Scandinavian Journal of Child and Adolescent Psychiatry and Psychology
Vol. 1, pp. 33-40 (2013)

Research Article **Open Access**

How Prevalent Are Autistic Traits Among Children With Attention-Deficit/Hyperactivity Disorder? A Qualitative Review of the Literature

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Abstract

Background: Twin, family, and linkage studies have indicated that attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorders (ASDs) share a portion of their heritable etiology. This suggests that individuals with ADHD may manifest different forms of ASDs that may range from fully developed syndromic forms of the disorder to milder manifestations of ASD symptomatology, which will henceforth be referred to as *autistic traits*.
Objective: The main purpose of this study was to conduct a literature search to examine the current body of knowledge regarding the prevalence of autistic traits (operationalized as the presence of autistic symptoms in the absence of a diagnosis of ASD) among children with ADHD and the associated morbidity of such traits.
Method: A systematic literature search in PubMed was conducted to discover all controlled studies published in the English language that systematically assessed the presence of autistic traits in children with ADHD who did not meet the criteria for ASDs. Three articles met our inclusion and exclusion criteria and were included in this qualitative review.
Results: Only three scientific papers that met our a priori inclusion and exclusion criteria were identified. These articles described findings obtained from clinical samples and identified a prevalence of autistic traits among children with ADHD that ranged from 7% to 60%. As compared with children with ADHD without these traits, the presence of autistic traits in children with ADHD was associated with more severe dysfunction in a wide range of non-overlapping domains and in the social and communication domains in particular.
Conclusions: Although this study was limited by the small amount of available literature about this subject, these findings suggest that a sizeable subset of children with ADHD manifest autistic traits and that the presence of these traits is associated with increased dysfunction and social and communication deficits.

Key Words: Autism; Autistic traits; ADHD; review

Introduction

Twin, family, and linkage studies indicate that attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorders (ASDs) share a portion of their heritable etiology (1-6). Genome-wide association studies found rare copy number variants that were shared between the two disorders (7). This state of affairs would suggest that individuals with ADHD may manifest different forms of ASDs that may range from fully developed syndromatic forms of the disorder to milder forms of ASD symptomatology, which will henceforth be referred to as *autistic traits*. However, in contrast with the well-developed literature regarding the overlap of ADHD and syndromatic ASD, much less is known about whether children with ADHD exhibit autistic traits and whether such symptoms are associated with unique morbidity and dysfunction.

A better understanding of whether children with ADHD exhibit autistic traits and whether such traits are associated with dysfunction and morbidity has important implications. Clinically, such knowledge may encourage the development of individualized treatment approaches to help address these problems. Scientifically, such knowledge can help with the identification of a more homogeneous subgroup of children with ADHD with a unique neurobiological underpinning.

The main aim of this study was to examine the current body of knowledge regarding the prevalence of autistic traits among children with ADHD and the associated morbidity of such traits. To this end, we conducted a literature search and examined studies that assessed autistic traits in children with ADHD in the absence of syndromatic levels of ASD. Related aims were to inventory the conceptualization of autistic traits and the methods used to assess them. To the best of our knowledge, this is the first systematic review that examined the prevalence of autistic traits among children with ADHD who do not meet the criteria for ASDs.

Methods

We conducted a comprehensive search of the scientific literature using the following PubMed search criteria: (ADHD[Title] OR "attention deficit hyperactive disorder"[Title] OR autism[Title] OR "autistic traits"[Title] OR autistic[Title] OR "autism traits"[Title] OR "autistic spectrum disorder traits"[Title] OR "autism spectrum disorder traits"[Title]) AND (("autism traits"[All Fields] OR "autistic traits"[All Fields] OR autistic[All Fields] OR "autistic spectrum disorder traits"[All Fields]) AND (ADHD[All Fields] OR "attention deficit hyperactivity disorder"[All Fields])). If the reference sections of the articles that were found suggested any additional articles, these were also examined.

For inclusion in the review, we restricted the PubMed literature to studies that included the following: 1) operationalized diagnosis of ADHD; 2) operationalized assessment of autistic traits; 3) operationalized assessment of ASD to ensure that subjects did not meet one of the ASD diagnoses; 4) availability of healthy controls for comparison; and 5) provision of the prevalence of autistic traits among the children with ADHD. The requirement of having healthy controls was to examine if the autistic traits were overrepresented among the children with ADHD as compared with general population rates. Articles that were written in non-English languages, articles that were not peer reviewed, and review articles were excluded. Four child psychiatrists and one psychologist examined the identified articles and evaluated their eligibility.

We extracted the following methodological features from each article: 1) study sample size; 2) proband mean age; 3) the diagnostic system used to make diagnoses and the method of diagnoses; 4) inclusion and exclusion criteria; 5) study measures; 5) the definition of autistic traits; and 6) the prevalence of autistic traits among the children with ADHD.

Results

From the initial database search, 393 papers were identified and screened by one psychologist and one child and adolescent psychiatrist. After the screening, 25 articles were identified as possibly being relevant, and their full text was carefully examined. Of these 25 articles, 22 were excluded for the following reasons: 1) 5 did not report the prevalence of autistic traits in the ADHD probands; 2) 12 did not exclude the ASD diagnoses; 3) 4 were reviews; and 4) one was a validation study of the Social Responsiveness Scale (SRS) (8). Thus, only three studies met our inclusion and exclusion criteria and were included in this qualitative review (4;9;10).

Table 1 lists the characteristics of each study, including its design and its definition of autistic traits. There were 926 children with ADHD that were evaluated by these studies. The studies used five different measures to assess autistic traits; details of individual studies are provided in the following sections of this article.

Table 1. Study characteristics, assessment and measurement methods, design, and prevalence of autistic traits among children with attention-deficit/hyperactivity disorder

Study	Total no. of subjects per group	Age	Autism spectrum disorder diagnosis as exclusion?	Diagnostic system and method	Measures	Definition of autistic traits
Grzadzinski et al., 2011	144 (ADHD group = 75; control group = 69)	7.1 to 17.8 years	Yes	Schedule of Affective Disorders and Schizophrenia for Children - Present and Lifetime Version (K-SADS-PL) was used to confirm a DSM-IV diagnosis.	Social Responsiveness Scale Children's Communication Checklist—2	1. Total Social Responsiveness Scale T score of ≥60 2. Children's Communication Checklist—2 autism spectrum disorder profile: General Communication Composite score of <55 with a negative Social Interaction Deviance Composite score or a Social Interaction Deviance Composite score of ≤–15 regardless of General Communication Composite score 3. Meets criteria of both 1 and 2 as listed here
Kochhar et al., 2011	60 (ADHD group = 30; control group = 30)	9 to 15 years	Yes	Development and Well-Being Assessment (DAWBA) was reviewed by at least 2 child psychiatrist to confirm a DSM-IV diagnosis.	Social Aptitudes Scale (part of the Development and Well-Being Assessment) Lifetime version of Social Communication Questionnaire	1. Social Aptitudes Scale score of ≤12 2. Social Communication Questionnaire score of ≥15
Mulligan et al., 2009	970 (ADHD group = 821; control group = 149)	5 to 17 years	Yes	Parental Account of Children's Symptoms (PACS interview), Strengths and Difficulties Questionnaire (SDQ) and Connor's parent and teacher ratings scales were used to confirm a DSM-IV diagnosis.	Lifetime version of parent-rated Social Communication Questionnaire Autism Diagnostic Interview – Revised	Latent class analysis of Social Communication Questionnaire symptoms in probands with ADHD identified five clusters that corresponded with domains of the Autism Diagnostic Interview – Revised; three of the clusters with high mean Social Communication Questionnaire scores were used to identify autistic traits: • Cluster 2: repetitive and stereotyped behaviors (mean score, 10.22) ▪ Cluster 4: communication and social reciprocal interaction (mean score, 13.58) ▪ Cluster 5: repetitive and stereotyped behaviors; communication, and social reciprocal interaction (mean score, 21.4)

ADHD, Attention-deficit/hyperactivity disorder; *DSM-IV, Diagnostic and Statistical Manual of Mental Disorders,* 4th Edition; *DSM-IV-TR, Diagnostic and Statistical Manual of Mental Disorders,* 4th Edition, Text Revision

Figure 1. Prevalence of Autistic Traits in ADHD Children Reported in Reviewed Studies

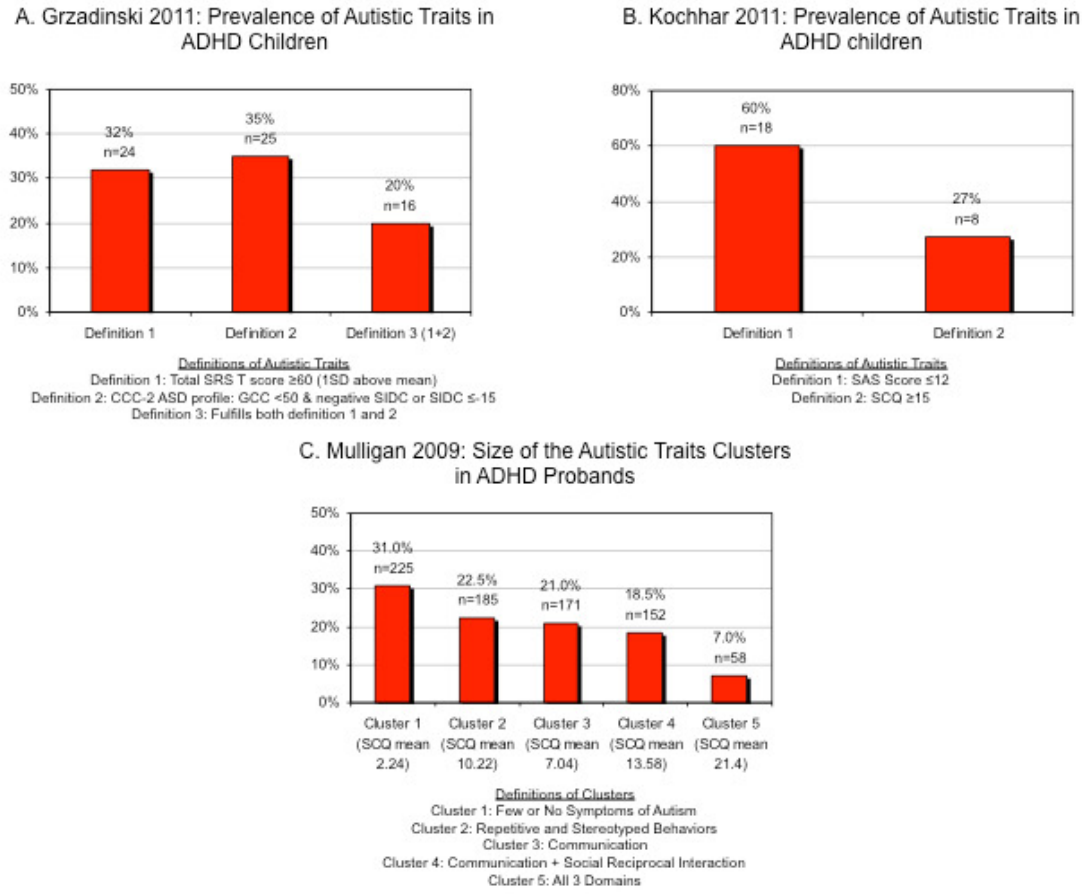

Figure 1 shows the prevalence of autistic traits among ADHD probands as reported in each of the three studies reviewed. All studies showed a sizeable prevalence of autistic traits, which ranged from 7% to 60% among children with ADHD.

Detailed Review of Identified Studies

Study by Grzadzinski and Colleagues (2011)

The sample studied by Grzadzinski and colleagues included 75 children who met the diagnostic criteria for ADHD and 69 healthy controls. Subjects with history of ASD were excluded. The first method that the authors used to identify autistic traits was the total T score of at least 60 (i.e., one standard deviation above the mean) on the SRS. The SRS is a 65-item scale with 53 items that focus on social-communicative abilities and 12 items that probe for repetitive behaviors or restricted patterns of interest (11). An SRS cutoff score of 75 has been used to differentiation between children with and without ASD, and SRS scores have been shown to strongly correlate with the Autistic Diagnostic Interview, Revised (8;11;12). This approach yielded a prevalence of autistic traits among children with ADHD of 32% (N = 25) (see Figure 1, *A*). Similar results were obtained with the use of the Children's Communication Checklist—2 (CCC—2). The CCC—2 is a checklist that addresses 10 communication-related domains: 1) speech; 2) syntax; 3) semantics; 4) coherence; 5) inappropriate initiation; 6) stereotyped language; 7) use of context; 8) non-verbal communication; 9) social relations; and 10) interests. The General Communication Composite score for the CCC—2 represents the sum of the scores of the first seven listed domains, and the Social Interaction Deviance Composite score represents the sum of the scores of domains 5, 8, 9, and 10 subtracted from the sum of the total of the scores of the remaining domains. Reports suggest that a General Communication Composite score of less than 55 in combination with a negative Social

Interaction Deviance Composite score or a Social Interaction Deviance Composite score of –15 or less correlate with a profile that includes ASD (13;14).

In this study, the authors used the previously described CCC—2 cutoff scores that identify ASD profiles to detect children with ADHD who also have autistic traits and found that 35% of these children demonstrated such traits. When the authors combined the SRS and the CCC—2 definitions of autistic traits, they found that 20% of children with ADHD were identified as having such traits (see Figure 1, *A*). Irrespective of the method used, children with ADHD with autistic traits showed statistically significantly more deviant scores for each domain of the SRS: 1) social; 2) communication; and 3) restricted/repetitive behavior/interests. This was true even after accounting for the severity of the child's psychopathology and ADHD symptoms. Children with ADHD with and without autistic traits did not differ with regard to their symptomatology related to inattention, hyperactivity, anxiety, or intelligence. Children with ADHD with the autistic trait profile also had significantly higher ratings of oppositional behavior according to the Conners' Parent Rating Scale – Revised: Long Version (15) and more significantly impaired scores on the withdrawn/depressed and total problems domains of the Child Behavior Checklist (16).

Study by Kochhar and Colleagues (2011)

Kochhar and colleagues' (10) sample consisted of 30 children with ADHD and 30 healthy controls, both without ASD diagnoses. The authors used the Social Aptitudes Scale (17), a 10-item scale that forms part of the Development and Well-Being Assessment. For this assessment, parents were asked to compare their child's behaviors with those of their peers across a range of situations. Autistic traits were defined by a score of 12 or less on the Social Aptitudes Scale, which has been reported to be indicative of difficulties with social functioning (18). Sixty percent of the children with ADHD in this sample met this criterion for autistic traits as compared with none of control group ($P < .05$) (see Figure 1, *B*).

The second measure that the authors used was the Lifetime version of the Social Communication Questionnaire (SCQ) (19). This is a well-validated, 40-item, parent-rated questionnaire for autism screening among children. Reports recommend using an SCQ cutoff score of 15 to separate children with ASD from those without ASD. In this study, a significantly higher rate of autistic traits (27% for children with ADHD vs. 0% for controls; $P < .05$) was identified with the use of this score (Figure 1, *B*). As compared with children without autistic traits, children with ADHD with the autistic trait profile had significantly higher levels of communication and social deficits; however, they did not demonstrate repetitive or stereotyped behaviors, even after controlling for intelligence. Children with ADHD with autistic traits demonstrated significant differences in 6 of the 16 items of the social domain of the SCQ: 1) friendly chat; 2) eye gaze; 3) offering to share; 4) response to another child's approaches; 5) imaginative play with peers; and 6) group play. These children also had significant differences in 5 of the 13 items of the communication domain of this assessment: 1) stereotyped utterances; 2) inappropriate questions; 3) verbal rituals; 4) imitation deficit; and 5) imaginative play deficit.

Study by Mulligan and Colleagues (2009)

The study by Mulligan and colleagues (4) looked at a sample that consisted of 821 children with ADHD and 149 healthy controls. Subjects with an ASD diagnosis were excluded. This study also defined autistic traits using the Lifetime version of the SCQ, but a latent class analysis was also run on its 39 questions to determine if responses to the questionnaire identified one or more clusters of children within the ADHD group. The cluster analysis identified five clusters that corresponded with the following domains of the Autism Diagnostic Interview – Revised (12): Cluster 1: few or no symptoms of autism; Cluster 2: repetitive and stereotyped behaviors; Cluster 3: communication; Cluster 4: communication and social reciprocal interaction; and Cluster 5: all three domains. The authors measured the mean SCQ score for each cluster and then examined the size of the ADHD probands of the five clusters. The mean SCQ scores of ADHD probands in the clusters were as follows: Cluster 1: 2.24; Cluster 2: 10.22; Cluster 3: 7.04; Cluster 4: 13.58; and Cluster 5: 21.4. The mean SCQ score of healthy controls was 3.89. Cluster 1 consisted of 31% of the ADHD probands; Cluster 2 consisted of 22.5%, Cluster 3 consisted of 21%, Cluster 4 consisted of 18.5%, and Cluster 5 consisted of 7%. Although the exact prevalence of autistic traits in this sample of children with ADHD cannot be accurately determined, the formation of these clusters suggested a prevalence range of 7% (Cluster 5), as defined by the strictest criteria, to 48%, as defined by looser criteria (i.e., the sum of Clusters 2, 4, and 5 when the SCQ scores were higher than the mean) (see Figure 1, *C*). Subjects in Cluster 5 were also more likely to have

oppositional defiant disorder (ODD) (77%), conduct disorder (44%), and language disorder (25%).

Discussion

Our systematic review of the extant literature examined the prevalence and correlates of autistic traits in children with a clinical diagnosis of ADHD in whom a diagnosis of ASD had been explicitly excluded. Only three studies met our inclusion and exclusion criteria. The three studies encompassed 926 children with ADHD and reported a prevalence of autistic traits in the samples studied that ranged from 7% to 60%. In all three studies, children with ADHD who were afflicted with autistic traits had more severe illness and more dysfunction, particularly in the interpersonal domain.

Despite the varied assessment methods used to define autistic traits, all three studies identified a substantial prevalence of these traits among children with ADHD. This finding is particularly noteworthy considering that the investigators explicitly ruled out a diagnosis of ASDs. Taken together, these findings highlight that autistic traits are common among children with ADHD.

It is noteworthy that all three studies identified social and communication deficits associated with autistic traits in children with ADHD, even after controlling for the severity of the ADHD symptoms, intelligence, and other measures of psychopathology. Grzadzinski and colleagues (9) showed that children with ADHD with autistic traits had elevated scores for all SRS items, including items in the social, communication, repetitive, and restrictive behavior categories as well as the category of items that were not specific to ASDs. Similar findings of heightened deficits in social and communication profiles among children with ADHD with autistic traits were also reported by Kochhar and colleagues (10). It is of note that these authors failed to find other features of autism such as repetitive and stereotyped deficits, which suggests that autistic traits selectively identify a particular type of social and communication deficits. Taken together, these findings strongly suggest that the social and communication impairments in this sample of children with ADHD were not solely the results of the core symptoms of ADHD. Appropriate consideration of these different types of social and communication deficits in children with ADHD can improve efforts that are designed to help individualize therapeutic approaches to address such deficits in these patients.

Grzadzinski and colleagues (9) and Mulligan and colleagues (4) also reported that children with ADHD with autistic traits had higher levels of disruptive behavior disorders in general and of ODD in particular. These findings are consistent with the higher rates of disruptive behavior disorders identified in children with ASDs and comorbid ADHD as compared with children with ASDs without comorbid ADHD (20;21).

The finding of elevated rates of ODD among children with ADHD with autistic traits is also consistent with reports of increased social difficulties among children with ADHD and comorbid ODD (22;23). This is also consistent with the findings reported by Lundstrom and colleagues (6), who found that the presence of even low-grade autistic traits increased the risk of ADHD, conduct disorder, anxiety, and substance abuse among patient samples who were enrolled in nationwide epidemiological twin studies. Clearly more work is needed to further understand the three-way associations among ADHD, disruptive behavior disorders, and autistic traits. If some cases of ODD among youth with ADHD are mediated by the presence of ASD symptoms, this would likely have implications for treatment choices.

Although the reasons for the high prevalence of autistic traits among children with ADHD are not entirely clear, one explanation for their presence is that of shared genetic susceptibility between ADHD and ASDs. As mentioned previously, twin, family, and linkage studies have indicated that the two disorders share a portion of their heritable etiology (1-6;24). Smalley and colleagues (24) mapped the genetic linkage of ADHD to a 7-Mb region on chromosome 16p13 that had previously been highlighted in three genome scans for autism, thereby suggesting that variations in chromosome 16p13 may contribute to the common deficits found with both ADHD and autism. Similarly, the excessive frequency of large, rare copy number variations in chromosome 16p13 was reported for a well-characterized sample of patients with ADHD (25), and significantly enriched copy number variants for certain loci were implicated for autism in patients with ADHD (7). In a study by Lionel and colleagues (26), deletions of the neuronal ASTN2 gene and the ASTN2-intronic TRIM32 gene yielded the strongest associations with ADHD and ASD; this was in addition to deletions in other shared candidate genes, such as CHCHD3 and MACROD2, and in the 16p11.2 region. More work is needed to further investigate other etiological risk factors for the development of autistic traits in individuals with

ADHD and to examine whether autistic traits could represent an intermediate phenotype or endophenotype worthy of consideration in neurobiological and genetic studies of ADHD.

Our findings are tempered by some methodological shortcomings. Although when considered together the studies included a very sizeable number of children with ADHD (N = 926), because we were only able to identify three informative studies in our review, our conclusions need to be viewed as preliminary until they are confirmed in future studies. The studies examined excluded children who had been diagnosed with ASDs; however, these studies did not specifically state whether children who met the criteria for pervasive developmental disorder, not otherwise specified were specifically excluded. Because the rating scales used in these studies were developed for the detection of ASDs, it is possible that these studies may have included children with otherwise undiagnosed and previously undetected subsyndromal forms of ASDs as opposed to autistic traits. Because the different studies used different methods to identify autistic traits, it remains uncertain whether the definitions used captured the same constructs. Because the three studies relied on clinically ascertained samples, we do not know whether these findings will be generalizable to community samples.

Despite these considerations, our review of the literature indicates that a substantial minority of children with ADHD manifests autistic traits. Our review also indicates that the presence of autistic traits among children with ADHD heralds a more compromised social and communication environment for such children and that these traits are reminiscent of the social and communication impairments seen in children with ASDs. More work is needed to gain additional insights regarding the clinical and neurobiological implications of autistic traits in children with ADHD.

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Authors' Disclosures

Dr. Joseph Biederman is currently receiving research support from the following sources: APSARD, The Department of Defense, ElMindA, Janssen, McNeil, Shire, and VayaPharma/Enzymotec.*In 2013, Dr. Joseph Biederman* received an honorarium from the MGH Psychiatry Academy for a tuition-funded CME course. He has a US Patent Application pending (Provisional Number #61/233,686) through MGH corporate licensing, on a method to prevent stimulant abuse. Dr. Biederman received departmental royalties from a copyrighted rating scale used for ADHD diagnoses, paid by Shire and Sunovion; these royalties are paid to the Department of Psychiatry at MGH. *In 2012, Dr. Joseph Biederman* received an honorarium from the MGH Psychiatry Academy and The Children's Hospital of Southwest Florida/Lee Memorial Health System for tuition-funded CME courses. *In 2011, Dr. Joseph Biederman* gave a single unpaid talk for Juste Pharmaceutical Spain, received honoraria from the MGH Psychiatry Academy for a tuition-funded CME course, and received honoraria for presenting at international scientific conference on ADHD. He also received an honorarium from Cambridge University Press for a chapter publication. Dr. Biederman received departmental royalties from a copyrighted rating scale used for ADHD diagnoses, paid by Eli Lilly, Shire and AstraZeneca; these royalties are paid to the Department of Psychiatry at MGH. *In 2010, Dr. Joseph Biederman* received a speaker's fee from a single talk given at Fundación Dr.Manuel Camelo A.C. in Monterrey Mexico. Dr. Biederman provided single consultations for Shionogi Pharma Inc. and Cipher Pharmaceuticals Inc.; the honoraria for these consultations were paid to the Department of Psychiatry at the MGH. Dr. Biederman received honoraria from the MGH Psychiatry Academy for a tuition-funded CME course. *In previous years, Dr. Joseph Biederman* received research support, consultation fees, or speaker's fees for/from the following additional sources: Abbott, Alza, AstraZeneca, Boston University, Bristol Myers Squibb, Celltech, Cephalon, Eli Lilly and Co., Esai, FundacionAreces (Spain), Forest, Glaxo, Gliatech, Hastings Center, Janssen, McNeil, Medice Pharmaceuticals (Germany), Merck, MMC Pediatric, NARSAD, NIDA, New River, NICHD, NIMH, Novartis, Noven, Neurosearch, Organon, Otsuka, Pfizer, Pharmacia, Phase V Communications, Physicians Academy, The Prechter Foundation, Quantia Communications, Reed Exhibitions, Shire, the Spanish Child Psychiatry Association, The Stanley Foundation, UCB Pharma Inc., Veritas, and Wyeth.

Gagan Joshi, M.D. receives research support from Forest Research Laboratories and Duke University as a site principal investigator for multi-site clinical trials. He is a co-investigator for clinical trials sponsored by Schering-Plough Corporation, Shire, Elminda, and the US Department of Defense. In 2011, Dr. Joshi received research support from Shire, Johnson & Johnson Pharmaceutical Research and Development, Eli Lilly, Forest Research Laboratories, Schering-Plough Corporation, ElMinda, and NIMH. In previous years, Dr. Joshi received research support from the following sources: Ethel DuPont Warren Fellowship Award 2005-6**;** Pilot Research Award from the American Academy of Child and Adolescent Psychiatry 2005**;** National Institute of Mental Health (Reviewer and member of the NIMH Editorial Board)**;** McNeil Pediatrics (CME sponsored by SynerMed Communications)**;** Bristol Myers Squibb (Site PI for Multi-centered Trial)**;** Glaxo Smith Kline (Site PI for Multi-centered Trial)**;** Shire (Member of national advisory board)**;** Subinvestigator for clinical trials sponsored by Shire, Johnson & Johnson, Pfizer, Merck, Cephlon, McNeil, Eli-Lily, Abbott, Novartis, Bristol Myers Squibb, Organon, Otsuka, Takeda, & New River Pharmaceuticals.

In the past year, Dr. Faraone received consulting income and/or research support from Shire, Otsuka and Alcobra and research support from the National Institutes of Health (NIH). He is also on the Clinical Advisory Board for Akili Interactive Labs. In previous years, he received consulting fees or was on Advisory Boards or participated in continuing medical education programs sponsored by: Shire, McNeil, Janssen, Novartis, Pfizer and Eli Lilly. Dr. Faraone receives royalties from books published by Guilford Press: *Straight Talk about Your Child's Mental Health* and Oxford University Press: *Schizophrenia: The Facts*.

Mai Uchida, M.D., Andrea Spencer, M.D., Tara Kenworthy and K. Yvonne Woodworth have no financial disclosures.

Acknowledgements

This was supported by the Pediatric Psychopharmacology Council Fund. Dr. Amelia Kotte drafted the previous version of this manuscript.