

Misdiagnosis of ADHD in Individuals Diagnosed With Obsessive-Compulsive Disorder: Guidelines for Practitioners

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Opinion statement

Attention deficit/hyperactivity disorder (ADHD) and obsessive-compulsive disorder (OCD) are reported to frequently co-occur, particularly in children. However, recent research undermines the viability of such comorbidity. Research further suggests that OCD is associated with deficient cognitive functioning, particularly in the domain of executive function. This may be the underlying reason for the high co-occurrence rates of ADHD reported in OCD samples, compared to the relatively low rates of OCD reported in ADHD samples. Furthermore, a contrasting neurobiological, phenomenological, pharmacological, and psychotherapeutic profile between the two disorders further challenges the viability of a genuine comorbidity. In addition, there is a lack of a solid etiological account for such comorbidity—which may be to a large extent mediated by the presence of tic disorders. The consequences of misdiagnosis of OCD as ADHD in children may be dire because of the putative negative impact of stimulant medications on OCD symptoms. It is recommended that clinicians exercise vigilance when facing a potential dual diagnosis of ADHD and OCD. In order to determine whether OCD is the primary disorder clinicians should inquire about the possibility of a background tic disorder, assess compulsive rituals, impulsivity, risk taking, and the level of distress associated with intrusive thoughts. Once OCD has been determined as the primary condition, inattention and executive dysfunction should be carefully considered as an epiphenomenon of obsessive-compulsive symptoms.

Introduction

Attention deficit/hyperactivity disorder (ADHD) is amongst the most controversial diagnostic entities in the diagnostic and statistical manual (DSM; [1, 2]). This is due in part to some central ADHD diagnostic criteria (e.g., distractibility, difficulty concentrating, restlessness, avoidance of mentally strenuous activity) that are common symptoms, criteria, or sequelae of a number of disorders, such as depressive and anxiety disorders [3]. Indeed, elevated rates of comorbidity have been reported between ADHD and a host of disorders including conduct disorder, oppositional defiant disorder, antisocial personality disorder, and tic disorders [4, 5]. These conditions, however, are in phenomenological proximity to ADHD, particularly concerning increased impulsivity, risk taking, and emotional regulation. More controversial are accounts of increased comorbidity with major depressive disorders, bipolar disorder, and anxiety disorders [5, 6]. To demonstrate, Chilakamarri and colleagues [7] assessed 64 children and adolescents and found that 38.1 % of the participants meeting DSM-IV major depressive disorder (MDD) criteria were previously erroneously diagnosed with ADHD. Similarly, the authors reported that the rate for past misdiagnosis of ADHD in a bipolar disorder sample was 28.6 %. One way to address this serious clinical problem would be to take an *inclusive* approach as articulated in the advice given by Dr. Joseph Biederman, one of the most prominent psychiatrists in the field of ADHD. In the context of a discussion about mistaking mania for ADHD, Dr. Biederman noted: "How then is child psychiatry to decide whether these severely ill children have mania, ADHD, or both? As a start, it may be useful to drop diagnostic hierarchies that are not based on empirical research. From a practical perspective, that would mean making both diagnoses if warranted by the patient's history of signs and symptoms." [8]. Such an approach may be highly problematic, especially in light of DSM's criterion E for ADHD, in which clinicians are instructed to verify that the symptoms of ADHD should not be accounted for by another disorder [9]. In their review of diagnostic controversies in adult ADHD, McGough and Barkley [10] addressed the issue of criterion E noting that, "It is unclear whether these DSM symptoms adequately differentiate ADHD from other adult disorders or how other disorders might be manifested when co-occurring with ADHD" [10]. Consider a person who meets criteria for a depressive episode and also presents with inattention and impulsivity, would it be sound to

diagnose comorbid ADHD, even when the minimum criteria have been met? Is it unreasonable to expect that treating depression would improve concentration?

It is estimated that 70–85 % of adults diagnosed with ADHD meet criteria for at least one other psychiatric disorder, most notably mood, anxiety, disruptive, and substance use disorders [11, 12]. The elevated prevalence rates of comorbid conditions in adult ADHD, together with the applicability of ADHD DSM criteria to symptoms seen across different disorders, prompted critical investigation of misdiagnosis of ADHD. This body of research documented alarming rates of misdiagnosis of ADHD in depressed and bipolar patients [7], in cases of autism and pervasive developmental disorder, sleep disorders, and even giftedness [13–17]. In addition, some studies report that as much as one third of individuals referred for the purpose of an ADHD diagnosis do not have ADHD, but do meet criteria for affective, anxiety, and personality disorders [11]. Examination of the evidence concerning concomitant ADHD and obsessive-compulsive disorders (OCD) may be particularly important due to profound phenomenological, behavioral, and neurobiological differences between the two disorders [18•]. A careful examination of the validity of concomitant ADHD and OCD is particularly important due to the differences in pharmacological treatment, where ADHD medications have been found to exacerbate obsessive-compulsive symptoms in individuals diagnosed with OCD [19, 20]. Moreover, it may be that the oft neglected similarities between the two disorders in terms of deficiencies in cognitive functioning are of importance in the context of misdiagnosis of OCD as OCD + ADHD [18•]. Indeed, OCD-related cognitive deficiencies may be erroneously evaluated as ADHD-like symptoms [21].

OCD is a condition associated with obsessive thinking and compulsive rituals, as well as with overthinking the results of one's actions, inhibited temperament, and harm and risk aversion [22–24]. ADHD, on the other hand, is clinically antithetical to OCD: it is a disorder that lies at the other end of a compulsive-impulsive continuum [18•, 25], characterized by contrasting behavioral characteristics, such as increased risk taking, impulsivity, disinhibition, and lack of forethought [9]. Furthermore, an abundance of neuroimaging studies depicts contrasting resting neural connectivity between, and activity across major regions of the frontostriatal system. OCD is associated with hyperactivation, and

ADHD with underactivity of the same regions [26•]. The resting-state contrasting functionality is observed in brain regions that include the anterior cingulate cortex, the basal ganglia, the dorsolateral prefrontal cortex, the orbitofrontal cortex, and the thalamus [27–29]. In fact, these differences were demonstrated in one of the only fMRI studies directly comparing a sample with OCD and a sample with ADHD [30•]. More recently, Norman and colleagues [31•] conducted a comparative meta-analysis examining structural and functional datasets from pediatric and adult OCD, and ADHD samples. The authors found that although the two disorders share performance deficiencies on executive function tests, there are substantial functional and structural

contrasts between the two disorders, implying different underlying mechanisms. The authors concluded that "...inhibitory control impairments, rather than representing a transdiagnostic endophenotype in ADHD and OCD, were associated with disorder-differential functional and structural abnormalities" [31•]. Corresponding to these contrasting features, the first-line pharmacotherapy recommended for the treatment of ADHD are dopamine agonists (i.e., stimulants) [32], while for OCD, serotonin agonists (i.e., serotonin reuptake inhibitors (SRIs)) [33]. Moreover, in more than 25 % of cases, SRI treatment for OCD is augmented with neuroleptics (dopamine antagonists; [34]).

Research Into Concomitant ADHD and OCD

These stark differences are at odds [35] with numerous reports of comorbidity between OCD and ADHD that first appeared a quarter century ago (for a review, see [26•]). A systematic review of the literature reveals that the majority of the data related to ADHD-OCD comorbidity was derived from pediatric samples, mostly assessed ADHD in OCD samples, and was characterized by substantial inconsistent findings. Overall, the prevalence of concomitant ADHD and OCD ranges between 0 to 60 %, for ADHD in OCD samples, and 0 to 15 % in OCD identified in ADHD samples [26•]. Importantly, concomitant rates found in three large representative samples were 10 % or less [36–38].

Methodological Consideration in Concomitant ADHD and OCD Research

The profound and multidimensional differences between ADHD and OCD pose a conceptual challenge as to the legitimacy of co-occurrence of these conditions. Not surprisingly, the literature reporting concomitant ADHD and OCD is characterized by several important methodological caveats. First, the vast majority of studies recruited participants from specialty clinics (e.g., [39–41]). Individuals recruited from such clinics are known to present with increased clinical complexity and comorbidity [42]. This corresponds to findings that studies assessing participants recruited from specialty clinics report higher ADHD-OCD concomitance rates (20–60 %), compared to more representative samples (<10 %) [26•]. Second, most of the samples reporting concomitant ADHD and OCD rates had a majority of male participants (62 %; [26•]). Given that the male to female ratio in ADHD is estimated to be at least 2:1 [43], this poses additional potential bias. Third, there is an apparent discrepancy between concomitant rates reported in adult samples compared to youth samples. Prevalence rates of concomitant ADHD and OCD are approximately twice as large in youth samples compared to adult. This unusual finding may be

important given the suggestion that pediatric OCD is associated with neuromaturational abnormalities [44]. This notion received indirect support in a large study demonstrating that pediatric OCD is associated with a different patterns of frontostriatal brain activity [45•], with no evidence of neuropsychological impairments [46], and with remission rates of approximately 60 % when transitioning to adulthood [47]. Fourth, some large studies reporting OCD-ADHD comorbidity rates did not employ any exclusion criteria (e.g., [40, 48•, 49•, 50, 51]). Although lack of exclusion criteria may potentially increase the study's ecological validity, it is important to note that tic disorders are associated with significantly higher rates of comorbid OCD + ADHD, and some studies find that more than a third of their primary tic disorder samples exhibit both OCD and ADHD [52]. In light of the association between tic disorders and presentation of concomitant OCD and ADHD, the evidence that nearly 90 % of studies did not exclude or control for tic disorders [26•] points to an additional potentially significant bias. In sum, together with the antithetical neurobiology and phenomenology, these methodological caveats further undermine the validity of a genuine comorbidity between OCD and ADHD.

Etiology of Concomitant ADHD-OCD

Validation of a genuine comorbidity between disorders cannot rely solely on epidemiological data regarding concomitance between disorders. Validation of comorbidity necessitates a theoretical and etiological explanation. For example, anxiety and depression frequently seen together may share genetic etiological factors [53], familial environmental factors, as well as dysfunctional beliefs and cognitive biases [54]. Similarly, ADHD, conduct disorder, and oppositional defiant disorder were found to share a common genetic factor governing the covariation between the phenotypes [55]. However, in the case of ADHD and OCD—disorders associated with different genes, neurotransmitters, and core symptoms [56, 57]—only one attempt to provide an etiological explanation for comorbid ADHD-OCD was offered to date. This explanation was based on familial risk analyses in pediatric probands and parents with ADHD [58, 59], suggesting a familial association and co-segregation between OCD and ADHD. Notably, this pilot work does not prove that there is a genetic association between the two conditions, but only that there is a tendency among probands and family members that are diagnosed with one disorder, to receive a diagnosis of a second disorder that is higher than in non-affected families.

A more parsimonious and critical etiological account for the findings regarding increased concomitance between ADHD and OCD is that OCD-related inattention and executive function deficiencies may be perceived as comorbid ADHD. This mechanism has been outlined in the Executive Overload Model of OCD [26•]. This model suggests that the overflow of obsessive thoughts in OCD causes an overload on the executive system, which leads to a depletion in resources required for intact executive functions. Thus, attention and executive function deficiencies may stem from psychopathological mechanisms in OCD and subsequently may be erroneously perceived as symptoms of ADHD [21]. This may account for the high rates of ADHD identified in OCD samples, compared to OCD

identified in ADHD samples. The former would require identification of symptoms associated with inattention and executive dysfunction in OCD, and the latter would require identification of obsessions and/or compulsions in individuals diagnosed with ADHD. Whereas intrusive worrisome thoughts have been documented in adult ADHD [60], obsessive-compulsive symptom-severity were found to be significantly lower in ADHD compared to those in OCD [18•]. In fact, childhood and adult ADHD symptoms have been found to be strongly correlated in adult ADHD and non-psychiatric controls, but no such association was found within an OCD sample. The same study demonstrated how obsessive-compulsive symptoms and total ADHD symptoms were positively correlated in OCD, but no such association was found in the control or ADHD samples [21]. Finally, in contrast to the significant distress that accompanies obsessive thoughts in OCD, individuals diagnosed with ADHD frequently report being distracted by random intrusive thoughts, but that those thoughts do not cause emotional distress [61].

Assessment of Suspected Concomitant OCD-ADHD

It appears that there are strong indications that comorbidity between OCD and ADHD is largely based on erroneous diagnosis stemming from focusing largely on self-report of functional problems associated with OCD-related executive dysfunction [18•, 21, 26•]. It is reasonable to assume that genuine OCD-ADHD comorbidity is rare, and most probably exists solely in the presence of a primary (or a history of) tic disorder. As noted above, blindly adhering to the DSM may result in erroneous double diagnosis. For example, clinicians cannot use inattention as a symptom of depression and subsequently as a criterion for ADHD, just because the patient exhibits this symptom. Thus, particularly in the case of ADHD, there is a need to identify the primary condition, and to carefully examine differential factors prior to determining the presence of a legitimate comorbidity. That is, if a person that appears to meet criteria for OCD also complains about inattention, being distracted (at work or school), procrastination, and forgetfulness, clinicians are strongly encouraged to take special care and examine some particular differential factors. First, it is important to emphasize that most individuals diagnosed with OCD tend to be perfectionist and extremely critical about their performance [62]. Thus, their threshold for what would be considered a problem or a “deficit” is very different than most individuals. For example, one study demonstrated how a sample of individuals diagnosed with OCD exhibited no difference from a sample of non-psychiatric controls on a self-report measure of impulsivity, but a significantly higher proportion of positive responses to the question “are you an impulsive person?” were found in the OCD sample [18•]. Thus, it would be important to attempt to obtain objective information such as school grades, vocational performance ratings, or informant’s input to understand the nature of such complaints.

Second, OCD compulsive rituals are in most cases carefully planned, rigidly executed sequences of mental or behavioral acts, that are governed by rules such as “do *x* while not doing *y*.” These characteristics are associated with overloading the executive system, particularly working memory [63], and would make OCD

compulsive rituals unlikely to be performed by individuals with primary ADHD. Indeed, to my knowledge, no research or case study evidencing OCD-like compulsive rituals in primary ADHD has been published to date. Furthermore, in cases where individuals with primary ADHD report intrusive thoughts [60], it is important to inquire whether these thoughts cause significant emotional distress, as seen in OCD, or alternatively whether the individual does not report distress associated with these thoughts, as seen in ADHD [61]. In such cases, it is also important to assess whether the person is trying to cancel these thoughts by mental or behavioral rituals. Third, ADHD is associated with behavioral impulsivity, sensation seeking, and risk taking, and most individuals with ADHD present with the hyperactive impulsive type [64]. In contrast, studies show that OCD is characterized by reduced impulsivity compared to non-psychiatric controls [65–70], and by significantly lower behavioral impulsivity and risk taking compared to ADHD [18•]. In sum, in order to make a reliable diagnostic decision when facing a suspected ADHD-OCD comorbidity, clinicians are advised to examine the presence of compulsive rituals, impulsivity, and risk taking; the nature of obsessive or intrusive thoughts and their sequelae; and a better understanding of the objective status of self-report symptoms.

Treatment

The ultimate purpose of research on comorbidity is to inform and improve treatment for these complex cases [71]. For example, a case of an individual presenting with debilitating specific phobia, in addition to a severe depression, may call for prioritizing treatment for depression. However, there is no mention in the literature of any treatment guidelines or clinical consideration for concomitant ADHD-OCD. This is not surprising given that over and above the questionable validity of such a comorbidity, the treatment for the two disorders is very different. Treatment for OCD focuses on exposure and response-prevention and high-to-maximum dosages of SRIs/SSRIs [72]. In contrast, treatment for ADHD entails stimulant medications and modular behavioral therapy that largely targets specific behaviors, while providing compensatory strategies [73]. However, a misdiagnosis of an inattentive child as having ADHD when in fact she suffers from OCD may result in dire consequences, due to the effect of stimulants that can exacerbate or even induce OCD [e.g., 74, 75]. Thus, it is imperative that the diagnostic process in cases of suspected ADHD-OCD comorbidity be conducted prudently.

Summary

In the context of mental health, comorbidity is one of the most challenging clinical problems in terms of diagnosis and treatment. Although the issue of comorbidity in general is subject to harsh criticism, predominantly in the context of the DSM, the case of ADHD and OCD may be particularly important. The two disorders are neurobiologically and phenomenologically antithetical; they respond to very different types of treatment, and ultimately, a careful examination of the literature yields serious problems that undermine the legitimacy of a diagnosis of comorbid ADHD and OCD. The literature and

clinical experience suggest that if such a comorbidity exists, it is probably much rarer than previously thought, and the genuine comorbidity cases are most likely associated with tic disorders. Clinicians should not mistake problems with attention and executive function with ADHD. In fact, research suggests that numerous disorders are associated with underperformance on neuropsychological tests of executive functions [76–78], and the fact that those deficiencies uniquely correspond with central ADHD diagnostic criteria may promote diagnostic errors. However, the case of ADHD and OCD may be of paramount importance, not only because of the fact that most cases of ADHD are diagnosed in children, but because of the potential of a strong aversive reaction to stimulants among individuals struggling with primary OCD. Research indicates that regardless of the presence of a psychiatric diagnosis, stimulants may improve cognitive function and enhance behavioral control. However, seeing firsthand how individuals who have been treated for suspected ADHD with multiple types of stimulant medications experience worsening of OCD and anxiety symptoms, benefit from a correct diagnosis of OCD, underscores the importance of being vigilant and critical in these cases.

Compliance With Ethical Standards

Conflict of Interest

The author declares that he has no conflict of interest.

Human and Animal Rights and Informed Consent

This article does not contain any studies with animal subjects performed by the author. With regard to the author's research cited in this paper, all procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000 and 2008.

References and Recommended Reading

Papers of particular interest, published recently, have been highlighted as:

- Of importance
1. Wolraich ML. Attention deficit hyperactivity disorder: the most studied and yet most controversial diagnosis. *Ment Retard Dev Disabil Res Rev.* 1999;5(3):163–8. doi:10.1002/(SICI)1098-2779(1999)5:3<163::AID-MRDD1>3.0.CO;2-T.
 2. Nigg JT. ADHD's controversies. What causes ADHD?: understanding what goes wrong and why. New York: Guilford Press; 2006. p. 3–29.
 3. American Psychiatric A, American Psychiatric A, Force DSMT. Diagnostic and statistical manual of mental disorders : DSM-5. 2013.
 4. Storebo OJ, Simonsen E. The association between ADHD and antisocial personality disorder (ASPD): a review. *J Atten Disord.* 2013. doi:10.1177/1087054713512150.
 5. Schatz DB, Rostain AL. ADHD with comorbid anxiety: a review of the current literature. *J Atten Disord.* 2006;10(2):141–9. doi:10.1177/1087054706286698.
 6. Kim EY, Miklowitz DJ. Childhood mania, attention deficit hyperactivity disorder and conduct disorder: a critical review of diagnostic dilemmas. *Bipolar Disord.* 2002;4(4):215–25.
 7. Chilakamarri JK, Filkowski MM, Ghaemi SN. Misdiagnosis of bipolar disorder in children and adolescents: a comparison with ADHD and major depressive disorder. *Ann Clin Psychiatry.* 2011;23(1):25–9.
 8. Biederman J, Klein RG, Pine DS, Klein DF. Resolved: mania is mistaken for ADHD in prepubertal children. *J Am Acad Child Adolesc Psychiatry.* 1998;37(10):1091–6. discussion 6–9.

9. American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-5. 5th ed. Arlington: American Psychiatric Association; 2013.
 10. McGough JJ, Barkley RA. Diagnostic controversies in adult attention deficit hyperactivity disorder. *Am J Psychiatry*. 2004;161(11):1948–56.
 11. Cumyn L, French L, Hechtman L. Comorbidity in adults with attention-deficit hyperactivity disorder. *Can J Psychiatry*. 2009;54(10):673–83.
 12. McGough JJ, Smalley SL, McCracken JT, Yang M, Del’Homme M, Lynn DE, et al. Psychiatric comorbidity in adult attention deficit hyperactivity disorder: findings from multiplex families. *Am J Psychiatry*. 2005;162(9):1621–7. doi:10.1176/appi.ajp.162.9.1621.
 13. Perry R. Misdiagnosed ADD/ADHD; rediagnosed PDD. *J Am Acad Child Psychiatry*. 1998;37(1):113–4. doi:10.1097/00004583-199801000-00024.
 14. Mayes SD, Calhoun SL, Mayes RD, Molitoris S. Autism and ADHD: overlapping and discriminating symptoms. *Res Autism Spectr Disord*. 2012;6(1):277–85. <http://dx.doi.org/10.1016/j.rasd.2011.05.009>.
 15. Hartley SL, Sikora DM. Which DSM-IV-TR criteria best differentiate high-functioning autism spectrum disorder from ADHD and anxiety disorders in older children? *Autism*. 2009;13(5):485–509. doi:10.1177/1362361309335717.
 16. Aronen ET, Paavonen EJ, Fjallberg M, Soininen M, Torronen J. Sleep and psychiatric symptoms in school-age children. *J Am Acad Child Psychiatry*. 2000;39(4):502–8. doi:10.1097/00004583-200004000-00020.
 17. Hartnett DN, Nelson JM, Rinn AN. Gifted or ADHD? The possibilities of misdiagnosis. *Roeper Rev*. 2004;26(2):73–6. doi:10.1080/02783190409554245.
 18. • Abramovitch A, Dar R, Hermesh H, Schweiger A. Comparative neuropsychology of adult obsessive-compulsive disorder and attention deficit/hyperactivity disorder: implications for a novel executive overload model of OCD. *J Neuropsychol*. 2012;6(2):161–91. doi:10.1111/j.1748-6653.2011.02021.x.
- This article provides empirical support for the executive overload model of OCD, suggesting that inattention and executive function deficits may stem from OCD symptoms.
19. Koizumi HM. Obsessive-compulsive symptoms following stimulants. *Biol Psychiatry*. 1985;20(12):1332–3.
 20. Kouris S. Methylphenidate-induced obsessive-compulsiveness. *J Am Acad Child Adolesc Psychiatry*. 1998;37(2):135.
 21. Abramovitch A, Dar R, Mittelman A, Schweiger A. Don’t judge a book by its cover: ADHD-like symptoms in obsessive-compulsive disorder. *J Obsessive Compuls Relat Disord*. 2013;2:53–61.
 22. Coles ME, Schofield CA, Pietrefesa AS. Behavioral inhibition and obsessive-compulsive disorder. *J Anxiety Disord*. 2006;20(8):1118–32.
 23. Steketee G, Frost RO. Measurement of risk-taking in obsessive-compulsive disorder. *Behav Cogn Psychother*. 1994;22(04):287–98.
 24. Ettelt S, Grabe HJ, Ruhrmann S, Buhtz F, Hochrein A, Kraft S, et al. Harm avoidance in subjects with obsessive-compulsive disorder and their families. *J Affect Disord*. 2008;107(1):265–9. doi:10.1016/j.jad.2007.08.017.
 25. Hollander E. Obsessive-compulsive disorder and spectrum across the life span. *Int J Psychiatry Clin Pract*. 2005;9(2):79–86.
 26. • Abramovitch A, Dar R, Mittelman A, Wilhelm S. Comorbidity between attention deficit/hyperactivity disorder and obsessive-compulsive disorder across the lifespan: a systematic and critical review. *Harv Rev Psychiatry*. 2015;23(4):245–62. doi:10.1097/HRP.0000000000000050.
- This article provides a comprehensive and critical review examining comorbidity between OCD and ADHD.
27. Bush G, Valera EM, Seidman LJ. Functional neuroimaging of attention-deficit/hyperactivity disorder: a review and suggested future directions. *Biol Psychiatry*. 2005;57(11):1273–84.
 28. Harrison BJ, Soriano-Mas C, Pujol J, Ortiz H, Lopez-Sola M, Hernandez-Ribas R, et al. Altered corticostriatal functional connectivity in obsessive-compulsive disorder. *Arch Gen Psychiatry*. 2009;66(11):1189–200.
 29. Whiteside SP, Port JD, Abramowitz JS. A meta-analysis of functional neuroimaging in obsessive-compulsive disorder. *Psychiatry Res Neuroimaging*. 2004;132(1):69–79.
 30. • Rubia K, Cubillo A, Woolley J, Brammer MJ, Smith A. Disorder-specific dysfunctions in patients with attention-deficit/hyperactivity disorder compared to patients with obsessive-compulsive disorder during interference inhibition and attention allocation. *Hum Brain Mapp*. 2011;32(4):601–11.
- In this unique imaging study, the authors examined brain activity during cognitive tasks between an OCD and ADHD samples.
31. • Norman LJ, Carlisi C, Lukito S, Hart H, Mataix-Cols D, Radua J, et al. Structural and functional brain abnormalities in attention-deficit/hyperactivity disorder and obsessive-compulsive disorder: a comparative meta-analysis. *JAMA Psychiatry*. 2016. doi:10.1001/jamapsychiatry.2016.0700.
- This paper reports a recent comparative meta-analysis of structural and functional brain imaging studies in OCD and in ADHD, concluding that there are substantial neurobiological contrasting differences between OCD and ADHD, in both pediatric and adult samples.
32. Gibbins C, Weiss M. Clinical recommendations in current practice guidelines for diagnosis and treatment of ADHD in adults. *Curr Psychiatry Rep*. 2007;9(5):420–6.
 33. Bandelow B, Zohar J, Hollander E, Kasper S, Moller HJ, Zohar J, et al. World Federation of Societies of Biological Psychiatry (WFSBP) guidelines for the pharmacological treatment of anxiety, obsessive-compulsive and post-traumatic stress disorders—first revision. *World J Biol Psychiatry*. 2008;9(4):248–312. doi:10.1080/15622970802465807.

34. Isomura K, Nordsetten AE, Rück C, Ljung R, Ivarsson T, Larsson H et al. Pharmacoeconomics of obsessive-compulsive disorder: a Swedish nationwide cohort study. *Eur Neuropsychopharmacol*. in-press. <http://dx.doi.org/10.1016/j.euroneuro.2016.02.004>.
35. Delorme R, Gousse V, Roy I, Trandafir A, Mathieu F, Mouren-Simeoni MC, et al. Shared executive dysfunctions in unaffected relatives of patients with autism and obsessive-compulsive disorder. *Eur Psychiatry*. 2007;22(1):32–8. doi:10.1016/j.eurpsy.2006.05.002.
36. Heyman I, Fombonne E, Simmons H, Ford T, Meltzer H, Goodman R. Prevalence of obsessive-compulsive disorder in the British nationwide survey of child mental health. *Br J Psychiatry*. 2001;179:324–9.
37. Kessler RC, Adler L, Barkley R, Biederman J, Conners CK, Demler O, et al. The prevalence and correlates of adult ADHD in the United States: results from the National Comorbidity Survey Replication. *Am J Psychiatry*. 2006;163(4):716–23.
38. Zohar AH, Ratzoni G, Pauls DL, Apter A, Bleich A, Kron S, et al. An epidemiological study of obsessive-compulsive disorder and related disorders in Israeli adolescents. *J Am Acad Child Adolesc Psychiatry*. 1992;31(6):1057–61.
39. Geller DA, Wieland N, Carey K, Vivas F, Petty CR, Johnson J, et al. Perinatal factors affecting expression of obsessive compulsive disorder in children and adolescents. *J Child Adolesc Psychopharmacol*. 2008;18(4):373–9. doi:10.1089/cap.2007.0112.
40. Lack CW, Storch EA, Keeley ML, Geffken GR, Ricketts ED, Murphy TK, et al. Quality of life in children and adolescents with obsessive-compulsive disorder: base rates, parent-child agreement, and clinical correlates. *Soc Psychiatry Psychiatr Epidemiol*. 2009;44(11):935–42. doi:10.1007/s00127-009-0013-9.
41. Storch EA, Lewin AB, Geffken GR, Morgan JR, Murphy TK. The role of comorbid disruptive behavior in the clinical expression of pediatric obsessive-compulsive disorder. *Behav Res Ther*. 2010;48(12):1204–10. doi:10.1016/j.brat.2010.09.004.
42. McConaughy SH, Achenbach TM. Comorbidity of empirically based syndromes in matched general population and clinical samples. *J Child Psychol Psychiatry*. 1994;35(6):1141–57.
43. Polanczyk G, de Lima MS, Horta BL, Biederman J, Rohde LA. The worldwide prevalence of ADHD: a systematic review and meta-regression analysis. *Am J Psychiatry*. 2007;164(6):942–8.
44. Abramovitch A, Mittelman A, Henin A, Geller DA. Neuroimaging and neuropsychological findings in pediatric obsessive-compulsive disorder: a review and developmental considerations. *Neuropsychiatry*. 2012;2(4):313–29.
45. Fitzgerald KD, Welsh RC, Stern ER, Angststadt M, Hanna GL, Abelson JL, et al. Developmental alterations of frontal-striatal-thalamic connectivity in obsessive-compulsive disorder. *J Am Acad Child Adolesc Psychiatry*. 2011;50(9):938–48 e3. doi:10.1016/j.jaac.2011.06.011.
- In this large imaging study, the authors found that the youngest OCD age group demonstrated frontostriatal connectivity that was different from all other age groups, and one that may resemble connectivity in ADHD.
46. Abramovitch A, Abramowitz JS, Mittelman A, Stark A, Ramsey K, Geller DA. Research review: neuropsychological test performance in pediatric obsessive-compulsive disorder—a meta-analysis. *J Child Psychol Psychiatry*. 2015;56(8):837–47. doi:10.1111/jcpp.12414.
47. Stewart SE, Geller DA, Jenike M, Pauls D, Shaw D, Mullin B, et al. Long-term outcome of pediatric obsessive-compulsive disorder: a meta-analysis and qualitative review of the literature. *Acta Psychiatr Scand*. 2004;110(1):4–13. doi:10.1111/j.1600-0447.2004.00302.x.
48. Geller DA, Biederman J, Faraone SV, Frazier J, Coffey BJ, Kim G, et al. Clinical correlates of obsessive compulsive disorder in children and adolescents referred to specialized and non-specialized clinical settings. *Depress Anxiety*. 2000;11(4):163–8.
- These two studies were the first to examine co-occurrence of OCD and ADHD in families.
49. Geller DA, Biederman J, Griffin S, Jones J, Lefkowitz TR. Comorbidity of juvenile obsessive-compulsive disorder with disruptive behavior disorders. *J Am Acad Child Adolesc Psychiatry*. 1996;35(12):1637–46.
- These two studies were the first to examine co-occurrence of OCD and ADHD in families.
50. Ghanizadeh A. Comorbidity of enuresis in children with attention-deficit/hyperactivity disorder. *J Atten Disord*. 2010;13(5):464–7. doi:10.1177/1087054709332411.
51. Zohar AH. The epidemiology of obsessive-compulsive disorder in children and adolescents. *Child Adolesc Psychiatr Clin N Am*. 1999;8(3):445–60.
52. Grados MA, Mathews CA. Latent class analysis of Gilles de la Tourette syndrome using comorbidities: clinical and genetic implications. *Biol Psychiatry*. 2008;64(3):219–25. doi:10.1016/j.biopsych.2008.01.019.
53. Kendler KS, Heath A, Martin NG, Eaves LJ. Symptoms of anxiety and depression in a volunteer twin population: the etiologic role of genetic and environmental factors. *Arch Gen Psychiatry*. 1986;43(3):213–21. doi:10.1001/archpsyc.1986.01800030023002.
54. Beck AT, Clark DA. Anxiety and depression: an information processing perspective. *Anxiety Research*. 1988;1(1):23–36. doi:10.1080/10615808808248218.
55. Nadder TS, Rutter M, Silberg JL, Maes HH, Eaves LJ. Genetic effects on the variation and covariation of attention deficit-hyperactivity disorder (ADHD) and oppositional-defiant disorder/conduct disorder (ODD) symptomatology across informant and occasion of measurement. *Psychol Med*. 2002;32(1):39–53.
56. Pauls DL, Abramovitch A, Rauch SL, Geller DA. Obsessive-compulsive disorder: an integrative genetic and neurobiological perspective. *Nat Rev Neurosci*. 2014;15(6):410–24. doi:10.1038/nrn3746.

57. Franke B, Faraone SV, Asherson P, Buitelaar J, Bau CH, Ramos-Quiroga JA, et al. The genetics of attention deficit/hyperactivity disorder in adults, a review. *Mol Psychiatry*. 2012;17(10):960–87. doi:10.1038/mp.2011.138.
58. Geller DA, Petty C, Vivas F, Johnson J, Pauls D, Biederman J. Examining the relationship between obsessive-compulsive disorder and attention-deficit/hyperactivity disorder in children and adolescents: a familial risk analysis. *Biol Psychiatry*. 2007;61(3):316–21.
59. Geller DA, Petty C, Vivas F, Johnson J, Pauls D, Biederman J. Further evidence for co-segregation between pediatric obsessive compulsive disorder and attention deficit hyperactivity disorder: a familial risk analysis. *Biol Psychiatry*. 2007;61(12):1388–94.
60. Abramovitch A, Schweiger A. Unwanted intrusive and worrisome thoughts in adults with attention deficit/hyperactivity disorder. *Psychiatry Res*. 2009;168(3):230–3.
61. Brown FC, Katz LJ, Roth RM, Beers SR. The relationship of self-reported subclinical obsessive-compulsive symptoms and impulsivity among adults with AD/HD. *Psychiatry Res*. 2014;216(1):131–6. <http://dx.doi.org/10.1016/j.psychres.2014.01.034>.
62. Frost RO, Steketee G. Perfectionism in obsessive-compulsive disorder patients. *Behav Res Ther*. 1997;35(4):291–6. [http://dx.doi.org/10.1016/S0005-7967\(96\)00108-8](http://dx.doi.org/10.1016/S0005-7967(96)00108-8).
63. Boyer P, Lienard P. Why ritualized behavior? Precaution systems and action parsing in developmental, pathological and cultural rituals. *Behav Brain Sci*. 2006;29(6):595–613. discussion -50.
64. Willcutt EG. The prevalence of DSM-IV attention-deficit/hyperactivity disorder: a meta-analytic review. *Neurotherapeutics*. 2012;9(3):490–9. doi:10.1007/s13311-012-0135-8.
65. Alonso P, Menchon JM, Jimenez S, Segalas J, Mataix-Cols D, Jaurieta N, et al. Personality dimensions in obsessive-compulsive disorder: relation to clinical variables. *Psychiatry Res*. 2008;157(1-3):159–68.
66. Bejerot S, Schlette P, Ekselius L, Adolfsson R, von Knorring L. Personality disorders and relationship to personality dimensions measured by the Temperament and Character Inventory in patients with obsessive-compulsive disorder. *Acta Psychiatr Scand*. 1998;98(3):243–9. doi:10.1111/j.1600-0447.1998.tb10075.x.
67. Fullana MA, Mataix-Cols D, Caseras X, Alonso P, Manuel MJ, Vallejo J, et al. High sensitivity to punishment and low impulsivity in obsessive-compulsive patients with hoarding symptoms. *Psychiatry Res*. 2004;129(1):21–7.
68. Shoval G, Zalsman G, Sher L, Apter A, Weizman A. Clinical characteristics of inpatient adolescents with severe obsessive-compulsive disorder. *Depress Anxiety*. 2006;23(2):62–70.
69. Tavares H, Gentil V. Pathological gambling and obsessive-compulsive disorder: towards a spectrum of disorders of volition. *Rev Bras Psiquiatr*. 2007;29(2):107–17.
70. Wu KD, Clark LA, Watson D. Relations between Obsessive-Compulsive Disorder and personality: beyond Axis I-Axis II comorbidity. *J Anxiety Disord*. 2006;20(6):695–717.
71. Rachman S. A psychological approach to the study of comorbidity. *Clin Psychol Rev*. 1991;11(4):461–4. doi:10.1016/0272-7358(91)90118-e.
72. Koran LM, Hanna GL, Hollander E, Nestadt G, Simpson HB. Practice guideline for the treatment of patients with obsessive-compulsive disorder. *Am J Psychiatry*. 2007;164(7):1.
73. Subcommittee on Attention-Deficit/Hyperactivity Disorder, Steering Committee on Quality Improvement and Management. ADHD: clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics*. 2011;128(5):1007–22.
74. Serby M. Methylphenidate-induced obsessive-compulsive symptoms in an elderly man. *CNS Spectrums*. 2003;8(8):612–3.
75. Woolley JB, Heyman I. Dexamphetamine for obsessive-compulsive disorder. *Am J Psychiatry*. 2003;160(1):183–.
76. Lipszyc J, Schachar R. Inhibitory control and psychopathology: a meta-analysis of studies using the stop signal task. *J Int Neuropsychol Soc*. 2010;16(6):1064–76. doi:10.1017/s1355617710000895.
77. Snyder HR. Major depressive disorder is associated with broad impairments on neuropsychological measures of executive function: a meta-analysis and review. *Psychol Bull*. 2013;139(1):81–132. doi:10.1037/a0028727.
78. Wright L, Lipszyc J, Dupuis A, Thayapararajah SW, Schachar R. Response inhibition and psychopathology: a meta-analysis of go/no-go task performance. *J Abnorm Psychol*. 2014:No pagination specified. doi:10.1037/a0036295.