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Journal of Attention Disorders 2011 15: 382 originally published online 21 May 2010
DOI: 10.1177/1087054710367772

Journal of Attention Disorders
15(5) 382–391

DOI: 10.1177/1087054710367772
http://jad.sagepub.com

Heterogeneity in the Pharmacological Treatment of Children With ADHD: Cognitive, Behavioral, and Social Functioning Differences

Paulo A. Graziano[1], Gary R. Geffken[1], and Ayesha S. Lall[1]

Abstract

Objective: To investigate the extent to which children with ADHD in various medication statuses (i.e., medication naïve, pure stimulant, stimulant plus another medication, nonstimulants) varied on cognitive or academic, behavioral, and social functioning during a psychoeducational assessment battery. **Method:** Participants for this study consisted of 66 children (20 girls) with a *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.) (*DSM-IV*) diagnosis of ADHD confirmed by a comprehensive clinical diagnostic assessment, including the use of a semistructured interview and Conners' Parent Rating Scales. Standardized cognitive and academic measures along with parent report of medication status, behavioral, and social functioning were collected. **Results:** No differences were found among children in the various medication groups in terms of ADHD symptoms severity, academic performance, processing speed, verbal abilities, or perceptual reasoning skills. However, children in the medication-naïve group performed significantly better than the stimulant-plus-another-medication and nonstimulant groups in terms of overall cognitive abilities, working-memory skills, and social adaptability but had similar scores to children in the pure-stimulant group. Children in the pure-stimulant group also had marginally higher working-memory scores compared to children in the nonstimulant group but not compared to the stimulant-plus-another-medication group. The pure-stimulant group also had significantly lower externalizing and internalizing problems and higher social adaptability compared to the stimulant-plus-another-medication group but not compared to the medication-naïve or nonstimulant groups. **Conclusion:** Findings showed evidence for distinct cognitive, behavioral, and social profiles among children with ADHD who are proactively not on medication, as well as differences among children with ADHD who are on only one stimulant versus a nonstimulant or stimulant-plus-another-medication regimen. (*J. of Att. Dis. 2011; 15(5) 382-391*)

Keywords

ADHD, medication status, cognitive, social, behavior, assessment

ADHD is one of the most common childhood psychiatric disorders with prevalence rates ranging from 3% to 7% worldwide (American Psychiatric Association, 2000; Polanzyk, de Limas, Horta, Biederman, & Rohde, 2007). The core symptoms of ADHD, consisting of inattention, hyperactivity, and impulsivity, are associated with significant impairment across children's academic, social, and familial functioning (Mash & Barkley, 2003). For example, children diagnosed with ADHD have been shown to underachieve in academic testing, have higher rates of co-occurring learning disabilities, and are more likely to be retained relative to their peers (see Raggi & Chronis, 2006, for a review). Within the social domain, peer rejection rates are significantly higher in children with ADHD relative to their peers (Hoza et al., 2005) and are further exacerbated by high rates, ranging from 30% to 50%, of comorbid behavioral disorders such as oppositional-defiant disorder (ODD) and conduct disorder (CD; Nijmeijer et al., 2008). The core features of ADHD also create significant challenges within the familial environment as lower rates of parental satisfaction and higher rates of conflict, stress, and negative parent–child relationship patterns are found among parents of children with ADHD (Anastopoulos, Guevremont, Shelton, & DuPaul, 1992; Johnson & Mash, 2001). Given these significant negative consequences associated with ADHD, along with its relatively chronic and persistent course into adulthood

[1]University of Florida

Corresponding Author:
Paulo Graziano, PhD, Department of Psychiatry, University of Florida, P.O. Box 100234, Gainesville, FL 32610
Email: pagrazia@ufl.edu

(Faraone, Biederman, & Mick, 2006), it is not surprising that significant resources have been allocated into establishing empirically validated treatments for children with ADHD.

Current clinical guidelines along with the most recent evidence-based-treatment research strongly support the use of stimulant medications for treating the core symptoms of ADHD (American Academy of Child and Adolescent Psychiatry, 2002, 2007; Brown et al., 2005; The MTA Cooperative Group, 1999). Stimulants such as methylphenidate decrease ADHD symptoms via an increase in the synaptic concentration of dopamine and norepinephrine (Seeman & Madras, 1998; Volkow et al., 2001). This type of treatment is also consistent with current theoretical and neurobiological notions suggesting that the etiology of ADHD may involve behavioral disinhibition or executive function deficits involving the prefrontal cortex and its connections, including striatal regions and associated dopaminergic and norepinephrine systems (Barkley, 1997; Durston, 2003). However, despite the efficacy of such stimulants, a significant portion (25%-30%) of children with ADHD do not respond well to these medications and/or have a difficult time tolerating some of the side effects such as loss of appetite and insomnia (Barkley, McMurray, Edelbrock, & Robbins, 1990; DuPaul, Barkley, & Connor, 1998).

Subsequently, a significant portion of children with ADHD are also placed on a secondary medication such as an alpha agonist, most notably Clonidine. Clonidine and Guanfacine are direct-acting alpha 2 adrenergic agonists that may enhance attention and cognition by increasing norepinephrine in the prefrontal cortex (Rosenberg, 2002). The efficacy of a combination of stimulant and alpha-adrenergic medications have been well established, especially to combat behavioral and sleep difficulties associated with ADHD (Prince, Wilens, Biederman, Spencer, & Wozniak, 1996). Combination treatment may also best fit the child with coexisting hyperarousal states and distractibility (Hunt, Capper, & O'Connell, 1990). Atypical antipsychotic medications (e.g., Risperidone) have also been used as an add-on treatment for ADHD symptoms, most notably when the child has severe co-occurring behavioral problems such as aggression and/or bipolar disorder (Biederman et al., 2008; Snyder et al., 2002).

Instead of adding another medication to a child's current stimulant regimen, a secondary line of treatment may involve the use of a nonstimulant medication such as Atomoxetine (i.e., Strattera). Antidepressant medications, including tricyclics and selective serotonin reuptake inhibitors (SSRIs; Wood, Crager, Delap, & Heiskell, 2007) are also used. SSRI agents may be more efficacious for reducing comorbid depression or anxiety disorders rather than ADHD symptoms. Tricyclics may be helpful as third- or fourth-line agents for ADHD treatment, although side effects can be limiting and they require EKG monitoring because of their cardiovascular profile (American Academy of Child and Adolescent Psychiatry, 2007). The efficacy of these nonstimulant medications in reducing ADHD symptoms have been established, especially when the child has a co-occurring mood disorder (Levitas & Hurley, 2005). The antiseizure or mood-stabilizing medication, Carbamazepine, has also received some attention as an alternative treatment in children with ADHD (Silva, Munoz, & Alpert, 1996), although double-blind placebo-controlled studies are needed.

Given such heterogeneity in pharmacological treatment (i.e., stimulant, stimulant-plus another medication, nonstimulants), it is crucial to compare the efficacy of such treatment options. Most medication comparison studies have focused on examining within-drug-class variation such as examining short-term versus long-term acting stimulants or differences in their derivatives such as methylphenidate compared to mixed amphetamine salts (Brown et al., 2005). For the most part, no differences have been found in terms of the effectiveness of different stimulant medications in controlling ADHD symptoms (American Academy of Child and Adolescent Psychiatry, 2007; McMaster University Evidenced-Based Practice Center, 1999). Although the efficacy of nonstimulant medications along with stimulant-plus-another-medication treatments on controlling ADHD symptoms have been shown (Wood et al., 2007), direct studies comparing these pharmacological treatments to more typical pure-stimulant medication treatments are lacking (Faraone, Biederman, Spencer, & Aleardi, 2006).

Although there is evidence that all of these pharmacological treatments reduce ADHD symptoms, it remains unclear to what extent these medications differ in terms of targeting other behavioral (e.g., externalizing or internalizing difficulties) and cognitive difficulties (e.g., working memory, academic achievement) typically associated with ADHD. It is also unclear to what extent children in various treatment options differ in terms of their adaptability to social situations. Lastly, although medication is an evidence-based treatment for children with ADHD, there is a significant portion of children with ADHD who are not placed on medication. For example, a national survey data by the Centers for Disease Control and Prevention (CDC) indicated that about 40% of children with a diagnosis of ADHD were not taking any psychotropic medication (CDC, 2005).

Various reasons have been cited for children with ADHD who are medication naïve, including their young age and parental hesitation (Blackman, 1999; Bussing, Gary, Mills, & Garvan, 2003). Most research with medication-naïve children with ADHD tend to focus on examining differences in brain functioning and structure compared to children without ADHD and/or the effects of medication on brain functioning and cognitive performance (Smith, Taylor, Brammer, Halari, & Rubia, 2008). Medication-naïve children with ADHD have also been an important aspect of randomized treatment

studies in which their families were open for medication use but ended up as a wait-list control or received community treatment. Not surprisingly, the medication-naïve children with ADHD who did not receive medication treatment were worse off on various outcomes, including core ADHD symptoms, compared to children with ADHD who received a pharmacological treatment (The MTA Cooperative Group, 1999). However, almost no research has examined children with ADHD who are proactively medication naïve with no immediate plans on obtaining pharmacological treatment. This subsample of children with ADHD who are theoretically managed well without medication deserves more attention in terms of understanding their cognitive, behavioral, and social profiles. Understanding what constitutes a successful medication-naïve group will have significant implications for not only evaluating ADHD but also for clinicians' ability to provide an alternative treatment option (e.g., behavioral therapy) that may fit this subsample of children as well as medication.

Thus, the primary goal of the current study was to examine the extent to which children in various medication statuses (i.e., medication naïve, pure stimulant, stimulant plus another medication, nonstimulants) vary on cognitive or academic, behavioral, and social functioning. It is important to note that, given the cross-sectional design of the current study, we are not examining the efficacy of the medication regimens but rather which regimens physicians tend to prescribe to children with ADHD and whether there are cognitive, behavioral, and psychological functioning differences among children in these various regimens. We expected that children in the proactive medication-naïve group to have the highest level of functioning across domains, as their parents' choice of not having them on medication, following an evaluation, may indicate that they feel like they are managing their children's symptoms adequately. This may ultimately indicate that children in the proactive medication-naïve group have less secondary problems associated with ADHD (e.g., academic or cognitive difficulties, externalizing or internalizing difficulties, social adaptability) and thus have an easier time being managed by parents. We expected similar adequate functioning across domains from children in the pure-stimulant group as previous research has shown that stimulant medication can improve children with ADHD's cognitive functioning such as their working memory (Bedard, Jain, Hogg-Johnson, & Tannock, 2007; Mehta, Goodyer, & Sahakian, 2004), short-term academic functioning (Raggi & Chronis, 2006), as well as social functioning (De Boo & Prins, 2007). Children with ADHD who are prescribed a single-stimulant medication may also be less likely to have co-occurring externalizing and internalizing difficulties.

Lastly, we expected that children in the stimulant-plus-another-medication group and the nonstimulant group to have the lowest levels of functioning across cognitive, behavioral, and social domains, compared to the medication-naïve and pure-stimulant groups. The use of a nonstimulant medication on its own or as an add-on treatment to a stimulant is typically recommended for children with ADHD who may also have comorbid behavioral or mood difficulties (Wood et al., 2007). ADHD children with such comorbidity may present with worsening cognitive and social functioning, compared to children with ADHD who can be managed without medication or with a single-stimulant medication.

Method

Participants

Participants for this study consisted of 66 children (20 girls) with a diagnosis of ADHD whose parents provided consent to participate in a psychoeducational assessment. These children were primarily referred from psychiatrists (79%) and pediatricians (11%). All participants had a primary *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994) diagnosis of ADHD ($n = 48$ for ADHD combined type and $n = 18$ for ADHD predominantly inattentive type) confirmed by a comprehensive clinical diagnostic assessment, including the use of a semistructured interview (e.g., diagnostic interview schedule for children) and Conners' Parent Rating Scales. Exclusionary criteria included a diagnosis of mental retardation, a pervasive developmental disorder (e.g., autistic disorder), or a psychotic disorder. The majority of participants were White (82%), about 9% were African American, 8% Hispanic, and 1% Biracial. Almost 43% of children were from an intact biological family, 33% were from a single-parent household, 15% were from a remarried household, and the last 9% were in an adoptive/foster-family placement. In terms of comorbidity, 27% of the participants had a secondary behavioral-disorder diagnosis (e.g., ODD, CD), 32% had an internalizing disorder (e.g., depression, anxiety), and 29% had a learning disability diagnosis (e.g., reading, mathematics, or written language).

Measures

ADHD symptoms. To assess children's current severity level of ADHD symptoms, the Revised Conners' Parent Rating Scale (Conners, Parker, Sitarenios, & Epstein, 1998) or the Conners' Parent Rating Scale, 3rd edition, were administered (Conners, 2008). The inattention and hyperactivity-impulsivity *t* scores were used in the present study.

Cognitive and academic functioning. To assess children's cognitive functioning, the Wechsler Preschool and Primary Scale of Intelligence–3rd Edition (WPPSI-3; Wechsler, 2002a) or the Wechsler Intelligence Scale for Children–4th Edition (WISC-IV; Wechsler, 2003) was administered,

depending on the age of the child, by trained clinical psychology doctoral students who were blind to the other study measures. The full-scale IQ, verbal IQ, performance IQ, processing-speed IQ, and working-memory IQ standard scores were used in the current study. To assess children's academic functioning, the Wechsler Individual Achievement Test–2nd Edition (WIAT-2; Wechsler, 2002b) or the Woodcock-Johnson–III (Woodcock, McGrew, & Mather, 2001) was administered by trained clinical doctoral students. The reading, written language, and mathematics broad/composite standardized scores were used in the current study.

Behavioral functioning and adaptive skills. To assess children's behavioral functioning and adaptive skills, parents completed the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992). The BASC is a widely used behavior checklist that taps emotional and behavioral domains of children's functioning. The parent version used for children aged between 2.5 and 5 years contains 109 items, whereas the version used for children aged between 6 and 18 years contains 148 items. Each item on the BASC is rated on a 4-point scale with respect to the frequency of occurrence (*never*, *sometimes*, *often*, and *almost always*). The measure yields scores on broad internalizing, externalizing, and behavior-symptom domains as well as specific adaptive skills scales. The BASC has well-established internal consistency, reliability, and validity (Doyle, Ostrander, Skare, Crosby, & August, 1997; Reynolds & Kamphaus, 1992). For the purpose of the present study, the externalizing and internalizing *t* scores were examined as measures of children's overall behavioral functioning, whereas the adaptability-scale *t* score was examined as a measure of children's overall social-adaptive skills.

Medication status. Children's medication status was inquired during the clinical interview as part of the psychoeducational assessment. Parents also filled out a demographic sheet that asked them to list their child's current medications and a medical records review was conducted when parents were not sure about which medications their children were taking.

Results

Data Analytic Strategy

Descriptive statistics for all study variables are presented in Table 1. All analyses were conducted using SPSS version 16.0. First, the medication-status groups were created and descriptive information was provided. Second, preliminary analyses focused on determining whether the medication-status groups differed on demographic variables as well as severity of ADHD symptoms. Lastly, the medication-status groups were compared in terms of their cognitive and academic performance as well as behavioral/social functioning. All available data were used for each analysis, with no significant differences in the proportion of missing data according to medication status or any demographic variable.

Medication-Status Groups

On the basis of the information gathered from parents as well as a medical-records review, we assigned children to four medication-status groups. The first group, labeled *medication naïve*, was composed of children who had never been on any type of psychotropic medication ($n = 10$), despite having had participated in a psychiatric or pediatric consultation in which medication was offered. The second group, labeled *pure stimulant*, was composed of children who were currently taking a stimulant medication but no other psychotropic medication ($n = 20$). Stimulant medications included Concerta ($n = 7$), Focalin ($n = 5$), Ritalin ($n = 4$), Vyvanse ($n = 1$), Adderall ($n = 1$), Daytrana patch ($n = 1$), and Metadate ($n = 1$). The third group, labeled *stimulant plus*, consisted of children who were currently taking a stimulant medication along with another psychotropic medication such as an SSRI, mood stabilizer, alpha agonist, or antipsychotic medication ($n = 17$). The last and fourth group, labeled *nonstimulant*, consisted of children who were currently taking a psychotropic medication that was not a stimulant ($n = 19$). This last group was composed of children taking Atomoxetine (Strattera, $n = 6$); an SSRI such as Lexapro, Zoloft, or Prozac ($n = 7$); an alpha-agonist medication such as Clonidine ($n = 2$); an atypical antipsychotic or mood-stabilizing medication such as Risperdal or Depakote ($n = 3$); and a norepinephrine dopamine reuptake inhibitor (Wellbutrin, $n = 1$). Preliminary analyses focused on determining whether these medication-status groups differed on any demographic variables, severity of ADHD symptoms, or ADHD subtypes.

First, preliminary analyses indicating an effect of age on medication-status group assignment, $F(3, 62) = 3.25$, $p < .05$. Specifically, younger children were more likely to be classified in the medication-naïve group compared to the stimulant-plus-another-medication and nonstimulant groups ($p < .05$). No differences in children's age were found among the medication-naïve group and pure-stimulant group ($p > .05$). There were also no age differences among the medication groups ($p > .05$). No other demographic differences were found. Lastly, there were also no significant differences in terms of severity of ADHD symptoms or ADHD subtypes among medication status groups. The profile of these four medication-status groups are presented in Table 2.

Cognitive Functioning Among Medication-Status Groups

To investigate whether the medication-status groups differed in terms of cognitive functioning, a MANOVA was

Table 1. Descriptive Statistics for All Variables

	M	*SD*	Min.	Max.	*N*
ADHD symptoms severity					
Inattention *t* score (P)	70.57	11.91	42	100	60
Hyperactivity-impulsivity *t* score (P)	69.80	17.05	10	110	60
Cognitive functioning					
Full-scale IQ (L)	94.86	13.84	58	126	65
Verbal scale score (L)	94.73	14.31	59	129	64
Perceptual-reasoning-scale score (L)	99.53	15.15	69	127	64
Processing-speed-scale score (L)	92.77	13.63	65	118	61
Working-memory-scale score (L)	94.21	14.41	56	132	52
Academic functioning					
Reading composite score (L)	97.94	10.39	74	124	53
Mathematics composite score (L)	96.57	13.13	77	138	53
Written-language composite score (L)	97.06	12.98	76	133	50
Behavioral and adaptive functioning					
Externalizing composite *t* score (P)	62.00	12.68	36	92	49
Internalizing composite *t* score (P)	58.92	15.38	35	97	49
Adaptability *t* score (P)	38.76	9.35	23	63	50

P = parent report; L = laboratory measure.

Table 2. Profile of Medication-Status Groups

	Medication naïve[a]	Pure stimulant[b]	Stimulant plus Another medication[c]	Nonstimulant[d]
Age in months	97 $(40)_{e}$	120 $(33)_{ef}$	142 $(43)_{f}$	142 $(52)_{f}$
Gender				
Male	8	13	12	13
Female	2	7	5	6
Race				
White	8	16	16	14
African American	1	2	1	2
Hispanic	1	2	0	2
Biracial	0	0	0	1
Comorbid learning disability				
Yes/No	1/9	4/16	7/10	7/12
Comorbid behavioral disorder				
Yes/No	2/8	4/16	6/11	6/13
Comorbid mood disorder				
Yes/No	1/9	1/19	9/8	10/9
ADHD-CT	9	13	13	13
ADHD-PI	1	7	4	6
Inattention *t* score (C)	66.6 $(12.4)_{e}$	73.1 $(13.9)_{e}$	71.2 $(11.1)_{e}$	70.8 $(11.0)_{e}$
Hyperactivity-impulsivity *t* score (C)	72.3 $(14.4)_{e}$	69.5 $(20.4)_{e}$	72.2 $(17.8)_{e}$	67.8 $(15.3)_{e}$

CT = combined type; PI = predominantly inattentive type; C = Conners' Parent Rating Questionnaire. Values enclosed in parentheses represent standard deviations. Means in the same row that do not share subscripts differ at $p < .05$.

[a] $N = 10$.

[b] $N = 20$.

[c] $N = 17$.

[d] $N = 19$.

conducted using the general linear modeling. The dependent variables were children's standardized full-scale IQ score, verbal composite score, perceptual-reasoning composite score, processing-speed composite score, and working-memory composite score. Medication-status group was the between-subjects variable. Children's age covaried in this

Table 3. Summary of Results Comparing Medication-Status Groups

	Medication naïve[a]	Pure stimulant[b]	Stimulant plus another medication[c]	Nonstimulant[d]
Cognitive functioning				
Full-scale IQ (L)	106.19 (5.35)$_{e}$	95.03 (3.11)$_{ef}$	88.23 (3.56)$_{f}$	93.25 (3.60)$_{ef}$
Verbal skills (L)	100.98 (5.60)$_{e}$	92.06 (3.26)$_{e}$	87.95 (3.73)$_{e}$	96.90 (3.78)$_{e}$
Perceptual reasoning (L)	112.12 (6.13)$_{e}$	100.20 (3.56)$_{ef}$	97.52 (4.08)$_{ef}$	96.65 (4.13)$_{f}$
Processing speed (L)	97.99 (5.56)$_{e}$	95.87 (3.24)$_{e}$	86.77 (3.71)$_{e}$	94.06 (3.75)$_{e}$
Working memory (L)	106.49 (5.44)$_{e}$	97.00 (3.16)$_{eg}$	89.73 (3.63)$_{fg}$	88.07 (3.67)$_{fg}$
Academic functioning				
Reading (L)	98.76 (5.66)$_{e}$	99.79 (3.26)$_{e}$	95.65 (3.40)$_{e}$	94.27 (3.40)$_{e}$
Mathematics (L)	104.96 (6.61)$_{e}$	97.38 (3.80)$_{e}$	92.35 (3.97)$_{e}$	92.46 (3.97)$_{e}$
Written language (L)	99.97 (6.68)$_{e}$	100.72 (3.84)$_{e}$	94.02 (4.02)$_{e}$	91.24 (4.02)$_{e}$
Behavioral/adaptive functioning				
Externalizing *t* score (P)	61.13 (5.0)$_{ef}$	58.25 (3.1)$_{e}$	69.23 (3.9)$_{f}$	61.10 (3.2)$_{ef}$
Internalizing *t* score (P)	61.96 (5.8)$_{ef}$	53.20 (3.7)$_{e}$	66.07 (4.5)$_{f}$	58.35 (3.8)$_{ef}$
Adaptability *t* score (P)	44.00 (10.3)$_{eg}$	43.00 (9.3)$_{eg}$	34.91 (7.6)$_{eg}$	34.50 (6.8)$_{fg}$

P = parent report; L = lab assessment. Values enclosed in parentheses represent standard deviations. Means in the same row that do not share subscripts differ at $p < .05$.
[a]$N = 10$.
[b]$N = 20$.
[c]$N = 17$.
[d]$N = 19$.

analysis, given its earlier relationship to medication-status group.

This analysis revealed a significant main effect for medication status group, $F(15, 116.4) = 1.75$, $p < .05$, $\eta = .15$, on the cognitive functioning measures. Follow-up individual ANOVAs indicated a significant effect for medication-status group on the working-memory composite score, $F(3, 46) = 3.21$, $p < .05$, $\eta = .17$, and a marginally significant effect on full-scale IQ, $F(3, 46) = 2.55$, $p < .07$, $\eta = .14$. No medication-status group effects were found for processing-speed, verbal, and perceptual-reasoning composites. Follow-up contrast tests, using Bonferroni's correction to control the Type 1 error rate, revealed that children in the medication-naïve group had significantly higher full-scale IQ scores compared to children in stimulant-plus-another-medication group ($p < .01$) and marginally higher scores compared to children in the pure-stimulant and nonstimulant groups ($p < .08$). No differences among the medication groups were found. In terms of working memory, follow-up contrast tests indicated that children in the medication-naïve group had significantly higher scores compared to children in the stimulant-plus-another-medication group ($p < .05$) and nonstimulant group ($p < .01$). No differences in working-memory scores were found between children in the medication-naïve group and children in the pure-stimulant group ($p > .05$). Children in the pure-stimulant group did have marginally higher working-memory scores compared to children in the nonstimulant group ($p < .08$) but not compared to the stimulant-plus-another-medication group ($p > .05$). There was also no difference in working-memory scores between children in the stimulant-plus-another-medication group and children in the nonstimulant group ($p > .05$). The estimated means for these analyses are depicted in Table 3.

Academic Functioning Among Medication-Status Groups

To investigate whether the medication-status groups differed in terms of academic functioning, a MANOVA was conducted using the general linear modeling. The dependent variables were children's standardized reading composite scores, mathematics score, and written-language composite score. Medication-status group was the between-subjects variable. Children's age covaried in this analysis, given its earlier relationship to medication-status group. This analysis revealed no significant differences among the medication status groups in terms of academic functioning, $F(9, 107.2) = .60$, $p > .05$. The estimated means for these analyses are depicted in Table 3.

Behavioral Functioning Among Medication-Status Groups

To investigate whether the medication-status groups differed in terms of behavioral functioning, a MANOVA was conducted using the general linear modeling. The dependent variables were children's overall externalizing and

internalizing *t* scores. Medication-status group was the between-subjects variable. Children's age covaried in this analysis, given its earlier relationship to medication-status group. This analysis revealed no significant differences among the medication-status groups in terms of behavioral functioning, $F(6, 86) = 1.30$, $p > .05$. It is important to point out that post hoc analyses did indicate that the stimulant-plus-another-medication group had significantly higher externalizing and internalizing problems compared to pure-stimulant group ($p < .05$) but not compared to the medication-naïve or nonstimulant groups. The estimated means for these analyses are depicted in Table 3.

Adaptive Functioning Among Medication-Status Groups

To investigate whether the medication-status groups differed in terms of adaptive functioning skills, an ANOVA was conducted using the general linear modeling. The dependent variable was children's adaptability *t* score. Medication-status group was the between-subjects variable. Children's age covaried in this analysis, given its earlier relationship to medication-status group. This analysis revealed a significant main effect for medication status group, $F(3, 46) = 3.58$, $p < .05$, $\eta = .19$, on children's adaptability scores. Follow-up contrast tests indicated that children in the medication-naïve group had significantly higher adaptability scores compared to children in the nonstimulant group ($p < .05$) and marginally higher scores compared to children in the stimulant-plus-another-medication group ($p < .08$). No differences in adaptability scores were found between children in the medication-naïve group and the pure-stimulant group ($p > .05$). Children in the pure-stimulant group had significantly higher adaptability scores, compared to children in the stimulant-plus-another-medication and nonstimulant groups ($p < .05$ and $p < .01$, respectively). No differences in adaptability scores were found between the nonstimulant and stimulant-plus-another-medication groups ($p > .05$). The estimated means for these analyses are depicted in Table 3.

Discussion

The purpose of the current study was to examine the extent to which children with ADHD in various medication statuses (i.e., medication naïve, pure stimulant, stimulant plus another medication, nonstimulant) differ in cognitive or academic, behavioral, and social functioning. This study attempted to address several gaps in the ADHD treatment literature. First, although there is evidence that these various pharmacological treatments reduce ADHD symptoms, direct studies comparing their effects had been missing (Faraone et al., 2006). Our results indicated that children across different medication groups (pure stimulant, stimulant plus another medication, nonstimulant) had similar levels of hyperactivity-impulsivity and inattention as reported by parents. This finding is consistent with work showing the efficacy of nonstimulant medications along with stimulant-plus-another-medication treatments in controlling ADHD symptoms (Wood et al., 2007). It also extends the literature by showing that children on a nonstimulant medication regimen or a stimulant-plus-another-medication regimen have relatively equal severity levels of ADHD symptoms compared to children on a single-stimulant medication. Given the cross-sectional aspect of this study, we cannot rule out the possibility that children receiving nonstimulant medication or a stimulant plus another medication may have had greater severity levels of ADHD symptoms to start but improved significantly with the medication.

It is important to note that children with ADHD who were in the proactively medication-naïve group also had similar severity levels of ADHD symptoms compared to the medication groups. This is an important finding, as most past research examining medication-naïve children with ADHD have found them to have worse ADHD symptoms compared to those with ADHD who receive pharmacological treatment (The MTA Cooperative Group, 1999). This may speak to the importance of understanding why a child with ADHD may not be on medication. There is likely a significant difference in children with ADHD who are not on medication because of lack of resources or who were waiting to be placed on medication compared to children with ADHD who, after an evaluation, are not placed on medication.

The second and main aspect of our study was to examine the extent to which children with ADHD in various medication statuses differ in terms of having secondary problems associated with ADHD such as behavioral (e.g., externalizing or internalizing difficulties), cognitive (e.g., working memory, academic achievement), and social adaptability difficulties. We expected that children with ADHD in the stimulant-plus-another-medication group and the nonstimulant group would have the lowest levels of functioning across cognitive, behavioral, and social domains compared to the medication-naïve and pure-stimulant groups. No differences among the medication statuses were found in terms of academic achievement, although all groups were achieving on grade level. Previous work had suggested that when stimulant medication can improve children's short-term academic functioning and in-class productivity, it does not seem to have a long-term academic effect in terms of standardized test performance (Raggi & Chronis, 2006). Although our cross-sectional data cannot speak to any observed improvement in children's academic functioning as a result of their medication status, it does add to the literature by showing that children with ADHD on a nonstimulant medication regimen or on a stimulant-plus-another-medication regimen

score just as well in reading, mathematics, and written language, compared to children with ADHD who are on a single-stimulant medication. Once again it is important to note that children with ADHD who were in the proactively medication-naïve group also scored as well as children in the medication groups.

In terms of cognitive functioning and consistent with our hypotheses, children in the medication-naïve group performed significantly better than the stimulant-plus-another-medication and nonstimulant groups in terms of overall cognitive abilities (i.e., full-scale IQ) and working-memory skills but had similar scores to children in the pure-stimulant group. There were not any significant differences among the three medication groups in terms of overall cognitive abilities. However, children in the pure-stimulant group did have marginally higher working-memory scores compared to children in the nonstimulant group but not compared to the stimulant-plus-another-medication group. There were also no differences among the groups in terms of processing speed, verbal abilities, or perceptual-reasoning skills. These results suggest that children with ADHD's overall cognitive abilities and working-memory skills may be important factors in terms of differentiating whether they are placed on pharmacological treatment or not. It is unclear how such factors may play a role in a parent or physician's decision to not pursue pharmacological treatment, as past studies have established that children with ADHD, regardless of their IQ score, experience significant impairment across settings (Antshel et al., 2008). It may be the case that such higher cognitive functioning creates the perception that the child's ADHD symptoms are not that severe and thus treatment is not as actively pursued. Our results also suggest that children in the pure-stimulant group perform as well as children who are medication naïve across cognitive tasks and better than children in the nonstimulant group in terms of working memory. This finding is consistent with recent studies, suggesting that methylphenidate can improve children with ADHD's working-memory abilities (Bedard et al., 2007; Mehta et al., 2004). It may also suggest an additional benefit to stimulant-based treatments compared to nonstimulant treatments.

Lastly, in terms of behavioral functioning and social adaptability, the pure-stimulant group had significantly lower externalizing and internalizing problems and higher social adaptability compared to the stimulant-plus-another-medication group but not compared to the medication-naïve or nonstimulant groups. Children in the medication-naïve group also had higher adaptability scores compared to children in the nonstimulant group. These results are consistent with previous work, suggesting that a single-stimulant treatment is best indicated for a child with ADHD who is not having secondary mood or disruptive-behavior difficulties (Brown et al., 2005). It also extends the literature by demonstrating the importance of obtaining an assessment on the child's social adaptive skills, as it may be another important marker to observe during the course of treatment or even as a way to determine the severity of the impairment of the child's ADHD symptoms.

In terms of this study's limitations, the cross-sectional aspect of our study prevents us from determining the extent to which these various pharmacological regimens have improved children's ADHD symptoms as well as their secondary symptoms within the cognitive, behavioral, and social domains. Thus, it is feasible that children in the stimulant-plus-another-medication group, though currently performing worse compared to the other medication groups, may have had in fact a greater level of improvement over time compared to the other groups. We also did not have data on the dose and exact length of time children were placed on these various pharmacological treatments. Future randomized-controlled medication trials would be needed to truly compare the efficacy of these various pharmacological treatments in reducing children with ADHD's secondary symptoms. It is also important to note that the sample we used was relatively small, especially for the medication-naïve group, which can limit the confidence and generalizability of our findings. Nevertheless, the current study does provide initial data suggesting distinct cognitive, behavioral, and social profiles among children with ADHD who are proactively not on medication, as well as differences among children with ADHD who are placed on only one-stimulant versus a nonstimulant or stimulant-plus-another-medication regimen. If confirmed in a larger sample, these results may have significant implication for clinical practice, as baseline assessments of children's cognitive, behavioral, and social functioning may aid pharmacological or nonpharmacological treatment choice.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interests with respect to their authorship or the publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

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Bios

Paulo A. Graziano, PhD, is a postdoctoral fellow in pediatrics/child psychology at the University of Florida, Department of Psychiatry. His child specialty clinical training has primarily focused on the assessment and treatment of children and adolescents with ADHD. His line of research focuses on understanding physiological (i.e., RSA suppression or vagal regulation), cognitive (i.e., executive functioning abilities), and behavioral aspects of self-regulation as predictors of child psychopathology (ADHD), social competence, and academic readiness. He has also examined how maternal factors facilitate the acquisition of self-regulation abilities.

Gary R. Geffken, PhD, is an associate professor of psychiatry at the University of Florida, with additional academic appointments in pediatrics and clinical and health psychology. His teaching, research, and clinical practice involve children and adolescents with a special emphasis on cognitive-behavioral therapy and psychological assessments. His research interests and previous publications have focused on treatment of obsessive-compulsive disorder and enuresis, as well as adherence and health status in children and adolescents with difficult-to-manage diabetes.

Ayesha S. Lall, MD, is an assistant professor of psychiatry at the University of Florida. She is also the training director of the University of Florida's child and adolescent psychiatry fellowship program. Her teaching, research, and clinical practice involve children and adolescents with ADHD/disruptive-behavior disorders, mood, and anxiety disorders, with a special emphasis on providing pharmacological treatment and behavioral interventions.