 (BIS; (Patton et al., 1995)) comprises 30 items describing impulsive or non-impulsive (reverse scored) behaviours and preferences, which participants rate on a 4 point scale. Given the inconsistent factor structure of the scale (Reise et al., 2013), only total score was calculated with good current internal consistency (α values 0.92 and 0.83).

Hoarding and clutter

The Savings Inventory Revised (SIR, (Frost et al., 2004)) contains three subscales: difficulty discarding, excessive acquisition and clutter. Participants rate 23 items on a 5-point scale, with higher values indicating greater symptom severity. The typical clinical cut-off is 41 (Frost et al., 2011). The SIR has previously demonstrated excellent internal consistency, good test-retest reliability and convergent validity (Hartl et al 2004) with the two current samples showing excellent internal consistency on all subscales (α values 0.84-0.96). The Clutter Image Rating Scale (CIR; (Frost et al., 2008)) presents nine photographs for each room with

increasing degrees of clutter (living room, kitchen, and bedroom). Participants choose the image most closely representing their own living conditions. Another room was shown (bathroom) but not analysed further. Previous validation studies on the CIR have demonstrated good psychometric properties with current samples having good mean internal consistency (current α values 0.76 and 0.83)

Obsessive Compulsive severity

The Obsessive Compulsive Inventory-Revised (OCIR; (Foa et al., 2002)) is widely used to assess OCD traits with 18 items rated on a 5-point scale from “not at all” to “extremely”. Six subscales include hoarding, checking, washing, ordering, obsessing, and neutralising. Total and subscale scores have demonstrated good internal consistency, test-retest reliability and convergent and discriminant validity (Foa et al., 2002), with current subscales showing good to excellent internal consistency in both samples (α values 0.78-0.94).

Perfectionism

The Multidimensional Perfectionism Scale (MPS; (Frost et al., 1990)) contains 35 items on a 5-point scale (“strongly disagree” to “strongly agree”) generating six subscales: concern over mistakes, doubts about actions, personal standards, parental expectations, parental criticism, and organization. It has been found to be both reliable and valid for non-clinical and clinical populations (Frost et al., 1990). Current subscales showed good to excellent internal consistency in both samples (α values 0.78-0.92).

Depression and anxiety

Depression and Anxiety Severity Scale (DASS; (Lovibond & Lovibond, 1995)) contains 21 items with participants rating each item over the past week on a scale from 0 (“did not apply

to me at all”) to 3 (“applied to me very much”). The DASS has previously demonstrated excellent internal consistency and concurrent validity, as did total scores for present samples ($\alpha=0.95$ for both). The Alcohol Use Disorders Identification Test (AUDIT; (Saunders et al., 1993)) is an extensively validated 10 item Likert based instrument developed by the World Health Organisation. Present samples had good mean internal consistency (α values 0.79 and 0.85).

Functional impairment

The Weiss functional Impairment Scale (WFIRS; (Weiss, 2005)) contains 70 items with participants rating the extent to which emotional and behavioural problems (values from 0 to 3, or not applicable) have affected 7 domains over the last month (family, work, school, life skills, self-concept, social and risk). Higher mean scores of the summary index indicate greater functional impairment. Previous studies have shown good psychometric characteristics (Canu et al., 2016; Weiss et al., 2018), and current samples had reasonably good internal consistency in all domains (α values 0.74-0.93).

Procedure

Interested and eligible participants were sent an individual link to an online survey, with the data for patients who consented supplemented with data collected in clinic (BAARS, WFIRS). The online survey consisted of a demographics section followed by questionnaires presented in random order (ASRS, SIR, CIR, BIS, DASS, OCIR, MPS and AUDIT). All participants provided informed consent before taking part and were compensated for their participation. The study was approved by an NHS Research Ethics Committee (16/WM/0368) and received Health Research Authority approval. The subsequent online study was approved by the University Ethics Panel. The testing procedure for the online

sample were identical, with the following exceptions. Four attention check items were included to identify careless responding (Meade & Craig, 2012). Additional questionnaires were administered but not reported here.

Analyses and design

Comparisons between groups used Mann-Whitney and Chi-squared tests for continuous and categorical variables, respectively. Based on previous literature (Frost et al., 2008; Tolin et al., 2010; Wootton et al., 2015), clinically meaningful hoarding symptoms was defined as SIR value greater than 40 *and* OCIR-Hoarding greater than 6 *and* a rating of 4 in at least one CIR room. We note that an average of 4 on the CIR (Frost et al., 2008) would have unduly focused on clutter and appeared overly stringent given even diagnosed HD samples average lower values (Tolin et al., 2010). The frequency of those above and below the threshold was compared between the ADHD and control samples. Further comparisons using Mann-Whitney tests assessed group differences in those below the threshold, and within ADHD patients between those above versus below the threshold. Data for the AUDIT was available for only 74 of the patients. Data from the clinic for the BAARS self-report was available for 59 patients and the WFIRS for 58. Where analyses do not include the full sample, the number of observations is reported. Where multiple tests were performed, Bonferroni correction to control for type I error was applied. Finally, we examined the contribution of ADHD, depression and anxiety and OC-related variables to the presence of hoarding symptoms in each group. OCIR subscales were included as we hypothesised they constitute distinct behavioural dimensions in ADHD. Regression models using bootstrapped 95% confidence intervals (CI) and model parameters are reported, with variance inflation factor (VIF) values used to inspect multicollinearity and Cook's Distance to inspect the influence of individual data points. Values were acceptable, with VIF scores of less than 2.1 for all models.

Results

The ADHD and control groups did not differ significantly in gender and age, nor in family status and living arrangements (see Table 1). As would be expected given their treatment seeking status, ADHD patients scored significantly higher on measures of inattention, hyperactivity and impulsivity, in addition to reporting higher levels of depression and anxiety. The most common comorbidities in the ADHD group were depression and anxiety (18%) followed by Autism Spectrum Disorder (11.3%), OCD (4.5%), and eating disorders including binge eating disorder (3.4%). One patient was diagnosed with hoarding disorder. Compared with controls, ADHD patients reported significantly greater levels in all hoarding related questionnaires and subscales, all of which survived Bonferroni correction for multiple comparisons (see also Figure 1). Several additional OCIR subscales were higher in the ADHD group compared with controls, though only OCIR-obsessing survived multiple comparisons correction. There was no group difference in alcohol use. Several perfectionism subscales pointed to group differences, with the ADHD patients reporting lower organisation and greater concern over mistakes, doubting of actions and parental criticism, though the later did not survive correction.

There were 17 patients and 2 controls who scored above the threshold of clinically significant hoarding (19.31% vs. 2.22%, $\chi^2(1)=13.64$, $p<.001$). Elevated levels of hoarding were also found in patients who were below the threshold, as they too had significantly greater SIR values compared to controls, (27.69, $n=71$ vs. 16.57, $n=88$, $Z=4.91$, $U=1707$, $p<.001$, $d=0.88$). Similarly, these patients had higher OCI-hoarding compared with controls (3.87 vs. 2.66, $Z=2.81$, $U=2313$, $p=.004$, $d=0.45$) and higher CIR values (1.92 vs. 1.57, $Z=2.34$, $U=2314$, $p=.004$, $d=0.55$).

Within the ADHD group, we inspected whether patients with clinically significant hoarding symptoms differed from the remaining patients. Patients above the threshold were slightly though not statistically significant older compared with the other ADHD patients, being still in their 30's on average (36.17 vs. 31.84, $Z=1.51$, $U=461$, $p=.132$). There was no significant relationship with gender ($\chi^2(1)=0.01$, $p=.92$), with 6 of the 17 likely hoarders being female. There was also no significant difference in overall psychotropic medication status with 71% and 82% of likely hoarders and likely non-hoarders being medicated respectively ($\chi^2(1)=1.04$, $p=.31$). Nor did there seem to be significant patterns in medication type (e.g., atomoxetine specifically) though a greater proportion of those above the cut-off were receiving SSRIs (47% vs 27%, $p=.10$). Those above the threshold reported significantly greater levels of inattention (32.41 vs. 28.08, $Z=3.54$, $U=270$, $p<.001$, $d=0.88$) but not ASRS hyperactivity/impulsivity or BIS impulsivity. They had also reported greater inattention symptoms in the BAARS inattention subscale (31.29, $n=14$, vs. 24.98, $n=45$, $Z=2.90$, $U=152$, $p=.003$, $d=0.90$). Whilst those above the cut-off also had significantly greater BAARS hyperactivity ($Z=2.05$, $U=200$, $p=.04$), this did not survive correction nor were there differences in BAARS impulsivity or cognitive tempo. In addition, those above the threshold reported greater depression and anxiety (37.71 vs. 25.07, $Z=3.00$, $U=319$, $p=.002$, $d=1.00$), as well as concerns over mistakes (34.29 vs. 27.67, $Z=2.85$, $U=334$, $p=.003$) and parental criticism (13.71 vs. 10.11, $Z=2.77$, $U=342$, $p=.005$). There were no differences in alcohol use, though WFIRS mean functional impairment was higher for the patients with hoarding above compared to below the threshold (1.98, $n=13$ vs 1.19, $n=47$, $Z=3.90$, $U=88$, $p<.001$).

Associations with hoarding severity

The associations between ADHD symptoms and hoarding indices was examined in the ADHD group in more detail (Table 2). ASRS-inattention was consistently positively associated with all five hoarding indices whilst ASRS-hyperactivity/impulsivity was only

associated with clutter. Secondary analyses on the BAARS in available patients revealed a similar pattern. BAARS-inattention and BAARS-cognition were significantly associated with all three subscales of the SIR (r_s values of 0.29-0.30) whereas BAARS-hyperactivity was significantly associated with SIR-clutter only ($r_s=0.32$) and BAARS-impulsivity was not significantly associated with any SIR subscale. In contrast, in controls both ASRS-inattention and ASRS-hyperactivity were positively associated with most hoarding indices. The association between hyperactivity and SIR was significantly greater in controls than in ADHD patients (.40 versus .22, $p=.013$).

Statistical predictors of hoarding severity

In patients, a regression analysis with hoarding (SIR) as outcome and ADHD symptom subscales, BIS-impulsivity, anxiety and depression, and OC-related symptoms as predictors ($R^2=0.33$) found only inattention to be a significant predictor (Table 3). In controls this analysis revealed checking and to a lesser degree neutralizing as significant predictors ($R^2=0.37$). Similar regression models including gender and age in both groups or without BIS-impulsivity yielded the same results. Additional models indicated similar conclusions for each hoarding subscale when considered separately.

Independent online sample findings

The sample consisted of 220 individuals (111 female), with a mean age of 35.78 ($SD=12.74$). An additional four were removed having failed the attention checks. Clinically significant hoarding symptoms were found in 8 individuals (3.64%). Mean SIR clutter, discarding and acquisition values were 9.68 ($SD=5.36$), 6.65 ($SD=4.64$) and 6.61 ($SD=4.81$), respectively. Mean OCI-hoarding was 3.28 ($SD=2.86$) and mean CIR was 1.78 (0.73). The association between ADHD-related and hoarding indices pointed to consistent medium to large associations with hoarding for both inattention and for hyperactivity/impulsivity. A

regression analysis with SIR hoarding as outcome and ADHD symptoms, BIS-impulsivity, anxiety and depression, and OC-related subscales as predictors found a good fit ($R^2=0.36$). Again inattention was a significant predictor, in addition to depression and anxiety and ordering (Table 4).

General Discussion

The findings show significantly elevated hoarding symptoms in adult ADHD patients compared to a control group matched for key demographic characteristics. Clinically significant levels of hoarding were reported by approximately 20% of the ADHD patients, similar to levels previously reported in OCD cohorts (Frost et al., 2011). Patients who did not have clinically significant hoarding still reported more symptoms than controls, with a large effect size. These results suggest that hoarding symptoms should be routinely assessed in ADHD patients, particularly given issues of insight and limited awareness of hoarding as a potential clinical disorder. Present clinical and anecdotal evidence indicated that the patients demonstrated limited insight and did not spontaneously raise hoarding related issues, though they did endorse them once explicitly questioned. Clinically significant hoarding was associated with worse quality of life and higher depression and anxiety, with potentially greater likelihood of being prescribed SSRIs. Depression in hoarders stems in part from the social, family and occupational issues that emerge from chronic hoarding (Tolin et al., 2008). It may also be closely linked to emotional dysregulation which is routinely noted in both HD and in ADHD and itself contributes to impairment (Frost et al., 2011; Surman et al., 2013).

Consideration of comorbid hoarding in ADHD patients should contribute to behavioural and potentially to pharmacotherapy treatment choices. For example, preliminary open-label data suggest atomoxetine may be effective for HD symptoms (Grassi et al., 2016), as do some SSRIs (Piacentino et al., 2019). However, in part due to HD being recognised

only recently as a distinct condition, randomized control pharmacological trials are still lacking. In any case, greater awareness amongst clinicians, patients and their carers about the link between ADHD and hoarding could also facilitate more effective long term care management, as hoarding often gradually worsens with time. Further research into evidence-based treatment options for HD, including when co-presenting with ADHD or in mid-adulthood, is urgently needed.

Present findings point to a robust and unique association between hoarding and inattention supporting previous OCD and HD patient studies (Hall et al., 2013; Hartl et al., 2005; Sheppard et al., 2010). ADHD hoarders had more severe inattention symptoms with large effect sizes compared to ADHD non-hoarders on two independent measures taken at different time points and the unique contribution of inattention to hoarding was replicated in an independent community sample. Consistent associations between inattention and hoarding were also found in controls. The association is underscored by inattention and executive dysfunction contributing to symptoms in both disorders. Some ADHD patients show functional deficits of impaired organization, planning and working memory (Faraone et al., 2000; Nigg, 2005; Posner et al., 2020). These difficulties may jointly underscore both ADHD and HD symptoms, suggesting that ADHD patients who experience executive dysfunction would suffer from the most severe hoarding. This would anticipate that the high heritability found in both (Faraone & Larsson, 2019; Iervolino et al., 2009) could stem in part from shared genetic vulnerability (Hirschtritt et al., 2018).

Despite some overlap, inattention and impulsivity/hyperactivity are separate domains with domain specific genetic influences (Faraone et al., 2015). A unique link between impulsivity/hyperactivity and hoarding was not found in any of the three samples inspected suggesting the observed correlations were driven by general psychopathology-related variance. This is consistent with findings from OCD samples (Sheppard et al., 2010; Tolin &

Villavicencio, 2011). It is still possible that there is a link between hoarding and impulsivity specifically in HD, possibly expressed by impulse control problems, given that the association appears more consistently in such samples (Hall et al., 2013; Hartl et al., 2005). The absence of the unique association contrasts with its presence in children with ADHD (Hacker et al., 2016) and may stem from development trajectories relating to impulsivity/hyperactivity and hoarding. We also noted that ADHD patients scored higher than controls on some but not all OCIR and perfectionism subscales. ADHD appears to be associated with a unique profile, which could stem from ADHD-specific symptoms in addition to the well-established association between ADHD and OCD. Namely, some ADHD patients may endorse checking, doubts about actions, concern over mistakes and parental criticism in part due to the lifelong consequences of having ADHD. Also in light of concerns over discriminative validity of item relating to OC and inattention (Morein-Zamir et al., 2020), interpreting total values on OCIR and perfectionism scales in this population should be treated with caution.

Current findings also highlight the presence of hoarders with ADHD who were on average in their thirties. There was no gender difference in the ADHD sample, nor was gender found to be associated with hoarding severity in the other samples. Present hoarders were more similar in demographic profile to those expected in the general population compared to typical research studies (Woody et al., 2020). Not only do the findings have implications for earlier HD identification and possible intervention but also on HD research which should actively seek ADHD patients with hoarding, given their considerably younger age and the greater prevalence of males. It remains to be established whether the clinical and neuropsychological profiles of such individuals differ from typical HD cohorts who self-identify as hoarders or those with comorbid OCD. There already is some evidence pointing to cognitive and neural functional differences in hoarders depending on the presence of

comorbid OCD (Hough et al., 2016; Mataix-Cols et al., 2004; Morein-Zamir et al., 2014). If however, differences depending on comorbid ADHD are minimal, more flexible theoretical models alongside novel, more targeted behavioural treatments for hoarding symptoms may be needed (Lynch et al., 2017).

The present study did not assess the phenomenology of hoarding in detail, such as whether ADHD hoarders demonstrate a strong emotional and sentimental attachment to possessions (Frost & Hartl, 1996; Grisham et al., 2009). This could be a key difference between hoarders with and without ADHD, with symptoms in the former stemming to a greater extent from cognitive dysfunction per se (Fullana et al., 2013; Hacker et al., 2016). However qualitative data suggests that at least in children with ADHD there is indeed a strong sentimental attachment with increased distress when confronted with the need to discard (Lynch et al., 2017). Along with the presence of emotional dysregulation as mentioned above, on balance it would appear that hoarding in ADHD is not only simply a consequence of inattention or even impulsivity (Lynch et al., 2015). Despite the overlap between ADHD and HD, the majority of ADHD participants did not report clinically meaningful hoarding though many still had subclinical levels. This highlights the dimensionality of hoarding symptoms and is consistent with the notion of independent pathways to hoarding. For example, there is some evidence that hoarding is elevated in individuals with autism, and anorexia nervosa (Halmi et al., 2003; Storch et al., 2016) and anxiety disorders (Tolin et al., 2011). However, it remains to be established whether increased hoarding in these disorders is underscored by concomitant raised levels of ADHD or OCD symptoms as found in Tourette's syndrome (Dijk et al., 2016).

The present study relied on self-report rather than clinician-rated measures of hoarding, and it is possible the ADHD participants were biased in responding. However, the presence of a control group that underwent the same procedures and replication in the

community sample of the link with inattention mitigate this concern. Additionally, multiple well-validated measures were taken for ADHD and for HD-related symptoms, while employing previously established cut-off values for likely HD on multiple scales. This allowed us to avoid an overly liberal approach to hoarding difficulties. Moreover, present criteria yielded an online sample prevalence within the confidence intervals of a recent meta-analyses (Postlethwaite et al., 2019).

In sum, this study points to a hidden population of adults who demonstrate clinically significant hoarding symptoms. Inattention symptoms were specifically linked to hoarding severity and this was replicated in an independent online sample. The results suggest HD symptoms should be assessed in ADHD patients, particularly given insight issues. Moreover, HD research should actively investigate hoarding in these patients, given their age and gender ratio. A better understanding of the overlap between HD and ADHD will enrich theorizing and treatment development to ultimately improve functioning and outcomes for all.

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References

- American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)*. American Psychiatric Association. <https://doi.org/10.1176/appi.books.9780890423349>
- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders*. American Psychiatric Association. <https://doi.org/10.1176/appi.books.9780890425596>
- Barkley, R. A. (2011). *Barkley Adult ADHD Rating Scale-IV (BAARS-IV)*. The Guilford Press.
- Bratotiis, C., Schmalisch, C. S., & Steketee, G. (2011). (2011). *The hoarding handbook: A guide for human service professionals*. Oxford University Press.
- Brevik, E. J., Lundervold, A. J., Haavik, J., & Posserud, M. (2020). Validity and accuracy of the Adult Attention-Deficit/Hyperactivity Disorder (ADHD) Self-Report Scale (ASRS) and the Wender Utah Rating Scale (WURS) symptom checklists in discriminating between adults with and without ADHD. *Brain and Behavior, February*, e01605. <https://doi.org/10.1002/brb3.1605>
- Canu, W. H., Hartung, C. M., Stevens, A. E., & Lefler, E. K. (2016). Psychometric Properties of the Weiss Functional Impairment Rating Scale. *Journal of Attention Disorders*, 108705471666142. <https://doi.org/10.1177/1087054716661421>
- Dijk, H. M. H., Schoot, R. Van De, Rijkeboer, M. M., Mathews, C. A., & Cath, D. C. (2016). *The relationship between tics , OC , ADHD and autism symptoms : A cross- disorder symptom analysis in Gilles de la Tourette syndrome patients and family-members*. 237, 138–146. <https://doi.org/10.1016/j.psychres.2016.01.051>
- Dozier, M. E., Porter, B., & Ayers, C. R. (2016). Age of onset and progression of hoarding symptoms in older adults with hoarding disorder. *Aging & Mental Health*, 20(7), 736–742. <https://doi.org/10.1080/13607863.2015.1033684>
- Faraone, S. V., Asherson, P., Banaschewski, T., Biederman, J., Buitelaar, J. K., Ramos-Quiroga, J. A., Rohde, L. A., Sonuga-Barke, E. J. S., Tannock, R., & Franke, B. (2015). Attention-deficit/hyperactivity disorder. *Nature Reviews Disease Primers*, 1(1), 15020. <https://doi.org/10.1038/nrdp.2015.20>
- Faraone, S. V., Biederman, J., Spencer, T., Wilens, T., Seidman, L. J., Mick, E., & Doyle, A. E. (2000). Attention-deficit/hyperactivity disorder in adults: An overview. *Biological Psychiatry*, 48(1), 9–20. [https://doi.org/10.1016/S0006-3223\(00\)00889-1](https://doi.org/10.1016/S0006-3223(00)00889-1)
- Faraone, S. V., & Larsson, H. (2019). Genetics of attention deficit hyperactivity disorder. *Molecular Psychiatry*, 24(4), 562–575. <https://doi.org/10.1038/s41380-018-0070-0>
- Faraone, S. V., Asherson, P., Banaschewski, T., Biederman, J., Ramos-quiroya, J. A., Rohde, L. A., Tannock, R., & Franke, B. (2015). *Attention-deficit/hyperactivity disorder ---. 1*. <https://doi.org/10.1038/nrdp.2015.20>
- Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The obsessive-compulsive inventory: Development and validation of a short version. *Psychological Assessment*, 14(4), 485–496. <https://doi.org/10.1037/1040-3590.14.4.485>

- Frost, R. O., & Hartl, T. L. (1996). A cognitive-behavioral model of compulsive hoarding. *Behaviour Research and Therapy*, *34*(4), 341–350. [https://doi.org/10.1016/0005-7967\(95\)00071-2](https://doi.org/10.1016/0005-7967(95)00071-2)
- Frost, R. O., Marten, P., Lahart, C., & Rosenblate, R. (1990). The dimensions of perfectionism. *Cognitive Therapy and Research*, *14*(5), 449–468. <https://doi.org/10.1007/BF01172967>
- Frost, R. O., Steketee, G., & Grisham, J. (2004). Measurement of compulsive hoarding: saving inventory-revised. *Behaviour Research and Therapy*, *42*(10), 1163–1182. <https://doi.org/10.1016/j.brat.2003.07.006>
- Frost, R. O., Steketee, G., & Tolin, D. F. (2011). Comorbidity in hoarding disorder. *Depression and Anxiety*, *28*(10), 876–884. <https://doi.org/10.1002/da.20861>
- Frost, R. O., Steketee, G., Tolin, D. F., & Renaud, S. (2008). Development and validation of the clutter image rating. *Journal of Psychopathology and Behavioral Assessment*, *30*(3), 193–203. <https://doi.org/10.1007/s10862-007-9068-7>
- Frost, R. O., Tolin, D. F., & Maltby, N. (2010). Insight-Related Challenges in the Treatment of Hoarding. *Cognitive and Behavioral Practice*, *17*(4), 404–413. <https://doi.org/10.1016/j.cbpra.2009.07.004>
- Fullana, M. A., Vilagut, G., Mataix-Cols, D., Adroher, N. D., Bruffaerts, R., Bunting, B., De Almeida, J. M. C., Florescu, S., De Girolamo, G., De Graaf, R., Haro, J. M., Kovess, V., & Alonso, J. (2013). Is ADHD in childhood associated with lifetime hoarding symptoms? An epidemiological study. *Depression and Anxiety*, *30*(8), 741–748. <https://doi.org/10.1002/da.22123>
- Grassi, G., Laura, M., Lorenzo, D. C. M., Elisa, C., Lorenzo, R., Carla, G., & Stefano, P. (2016). Atomoxetine for hoarding disorder: A pre-clinical and clinical investigation. *Journal of Psychiatric Research*, *83*, 240–248. <https://doi.org/10.1016/j.jpsychires.2016.09.012>
- Grisham, J. R., Brown, T. A., Liverant, G. I., & Campbell-sills, L. (2005). *The distinctiveness of compulsive hoarding from obsessive – compulsive disorder*. *19*, 767–779. <https://doi.org/10.1016/j.janxdis.2004.09.003>
- Grisham, J. R., Frost, R. O., Steketee, G., Kim, H., & Hood, S. (2006). Age of onset of compulsive hoarding. *Journal of Anxiety Disorders*, *20*(5), 675–686. <https://doi.org/10.1016/j.janxdis.2005.07.004>
- Grisham, J. R., Frost, R. O., Steketee, G., Kim, H., Tarkoff, A., & Hood, S. (2009). Formation of attachment to possessions in compulsive hoarding. *Journal of Anxiety Disorders*, *23*(3), 357–361. <https://doi.org/10.1016/j.janxdis.2008.12.006>
- Hacker, L. E., Park, J. M., Timpano, K. R., Cavitt, M. A., Alvaro, J. L., Lewin, A. B., Murphy, T. K., & Storch, E. A. (2016). Hoarding in Children With ADHD. *Journal of Attention Disorders*, *20*(7), 617–626. <https://doi.org/10.1177/1087054712455845>
- Hall, B. J., Tolin, D. F., Frost, R. O., & Steketee, G. (2013). An exploration of comorbid symptoms and clinical correlates of clinically significant hoarding symptoms. *Depression and Anxiety*, *30*(1), 67–76. <https://doi.org/10.1002/da.22015>
- Halmi, K. A., Sunday, S. R., Klump, K. L., Strober, M., Leckman, J. F., Fichter, M., Kaplan, A., Woodside, B., Treasure, J., Berrettini, W. H., Al Shabboat, M., Bulik, C. M., &

- Kaye, W. H. (2003). Obsessions and compulsions in anorexia nervosa subtypes. *International Journal of Eating Disorders*, 33(3), 308–319. <https://doi.org/10.1002/eat.10138>
- Hartl, T. L., Duffany, S. R., Allen, G. J., Steketee, G., & Frost, R. O. (2005). Relationships among compulsive hoarding, trauma, and attention-deficit/hyperactivity disorder. *Behaviour Research and Therapy*, 43(2), 269–276. <https://doi.org/10.1016/j.brat.2004.02.002>
- Hirschtritt, M. E., Darrow, S. M., Illmann, C., Osiecki, L., Grados, M., Sandor, P., Dion, Y., King, R. A., Pauls, D., Budman, C. L., Cath, D. C., Greenberg, E., Lyon, G. J., Yu, D., McGrath, L. M., McMahon, W. M., Lee, P. C., Delucchi, K. L., Scharf, J. M., & Mathews, C. A. (2018). Genetic and phenotypic overlap of specific obsessive-compulsive and attention-deficit/hyperactive subtypes with Tourette syndrome. *Psychological Medicine*, 48(2), 279–293. <https://doi.org/10.1017/S0033291717001672>
- Hough, C. M., Luks, T. L., Lai, K., Vigil, O., Guillory, S., Nongpiur, A., Fekri, S. M., Kupferman, E., Mathalon, D. H., & Mathews, C. A. (2016). Comparison of brain activation patterns during executive function tasks in hoarding disorder and non-hoarding OCD. *Psychiatry Research: Neuroimaging*, 255, 50–59. <https://doi.org/10.1016/j.pscychresns.2016.07.007>
- Iervolino, A. C., Perroud, N., Fullana, M. A., Guipponi, M., Cherkas, L., Collier, D. A., & Mataix-Cols, D. (2009). Prevalence and Heritability of Compulsive Hoarding: A Twin Study. *American Journal of Psychiatry*, 166(10), 1156–1161. <https://doi.org/10.1176/appi.ajp.2009.08121789>
- Ivanov, V. Z., Mataix-Cols, D., Serlachius, E., Lichtenstein, P., Anckarsäter, H., Chang, Z., Gumpert, C. H., Lundström, S., Långström, N., & Rück, C. (2013). Prevalence, Comorbidity and Heritability of Hoarding Symptoms in Adolescence: A Population Based Twin Study in 15-Year Olds. *PLoS ONE*, 8(7), 1–7. <https://doi.org/10.1371/journal.pone.0069140>
- Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E., Howes, M. J., Jin, R., Secnik, K., Spencer, T., Ustun, T. B., & Walters, E. E. (2005). The World Health Organization Adult ADHD Self-Report Scale (ASRS). *Psychological Medicine*, 35(2)(2), 245–256. <https://doi.org/DOI:10.1017/S0033291704002892>
- Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, 33(3), 335–343. [https://doi.org/10.1016/0005-7967\(94\)00075-U](https://doi.org/10.1016/0005-7967(94)00075-U)
- Lynch, F. A., McGillivray, J. A., Moulding, R., & Byrne, L. K. (2015). Hoarding in attention deficit hyperactivity disorder: Understanding the comorbidity. *Journal of Obsessive-Compulsive and Related Disorders*, 4(2015), 37–46. <https://doi.org/10.1016/j.jocrd.2014.12.001>
- Lynch, F. A., Moulding, R., & McGillivray, J. A. (2017). Phenomenology of hoarding in children with comorbid attention-deficit/hyperactivity disorder (ADHD): The perceptions of parents. *Comprehensive Psychiatry*, 76, 1–10. <https://doi.org/10.1016/j.comppsy.2017.03.009>
- Mataix-Cols, D., Wooderson, S., Lawrence, N., Brammer, M. J., Speckens, A., & Phillips, M.

- L. (2004). Distinct Neural Correlates of Washing, Checking, and Hoarding Symptom Dimensions in Obsessive-compulsive Disorder. *Archives of General Psychiatry*, 61(6), 564. <https://doi.org/10.1001/archpsyc.61.6.564>
- Matte, B., Anselmi, L., Salum, G. A., Kieling, C., Gonçalves, H., Menezes, A., & Grevet, E. H. (2015). *ADHD in DSM-5 : a field trial in a large , representative sample of 18- to 19-year-old adults*. 361–373. <https://doi.org/10.1017/S0033291714001470>
- Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods*, 17(3), 437–455. <https://doi.org/10.1037/a0028085>
- Morein-Zamir, S., Pappmeyer, M., Pertusa, A., Chamberlain, S. R., Fineberg, N. A., Sahakian, B. J., Mataix-Cols, D., & Robbins, T. W. (2014). The profile of executive function in OCD hoarders and hoarding disorder. *Psychiatry Research*, 215(3), 659–667. <https://doi.org/10.1016/j.psychres.2013.12.026>
- Morein-Zamir, S., Shapher, S., Gasull-Camos, J., Fineberg, N. A., & Robbins, T. W. (2020). Avoid jumping to conclusions under uncertainty in Obsessive Compulsive Disorder. *PLOS ONE*, 15(1), e0225970. <https://doi.org/10.1371/journal.pone.0225970>
- Nigg, J. T. (2005). Neuropsychologic Theory and Findings in Attention-Deficit/Hyperactivity Disorder: The State of the Field and Salient Challenges for the Coming Decade. *Biological Psychiatry*, 57(11), 1424–1435. <https://doi.org/10.1016/j.biopsych.2004.11.011>
- Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the barratt impulsiveness scale. *Journal of Clinical Psychology*, 51(6), 768–774. [https://doi.org/10.1002/1097-4679\(199511\)51:6<768::AID-JCLP2270510607>3.0.CO;2-1](https://doi.org/10.1002/1097-4679(199511)51:6<768::AID-JCLP2270510607>3.0.CO;2-1)
- Piacentino, D., Pasquini, M., Cappelletti, S., Chetoni, C., Sani, G., & Kotzalidis, G. D. (2019). Pharmacotherapy for Hoarding Disorder: How did the Picture Change since its Excision from OCD? *Current Neuropharmacology*, 17(8), 808–815. <https://doi.org/10.2174/1570159X17666190124153048>
- Polanczyk, G., de Lima, M. S., Horta, B. L., Biederman, J., & Rohde, L. A. (2007). The Worldwide Prevalence of ADHD: A Systematic Review and Metaregression Analysis. *American Journal of Psychiatry*, 164(6), 942–948. <https://doi.org/10.1176/ajp.2007.164.6.942>
- Posner, J., Polanczyk, G. V., & Sonuga-Barke, E. (2020). Attention-deficit hyperactivity disorder. *The Lancet*, 395(10222), 450–462. [https://doi.org/10.1016/S0140-6736\(19\)33004-1](https://doi.org/10.1016/S0140-6736(19)33004-1)
- Postlethwaite, A., Kellett, S., & Mataix-Cols, D. (2019). Prevalence of Hoarding Disorder: A systematic review and meta-analysis. *Journal of Affective Disorders*, 256(April), 309–316. <https://doi.org/10.1016/j.jad.2019.06.004>
- Reise, S. P., Moore, T. M., Sabb, F. W., Brown, A. K., & London, E. D. (2013). The Barratt Impulsiveness Scale–11: Reassessment of its structure in a community sample. *Psychological Assessment*, 25(2), 631–642. <https://doi.org/10.1037/a0032161>
- Saunders, J. B., Aasland, O. G., Babor, T. F., De La Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol

- Consumption-II. *Addiction*, 88(6), 791–804. <https://doi.org/10.1111/j.1360-0443.1993.tb02093.x>
- Saxena, S. (2008). Neurobiology and Treatment of Compulsive Hoarding. *CNS Spectrums*, 13(S14), 29–36. <https://doi.org/10.1017/s1092852900026912>
- Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., Hergueta, T., Baker, R., & Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The Development and Validation of a Structured Diagnostic Psychiatric Interview for DSM-IV and ICD-10. *The Journal of Clinical Psychiatry*, 59(suppl 2), 22–33.
- Sheppard, B., Chavira, D., Azzam, A., Grados, M. A., Umana, P., Garrido, H., & Mathews, C. A. (2010). ADHD prevalence and association with hoarding behaviors in childhood-onset OCD. *Depression and Anxiety*, 27(7), 667–674. <https://doi.org/10.1002/da.20691>
- Simon, V., Czobor, P., Bálint, S., Mészáros, Á., & Bitter, I. (2009). Prevalence and correlates of adult attention-deficit hyperactivity disorder: meta-analysis. *British Journal of Psychiatry*, 194(3), 204–211. <https://doi.org/10.1192/bjp.bp.107.048827>
- Storch, E. A., Nadeau, J. M., Johnco, C., Timpano, K., McBride, N., Jane Mutch, P., Lewin, A. B., & Murphy, T. K. (2016). Hoarding in Youth with Autism Spectrum Disorders and Anxiety: Incidence, Clinical Correlates, and Behavioral Treatment Response. *Journal of Autism and Developmental Disorders*, 46(5), 1602–1612. <https://doi.org/10.1007/s10803-015-2687-z>
- Surman, C. B. H., Biederman, J., Spencer, T., Miller, C. A., McDermott, K. M., & Faraone, S. V. (2013). Understanding deficient emotional self-regulation in adults with attention deficit hyperactivity disorder: a controlled study. *ADHD Attention Deficit and Hyperactivity Disorders*, 5(3), 273–281. <https://doi.org/10.1007/s12402-012-0100-8>
- Timpano, K. R., Rasmussen, J., Exner, C., Rief, W., Schmidt, N. B., & Wilhelm, S. (2013). Hoarding and the multi-faceted construct of impulsivity : A cross-cultural investigation. *Journal of Psychiatric Research*, 47(3), 363–370. <https://doi.org/10.1016/j.jpsychires.2012.10.017>
- Tolin, D. F., Frost, R. O., & Steketee, G. (2010). A brief interview for assessing compulsive hoarding : The Hoarding Rating Scale-Interview. *Psychiatry Research*, 178(1), 147–152. <https://doi.org/10.1016/j.psychres.2009.05.001>
- Tolin, D. F., Frost, R. O., Steketee, G., & Fitch, K. E. (2008). Family burden of compulsive hoarding: Results of an internet survey. *Behaviour Research and Therapy*, 46(3), 334–344. <https://doi.org/10.1016/j.brat.2007.12.008>
- Tolin, D. F., Frost, R. O., Steketee, G., & Muroff, J. (2015). Cognitive behavioral therapy for hoarding disorder: A meta-analysis. *Depression and Anxiety*, 32(3), 158–166. <https://doi.org/10.1002/da.22327>
- Tolin, D. F., Meunier, S. A., Frost, R. O., & Steketee, G. (2011). Hoarding among patients seeking treatment for anxiety disorders. *Journal of Anxiety Disorders*, 25(1), 43–48. <https://doi.org/10.1016/j.janxdis.2010.08.001>
- Tolin, D. F., & Villavicencio, A. (2011). Inattention, but not OCD, predicts the core features of Hoarding Disorder. *Behaviour Research and Therapy*, 49(2), 120–125. <https://doi.org/10.1016/j.brat.2010.12.002>

- Ustun, B., Adler, L. A., Rudin, C., Faraone, S. V., Spencer, T. J., Berglund, P., Gruber, M. J., & Kessler, R. C. (2017). The world health organization adult attention-deficit/hyperactivity disorder self-report screening scale for DSM-5. *JAMA Psychiatry*, *74*(5), 520–526. <https://doi.org/10.1001/jamapsychiatry.2017.0298>
- Weiss, M. D. (2005). *Weiss Functional Impairment Rating Scale (WFIRS) Self-Report*. naceonline.com/AdultADHDtoolkit/assessmenttools/wfirs.pdf
- Weiss, M. D., McBride, N. M., Craig, S., & Jensen, P. (2018). Conceptual review of measuring functional impairment: findings from the Weiss Functional Impairment Rating Scale. *Evidence Based Mental Health*, *21*(4), 155–164. <https://doi.org/10.1136/ebmental-2018-300025>
- Woerner, M., Selles, R. R., De Nadai, A. S., Salloum, A., & Storch, E. A. (2017). Hoarding in college students: Exploring relationships with the obsessive compulsive spectrum and ADHD. *Journal of Obsessive-Compulsive and Related Disorders*, *12*(September 2016), 95–101. <https://doi.org/10.1016/j.jocrd.2017.01.004>
- Woody, S. R., Kellman-mcfarlane, K., & Welsted, A. (2014). Clinical Psychology Review Review of cognitive performance in hoarding disorder. *Clinical Psychology Review*, *34*(4), 324–336. <https://doi.org/10.1016/j.cpr.2014.04.002>
- Woody, S. R., Lenkic, P., Bratiotis, C., Kysow, K., Luu, M., Edsell-Vetter, J., Frost, R. O., Lauster, N., Steketee, G., & Tolin, D. F. (2020). How well do hoarding research samples represent cases that rise to community attention? *Behaviour Research and Therapy*, *126*(June 2019), 103555. <https://doi.org/10.1016/j.brat.2020.103555>
- Wootton, B. M., Diefenbach, G. J., Bragdon, L. B., Steketee, G., Frost, R. O., & Tolin, D. F. (2015). *A Contemporary Psychometric Evaluation of the Obsessive Compulsive Inventory — Revised (OCI-R)*. *27*(3), 874–882.
- Zaboski, B. A., Merritt, O. A., Schrack, A. P., Gayle, C., Gonzalez, M., Guerrero, L. A., Dueñas, J. A., Soreni, N., & Mathews, C. A. (2019). Hoarding: A meta-analysis of age of onset. *Depression and Anxiety*, *36*(6), 552–564. <https://doi.org/10.1002/da.22896>

Table 1. Demographic and clinical characteristics of ADHD patient and control groups

Characteristic	ADHD (n=88)		Controls (n=90)		Z/χ^2	d	p
	M	SD	M	SD			
Age in years	32.68	10.31	31.99	10.82	0.56		.55
Gender	56:32		58:32		0.01		.91
M:F							
Education					5.14		.162
GCSE/O levels	24		14				
A-levels/Equivalent	11		12				
Undergraduate	31		34				
Post graduate	21		30				
Living with:					10.33		.006
Alone	13		13				
Non-family	5		20				
Family	69		56				
Family Status					1.98		.74
Single	33		31				
Separated/divorced	4		3				
Partnered – living alone	7		11				
Living with partner /married	44		45				

Members in Household	3.11	1.63	3.16	1.61	0.27		.78
Inattention (ASRS)	28.92	5.21	14.06	5.94	10.53	2.66	<.001
Hyperactivity/ impulsivity (ASRS)	24.14	6.38	11.89	6.19	9.45	1.95	<.001
Impulsivity (BIS)	83.06	11.29	60.50	10.61	9.76	2.06	<.001
Clutter (SIR)	13.48	7.19	7.56	4.65	5.72	.98	<.001
Difficulty Discarding (SIR)	9.88	6.06	4.86	3.95	5.79	.98	<.001
Acquisition (SIR)	10.24	5.91	4.92	4.14	6.09	1.04	<.001
Hoarding (SIR Total)	33.59	18.15	17.33	12.09	6.15	1.06	<.001
Clutter (CIR)	2.26	1.01	1.61	0.59	4.34	.68	<.001
OCIR-Hoarding	4.94	3.43	2.81	2.72	4.25	.69	<.001
OCIR-Washing	2.12	3.05	1.52	2.34	0.53	0.22	.56
OCIR-Neutralizing	2.15	2.92	1.56	2.43	0.61	0.22	.52
OCIR-Checking	3.76	3.38	2.39	2.56	2.61	0.46	.008
OCIR-Ordering	4.48	3.69	3.14	3.11	2.37	0.39	.017

OCIR-Obsessing	5.46	3.78	1.88	2.37	6.66	1.14	<.001
OCIR-Total	22.92	14.73	13.30	11.86	4.62	0.68	<.001
FMPS –Concern Over Mistakes	28.95	9.15	22.32	7.22	4.85	0.81	<.001
FMPS –Personal Standards	22.83	6.67	22.39	4.98	0.81	0.08	0.42
FMPS –Parental Expectations	13.97	4.77	12.93	4.59	1.32	0.22	0.19
FMPS –Parental Criticism	10.81	4.84	8.84	3.32	2.51	0.47	0.012
FMPS –Doubting of Actions	14.99	3.39	11.23	2.95	6.89	1.18	<.001
FMPS –Organisation	18.08	5.84	21.43	5.04	3.83	0.62	<.001
Depression & Anxiety	27.51	13.55	10.30	8.65	8.27	1.52	<.001
Alcohol Use	4.43	4.14	3.93	4.19	0.75	0.12	0.45

Table 2. Spearman Ro’s correlations between ASRS subscales and hoarding-related indices in ADHD and in control participants.

	SIR Clutter	SIR Difficulty Discarding/S aving	SIR Acquisition	OCIR Hoarding	CIR
ADHD participants					
Inattention	0.36** [0.16,0.55]	0.35** [0.16,0.54]	0.45** [0.26,0.62]	0.27* [0.05,0.471]	0.32** [0.13,0.50]
Impulsivity/ Hyperactivit y	0.29** [0.09,0.48]	0.13 [-0.11,0.34]	0.20 [-0.02,0.42]	0.17 [-0.08,0.38]	0.03 [-0.20,0.24]
Control participants					
Inattention	0.34** [0.15,0.51]	0.32** [0.13,0.549]	0.37** [0.18, 0.53]	0.24* [0.06,0.43]	0.23* [0.03,0.43]
Impulsivity/ Hyperactivit y	0.34** [0.15,0.50]	0.33** [0.14,0.48]	0.35** [0.17,0.51]	0.17 [-0.03,0.38]	0.18 [-0.03,0.36]
Online participants					

Inattention	0.42**	0.42**	0.43**	0.39**	0.36**
	[0.30,0.52]	[0.29,0.52]	[0.30,0.54]	[0.26,0.50]	[0.24,0.47]
Impulsivity/	0.38**	0.36**	0.34**	0.32**	0.24**
Hyperactivit	[0.25,0.50]	[0.24,0.48]	[0.21,0.46]	[0.19,0.43]	[0.09,0.38]
y					

Note. * $p < .05$; ** $p < .01$; Spearman R_o correlations and 95% Bootstrapped Confidence intervals

Table 3. Results of regression analyses for ADHD and control participants

	Beta	B	SE	95% CI		p
				LL	UL	
ADHD Participants						
Intercept		-12.56	12.52	-35.34	7.45	0.29
Inattention	0.36	1.25	0.47	0.35	2.37	0.02
Impulsivity/ Hyperactivity	-0.19	-0.54	0.35	-1.24	0.13	0.12
Barret	0.06	0.09	0.20	-0.27	0.48	0.61
Impulsivity						
Depression & Anxiety	0.14	0.19	0.20	-0.18	0.59	0.34
Checking	0.23	1.25	0.74	-0.19	2.77	0.08
Ordering	0.15	0.72	0.64	-0.55	1.89	0.26
Neutralizing	0.08	0.50	0.91	-1.53	2.13	0.54
Washing	-0.12	-0.69	0.88	-2.38	0.95	0.40
Obsessing	0.09	0.41	0.71	-0.99	1.82	0.61
Control Participants						
Intercept		-3.36	6.77	-17.11	9.77	0.62

Inattention	0.12	0.27	0.25	-0.19	0.81	0.26
Impulsivity/ Hyperactivity	0.15	0.32	0.29	-0.30	0.80	0.28
Barret	0.11	0.16	0.14	-0.13	0.43	0.40
Impulsivity						
Depression & Anxiety	0.04	0.07	0.21	-0.30	0.51	0.74
Checking	0.44	2.11	0.70	0.70	3.39	<.001
Ordering	-0.01	-0.04	0.54	-0.94	1.19	0.94
Neutralizing	-0.29	-1.45	0.68	-2.67	0.02	0.03
Washing	0.13	0.7	0.83	-0.81	2.50	0.37
Obsessing	0.10	0.52	0.75	-1.07	1.91	0.44

Table 4. Online UK sample descriptive statistics and results of regression analysis.

	Mean	SD	Beta	B	SE	95% CI		p
						LL	UL	
Intercept				-3.68	6.42	-16.11	9.66	0.56
Inattention	16.78	6.02	0.21	0.49	0.20	0.13	0.98	0.02
Impulsivity/ Hyperactivity	13.51	6.15	0.05	0.11	0.18	-0.24	0.48	0.58
Barret	64.85	10.57	0.10	0.14	0.12	-0.10	0.35	0.22
Impulsivity Depression & Anxiety	19.78	13.99	0.24	0.24	0.09	0.08	0.41	0.01
Checking	3.16	3.15	0.05	0.23	0.44	-0.54	1.18	0.61
Ordering	3.17	2.90	0.17	0.81	0.39	0.03	1.53	0.04
Neutralizing	1.62	2.67	0.17	0.88	0.45	0.03	1.82	0.05
Washing	1.86	3.00	-0.15	-0.70	0.41	-1.52	0.05	0.08
Obsessing	3.58	3.44	-0.03	-0.11	0.35	-0.80	0.55	0.74

Figure 1. Violin plots showing hoarding severity (Savings Inventory Revised total) for the ADHD, control and online samples.

