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Nonpharmacological Treatments for ADHD: A Meta-Analytic Review

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Abstract

Objective: The authors replicated and expanded on Fabiano et al.'s meta-analysis of behavioral treatments for ADHD, systematically comparing the efficacy of 7 nonpharmacological interventions. **Method:** A total of 14 controlled treatment studies conducted post-1994—evaluating behavior modification, neurofeedback therapy, multimodal psychosocial treatment, school-based programs, working memory training, parent training, and self-monitoring—were identified, primarily by searching electronic English-language databases. The results were meta-analyzed: mean-weighted effect sizes for the treatment outcomes of 625 participants (382 treatment, 243 controls) were calculated, and moderator analyses examined contributions of gender, ADHD subtype, and treatment "dosage" to outcome. **Results:** Behavior modification and neurofeedback treatments were most supported by this evidence. Interventions were generally more efficacious for girls, and least efficacious for the "combined" ADHD subtype. The authors found no dose or age effects. **Conclusion:** Based on the small, published literature, this study supports some nonpharmacological interventions for ADHD, and indicates directions for more evaluation research into psychological treatments. *(J. of Att. Dis. 2012; XX(X) 1-XX)*

Keywords

ADHD, meta-analysis

ADHD is a neurobiological disorder (Valera, Faraone, Murray & Siedman, 2007) commonly presenting in childhood and characterized by varying combinations of inattention, executive dysfunction, and behavioral disinhibition (American Psychiatric Association [APA], 1994; Barkley, 1997a, 1997b, 1998, as cited by Bridgett & Walker, 2006). Accordingly, ADHD has three subtypes: predominantly hyperactive-impulsive, predominantly inattentive, and combined (APA, 1994). To meet diagnostic criteria for ADHD, an individual must demonstrate seven or more symptoms, present for a minimum of 6 months and inappropriate for the age of the child, listed in either the "inattentive" or the "hyperactive and impulsive" categories of the *Diagnostic and statistical manual of mental disorders* (4th ed.; *DSM-IV*; APA, 1994) criteria for ADHD (Purdie, Hattie, & Carroll, 2002). Because of the high prevalence of ADHD and its negative impact on quality of life, ADHD is a major contributor to psychological morbidity and social disadvantage among children and adolescents: hence, the importance of evidence-based treatments and evaluation research.

Stimulant medication is the most widely used treatment for ADHD because, in general, it has higher response rates than psychological and other nonpharmacological interventions (Donnelly, Haby, Carter, Andrews, & Vos, 2004; Purdie, Hattie, & Carroll, 2002). However, stimulant medication is not always acceptable to parents, children, and clinicians, and it cannot always be used because of associated risks and problems, including the need for multiple doses each day (Donnelly et al., 2004) and negative side effects such as weight loss, shakiness, nausea, insomnia, lowered energy, gas, diarrhea, muscle tension, teeth grinding, oral dryness, loss of appetite, and rarely but importantly, sudden death due to cardiovascular problems (Peterson, McDonagh, & Fu, 2008; Purdie et al., 2002). In addition, for maximal symptom reduction and improvement of general functioning, treatment approaches that combine stimulant medication and nonpharmacologically based interventions have been recommended (Majewicz-Hefley & Carlson, 2007; Purdie et al., 2002). Consequently, there is an ongoing need for development and evaluation of psychological interventions in ADHD.

Psychological interventions employing behavioral and cognitive techniques have been shown to be effective in the treatment of ADHD in children in empirical studies (e.g., Drechsler et al., 2007; Hechtman et al., 2004;

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Hoath & Sanders, 2002; Miranda, Jarque, & Rosel, 2006; Miranda, Presentacion, & Soriano, 2002). A recent meta-analysis (Fabiano et al., 2008) confirmed the utility of psychological interventions but that study only considered behavioral interventions. Thus, further research is warranted.

Seven psychological interventions were evaluated in the present meta-analysis: behavior modification, neurofeedback, multimodal psychosocial treatment, school-based programs, working memory training, parent training, and self-monitoring. Behavior modification interventions adopt the principles of learning theory and operant conditioning, utilizing techniques such as positive and negative reinforcement, and punishment, to improve the child's behavior (Damico & Armstrong, 1996 in Purdie et al., 2002). In neurofeedback, a newer nonpharmacological therapy for ADHD which has been described as promising (Beauregard & Levesque, 2006; Kaduson & Finnerty, 1995), the individual is trained to control particular brainwave patterns using electroencephalographic technology, increasing beta activity while decreasing theta activity. This enhances attention and concentration, providing a physiological means of self-control (Beauregard & Levesque, 2006; Drechsler et al., 2007; Kaduson & Finnerty, 1995). School-based psychological interventions for ADHD integrate behavior modification and cognitive-behavior modification techniques, applying them in the classroom setting to assist teachers and students to gain control of behavior at school (Miranda et al., 2002, 2006). In parent training interventions, parents are taught to use strategies to gain greater control of children's behavior, and children are taught a set of skills to use at home to improve their behavior (Hoath & Sanders, 2002). Working memory training involves the training of working memory, using a computerized task that is specific to the person's skill level and accordingly becomes more difficult as the training progresses (Klingberg et al., 2005). Self-monitoring involves regular completion of a checklist of the behaviors one has, or has not, engaged in over time. Multimodal psychosocial treatments integrate a number of individual psychological interventions to target symptoms across multiple functional domains, such as behavioral, neuropsychological, and academic areas (Hechtman et al., 2004).

The present meta-analysis aimed to investigate which psychologically based interventions were most efficacious in the treatment of ADHD in children aged between 5 and 10 years old. We hypothesized greater efficacy for (a) interventions that combined a range of psychological treatment techniques, over unitary treatments; (b) interventions with older children, rather than younger children; and (c) treatments with more therapist contact measured in minutes, that is, a "dose effect."

Method

A comprehensive search of the PsycINFO and PubMed research databases was conducted to identify all studies of psychological treatments in children with ADHD. Search terms are listed in Table 1. The search was restricted to studies published between the 1994 release of the *DSM-IV* (APA, 1994) and 2009, because *DSM-IV* included new definitions and diagnostic criteria for ADHD (APA, 1994). Reference lists of relevant review articles were also examined, and one additional article was identified. After careful observation of the titles and abstracts of all papers identified, with the study inclusion and exclusion criteria in mind, 120 articles emerged as potential candidates for inclusion in the meta-analysis. Full texts were obtained either electronically, as hard copies from the university library, or by direct request to their authors. The 120 full texts were comprehensively reviewed against study eligibility criteria, resulting in a final sample of 14 eligible papers. Impact factors for the journals in which these 14 papers were published ranged from low (<1) to quite high (>8). Most had impact factors of 1 or 2 because this is common for psychology journals. The inclusion of articles from journals with a range of different impact factors is a positive step in synthesizing data representative of the field.

Table 1. Terms Used to Search the Electronic Database

Disorder terms	Treatment terms
Attention deficit hyperactivity disorder	Treatment[a]
Attention deficit disorder	Intervention[a]
ADHD	
ADD	

Note: ADD = attention-deficit disorder.
[a]These terms may be searched for as they are written, or in their plural forms.

For inclusion in the meta-analysis, studies needed to meet the following inclusion criteria: Their participants were aged less than 18 years, had IQs of 80 or higher, and had been diagnosed with ADHD. Studies were also required to report primary data, include a control group (thus minimizing placebo effects), have a sample size greater than one, be published in English, and provide pre- and posttreatment measures and statistics for calculation of effect sizes (i.e., *M*s and *SD*s, *t* tests or *F* tests). In the interests of comprehensiveness, we elected to include all studies that met these inclusion criteria, rather than rating and selecting among studies on the basis of study quality. Studies were excluded if the participants were aged more than 18 years, had IQs of 79 or lower, or had not received a diagnosis of ADHD; or if the study did not include a control group, reported secondary data, was a case study or published in a language other than English, reported only posttreatment measures, or did not include the necessary statistics for the calculation of effect sizes (and if the author had not provided these statistics when directly requested).

Because we were evaluating the efficacy of treatments in terms of their impact on ADHD specifically, studies containing participants with comorbid learning or psychiatric disorders, including conduct or oppositional defiant disorder, were excluded. Studies in which participants' medication regimes were not held constant, or were not ceased a minimum of 48 hr prior to testing, were also excluded.

Importantly, reports of any studies that shared the same sample were examined together. If they compared the same treatment and measured the same outcomes, the study that was most suitable in relation to our study criteria was selected for analysis, and the others were excluded. This ensured the independence of individual studies, maintaining the integrity of the meta-analysis. The inclusion of studies using within-subjects design has been encouraged in meta-analyses because using such designs reduces the amount of error attributable to individual differences when comparing groups (Hunter & Schmidt, 1990). However, we excluded studies using within-subjects designs because the data would not be directly comparable to the data from studies using independent-subjects designs.

Treatment outcome measures in ADHD, like treatments, are quite diverse. Published outcomes include, but are not limited to, *DSM-IV* diagnostic criteria, behavioral rating scales (for specific ADHD-related behaviors, or general behaviors), IQ, academic performance, and neuropsychological test performance. The studies included in our meta-analysis used a total of 20 outcome measures, in different combinations, and no individual study addressed all of these functional domains. These measures were hyperactivity, inattention, impulsivity, Conners' Parent Rating Scale (CPRS), Conners' Teacher Rating Scale (CTRS) Digit Span, IQ, Homework Problems Checklist (HPC), self-control, sociability, aggression, anxiety, antisocial behavior, and performance on the Matching Familiar Figures Test (MFFT).

Effect sizes were calculated using Cohen's *d* for each study and weighted by the inverse of the variance, according to the standard procedure outlined by Lipsey and Wilson (2001). Only the postdata from the pre–post study designs was used for the statistical calculations, consistent with the Cochrane recommendations (Higgins & Green, 2008). When calculating Cohen's *d* for each study, the data for the control group was subtracted from that of the experimental group. Thus, a positive effect size as represented in Tables 3 to 5 demonstrated a greater improvement in the experimental participants, whereas a negative effect size reflected better outcomes of control participants. The standard error was calculated according to the guidelines of Lipsey and Wilson for a mean difference (standardized) effect size (Figure 1). If a confidence interval included 0, that indicated a lack of significant difference between the treatment outcomes of experimental and control participants.

It is important to note that we included some effect sizes based on a single study in this meta-analysis. Because of the small number of studies meeting inclusion criteria, this deviation from the meta-analytic framework was considered necessary to gain a comprehensive understanding of the evidence.

Next, the mean weighted effect size was calculated for each of the seven ADHD treatments reviewed. A 95% confidence interval between the mean scores of the treatment and control groups was also calculated for each treatment. Fail-safe *N* statistics were calculated for each comparison, indicating how many unpublished studies with nonsignificant results would have been necessary to reverse the findings. The higher the fail-safe *N* is, the more confidence can be placed in the combined effect size.

Age, gender, *DSM-IV* diagnosis (ADHD subtype), and treatment dosage (total length, in minutes, of the intervention contact) were analyzed as moderator variables to determine whether they significantly influenced the effect sizes. Pearson's *r* correlations were calculated to assess the relationships, for each study, between mean weighted effect sizes and these moderator variables.

Results

Data from 625 participants in 14 separate studies were analyzed. In total, 382 participants received nonpharmacologically based interventions to treat ADHD, and 243 participants were in control groups, receiving no treatment (28.5%), or placebo or alternative treatment (17.9%), or being on a waiting list for treatment (35.7%). The nature of the control group was not described for some participants (17.9%). Additional participant information, such as age, gender, diagnosis, and medication status, is presented in Table 2.

As can be seen in Tables 3 through 5, two psychological interventions in particular most commonly resulted in improvement in the treatment group across a range of different outcome measures. These were neurofeedback treatment and behavior modification. Improvement was observed in the domains of hyperactivity, inattention, CTRS score, sociability and number of errors made on the MFFT for the behavior modification intervention and in inattention, self-control, and performance on the Digit Span test for the neurofeedback treatment.

To determine which of the interventions was most efficacious in the treatment of ADHD, their overall effect on outcome measures was examined. On that basis, neurofeedback treatment was the most efficacious, being associated with the largest positive average weighted effect size, and thus greatest improvement in the treatment group, for outcome measures combined, followed by the multimodal psychosocial intervention (see Table 6). The working memory training, behavior modification, school-based, parent training, and self-monitoring interventions, on the basis of average weighted effect size across the outcome measures, did not result in greater improvement in the treatment group in contrast to the control group, and thus cannot be deemed to be efficacious (see Table 6). When statistical significance

$$\text{ESstderr} = \frac{\text{ExperimentalN + ControlN}}{\text{ExperimentalN * ControlN}} + \frac{\text{ESestimate}^2}{\text{2*(ExperimentalN + ControlN)}}$$

Figure 1. Formula for the calculation of the standard error of the effect size

Table 2. Participant Demographic Characteristics

	Treatment						Control					
	n studies	Participant *n*	*M*	*SD*	Minimum	Maximum	*n* studies	Participant *n*	*M*	*SD*	Minimum	Maximum
Participants	14	382	27.3	17.9	8	69	14	250	17.9	9.5	5	34
Age in years	7	109	8.6	1.9	5.1	10.5	7	109	8.6	2.0	5.06	11.2
Gender (male)	10	186	16.1	7.9	6	29	10	152	13.3	7.7	5	30
Gender (female)	10	186	2.5	1.6	0	5	10	152	1.9	1.9	0	5
Type (combined)	4	74	14.8	5.9	9	22	4	81	16	12.0	7	33
Type (H-I)	4	74	0.25	—	0	1	4	81	0	—	0	0
Type (inattentive)	4	74	3.5	0.57	0	5	4	81	4.3	4.04	0	10
Medicated (present)	7	190	8	11.9	0	34	7	137	12.1	13.8	0	34
Medicated (past)	7	190	2.9	3.7	0	8	7	137	3	4.5	0	11

Note: *n* studies = number of studies; *n* participants = number of participants; H-I = hyperactive-impulsive type. For the missing fields, there were insufficient data to allow for the calculation of the necessary statistics.

Table 3. Treatment Effect Sizes Sorted by *DSM* Symptoms, Total ADHD Symptomatology and Neuropsychological Test Performance

Treatment	Measure	*n* studies	*n* participants	*M* ESw	*SD* ESw	95% CI lower	95% CI upper	Nfs
Behavior modification	Hyperactivity	1	86	0.61[a]	0.23	0.38	0.83	11
School based	Hyperactivity	2	100	−0.57	0.30	−0.81	−0.33	0
Neurofeedback	Hyperactivity	3	113	−0.51	0.35	−0.91	−0.11	0
Parent training	Inattention	1	20	−0.54	0.46	−1.17	0.10	0
School based	Inattention	2	100	−0.52	0.30	−0.81	−0.23	0
Behavior modification	Inattention	1	86	0.52[a]	0.23	0.07	1.0	2
Neurofeedback	Inattention	4	100	0.46[a]	0.45	0.02	0.90	8
Working memory training	Inattention	1	53	0.03	0.28	−0.42	0.35	0
Behavior modification	Impulsivity	1	86	0.42	0.23	−0.03	0.87	1
Neurofeedback	Impulsivity	3	115	0.38	0.37	−0.04	0.79	5
Behavior modification	CPRS total	1	43	−1.53	0.36	−2.25	−0.82	0
Neurofeedback	CPRS total	1	30	0.08	0.37	−0.64	0.80	0
Behavior modification	CTRS total	1	86	0.95[a]	0.24	0.48	1.42	4
School based	CTRS total	2	100	−0.57	0.30	−0.98	−0.16	0
Neurofeedback	CTRS total	1	30	−0.30	0.37	−1.03	0.42	0
Neurofeedback	Digit Span	1	20	0.95[a]	0.24	0.48	1.42	4
School based	Digit Span	1	50	0.74	0.53	−0.30	1.78	3
Working memory training	Digit Span	1	53	0	0.29	−0.56	0.56	0

Note: *n* studies = number of studies; *n* participants = number of participants; ES_w = weighted effect size; CI = confidence interval; Nfs = fail-safe *N*; CPRS = Conners' Parent Rating Scale; CTRS = Conners' Teacher Rating Scale.
[a]Statistically significant results that signify greater improvement in the experimental group than in the control group.

Table 4. Treatment Effect Sizes for IQ and Academic Ability

Treatment	Measure	*n* studies	*n* participants	*M* ESw	*SD* ESw	95% CI lower	95% CI upper	Nfs
Behavior modification	FSIQ	1	86	−0.57	0.23	−1.03	−0.12	0
Neurofeedback	FSIQ	1	34	0.18	0.36	−0.53	0.88	0
Behavior modification	PIQ	1	86	−0.82	0.24	−1.29	−0.36	0
Neurofeedback	PIQ	1	34	0.08	0.36	−0.62	0.78	0
Behavior modification	VIQ	1	86	−0.36	0.23	−0.81	0.09	0
Neurofeedback	VIQ	1	34	0.24	0.36	−0.47	0.95	0
Behavior modification	Reading	1	86	−0.09	0.23	−0.54	0.36	0
Multimodal psychosocial	Reading	1	103	−0.04	0.21	−0.45	0.37	0
Behavior modification	Math computation	1	86	−0.17	0.23	−0.62	0.28	0
Multimodal psychosocial	Math computation	1	103	0.12	0.21	−0.29	0.54	0
Multimodal psychosocial	Spelling	1	103	0.29	0.21	−0.13	0.70	0
Behavior modification	Spelling	1	86	−0.18	0.23	−0.63	0.26	0
Self-monitoring	HPC total	1	42	−5.91	0.72	−7.33	−4.50	0
Multimodal psychosocial	HPC total	1	103	−0.03	0.21	−0.44	0.38	0

Note: *n* studies = number of studies; *n* participants = number of participants; ES_w = weighted effect size; CI = confidence interval; Nfs = fail-safe *N*; FSIQ = full scale IQ. PIQ = performance IQ; VIQ = verbal IQ; HPC = Homework Problems Checklist.

Table 5. Treatment Effect Sizes for Behavior and Neuropsychological Test Performance

Treatment	Measure	*n* studies	*n* participants	*M* ESw	*SD* ESw	95% CI lower	95% CI upper	Nfs
School based	Self-control	1	50	–0.74	0.30	–1.32	–0.16	0
Neurofeedback	Self-control	1	63	0.63[a]	0.27	0.10	1.17	2
Behavior modification	Sociability	1	86	0.50[a]	0.23	0.04	0.95	1
Neurofeedback	Sociability	1	63	0.13	0.27	–0.40	0.65	0
School based	Aggression	2	100	0.09	0.31	–0.26	0.45	0
Behavior modification	Aggression	1	86	0	0.23	–0.45	0.45	0
Parent training	Anxiety	1	20	–0.47	0.79	–1.36	0.43	1
School based	Anxiety	1	50	–0.46	0.29	–1.03	0.11	0
Behavior modification	Anxiety	1	86	0.21	0.23	–0.05	0.47	2
School based	Antisocial behavior	1	50	–0.32	0.29	–0.89	0.24	0
Behavior modification	Antisocial behavior	1	86	0.23	0.23	–0.22	0.68	0
Behavior modification	MFFT errors	1	86	0.72[a]	0.23	0.26	1.18	3
School based	MFFT errors	1	50	0.11	0.29	–0.45	0.68	0
School based	MFFT latency	1	50	–0.35	0.29	–0.92	0.21	0
Behavior modification	MFFT latency	1	86	–0.22	0.23	–0.66	0.23	0

Note: *n* Studies = number of studies; *n* Participants = number of participants; ES_w = weighted effect size; CI = confidence interval; Nfs = fail-safe *N*; MFFT = Matching Familiar Figures Test.
[a]Statistically significant results that signify greater improvement in the experimental group than in the control group.

rather than mean weighted effect size was considered, a different pattern emerged: behavior modification and neurofeedback treatment produced statistically significant improvement in the treatment group across five and three different outcome measures, respectively.

Moderator analyses for the contributions of gender, age, diagnosis, and dosage to outcome effect sizes revealed statistically significant correlations between gender and mean weighted effect size: a positive relationship ($r = .57$, $p = .03$) for females, and a negative relationship for males ($r = −.79$, $p < .01$). This was done by correlating the number of males and females in the study with the mean effect size, and suggested that in general the treatments were more efficacious for girls than for boys. The correlation between

Table 6. Ranking of the Psychologically Based Interventions for ADHD, on the Basis of the Average Weighted Effect Size, Across the 20 Outcome Measures

Psychological intervention	Average weighted effect size	Ranking number
Neurofeedback	0.21	1
Multimodal psychosocial	0.09	2
Working memory training	−0.02	3
Behavior modification	−0.03	4
School based	−0.26	5
Parent training	−0.51	6
Self-monitoring	−5.91	7

mean age and mean weighted effect size was not statistically significant (r = .36, p = .48). Similar to gender, this was analyzed via correlation of the number of participants in each subtype and the mean effect size. ADHD subtype did have some influence on treatment efficacy. Compared with other subtypes, ADHD combined type had a significantly lower mean weighted effect size for outcome measures (r = −.76, p = .03). In contrast, the mean weighted effect size for predominantly inattentive type ADHD did not differ from that for other subtypes (r = .29, p = .58). No correlation could be produced for the hyperactive-impulsive ADHD subtype because there was only one relevant study in our sample. Finally, the relationship between intervention "dosage" (total therapist contact, in minutes) and the mean weighted effect size was not statistically significant (r = .38, p = .14).

Discussion

Our first hypothesis, that the multicomponent interventions combining a number of psychological treatment techniques would be more efficacious, was not confirmed. Effect sizes for the multicomponent treatments (parent training, and the school-based and multimodal psychosocial interventions) were distributed evenly among those of the seven treatments, rather than ranking in the top positions. However, not one of these three multicomponent interventions resulted in statistically significant improvement in the treatment group. Similar to the first hypothesis, the second hypothesis that psychological treatments for ADHD would be more efficacious for older children was also not confirmed, due to the lack of any statistically significant relationship between greater age and the efficacy of the treatments. Finally, there was also no statistically significant relationship found between greater number of hours of treatment and its efficacy, thus allowing for disconfirmation of the third hypothesis.

Consistent with Fabiano et al. (2008), our results suggest that behavior modification is efficacious in the treatment of ADHD in children, improving functioning across a number of domains—including symptoms, behaviors, and neuropsychological test performance. On the basis of this study, behavior modification could be recommended as an effective intervention for the treatment of ADHD in children.

Claims within the literature that neurofeedback is a promising intervention for treatment of ADHD (Beauregard & Levesque, 2006; Drechsler et al., 2007) also received support from our results. Neurofeedback treatment resulted in statistically significant improvement in *DSM-IV* symptoms, neuropsychological test performance, and behavior. Therefore, it can be claimed that neurofeedback is efficacious in reducing the symptoms of ADHD in children and it too can be recommended as an evidence-based intervention in this context.

No statistically significant benefit was established for the school based, parent training, working memory training, self-monitoring, or multimodal psychosocial treatment interventions across any of the measured ADHD functional domains. This is contrary to past findings for each of these treatments (Hechtman et al., 2004; Hoath & Sanders, 2002; Klingberg et al., 2005; Meyer & Kelley, 2007; Miranda et al., 2002, 2006). Although our results do not support recommendation of these treatments as efficacious methods for the treatment of ADHD in children, we acknowledge that ours is a single meta-analysis utilizing a small data set. Future research combining more rigorous studies may invalidate this conclusion, and support the use of these interventions. Moreover, because statistical significance does not imply clinical significance, despite the lack of statistically significant improvements, clinically significant improvements may have occurred.

Three specific hypotheses were investigated by this study. These were that interventions that combine a range of psychological treatment techniques will be most efficacious, that interventions will generally be more efficacious for older children, and that the greater the total intervention "dosage," the more efficacious the treatment will be. None of these hypotheses was confirmed by the data. Fabiano et al. (2008) found the same statistically nonsignificant effects for age and treatment duration. However, as noted by Fabiano et al., it is possible that although the length of the treatment sessions may not significantly influence the efficacy of the intervention, the intensity of the intervention may be more relevant. Total duration of the treatment (over weeks, months, or years) may also have an impact. Such information needs to be collected and reported in primary research, so that it can be included in future meta-analyses. It is also important for primary researchers to collect outcome data across all the major functional domains affected by ADHD, using well-accepted outcome measures to reduce the inherent bias of selective measurement and allow new treatment outcome studies to be compared directly, and comprehensively, with each other.

In general, psychological treatments for ADHD were found to be more efficacious when used with girls than with boys, in the included studies. This may be because females with this disorder tend to exhibit lower levels of ADHD symptoms (Purdie et al., 2002). Psychological interventions had the least benefit for children with the combined-type ADHD diagnosis, but differences between the other subtypes were less apparent and/or unanalyzable within our data set. It is possible that children with combined-type ADHD experience more, or more severe, symptoms and more dysfunction. Future primary studies could usefully include a global measure of disability or illness severity, which may help clarify some of our findings such as the apparent effects of gender and ADHD subtype on treatment outcomes.

A major limitation of our meta-analysis arose from our decision to focus on studies comparing treatment and control groups, while excluding all studies using within-subjects designs. While minimizing the influence of placebo effects, this reduced the total number of studies. Future researchers could consider conducting separate but parallel meta-analyses to take advantage of all the available data without confounding the study designs. The lack of consideration of a pre-treatment baseline assessment is another limitation of the present study. Baseline testing should be considered in future research: It allows for individual differences and abilities to be taken into account, before attributing between-groups differences after treatment to the effects of treatment.

In addition, including all studies that conformed to the stringent inclusion criteria of this meta-analysis reduced the number of studies eligible for inclusion. An alternative approach for future research is to weight studies according to study quality. This would allow more of the existing literature to be statistically reviewed. It is also important to note that our primary search method utilized electronic databases (supplemented by inspection of reference lists of published empirical and review articles). Because we specified 1994 as the earliest publication year, it is unlikely that many relevant papers were invisible to electronic database searching, but it remains possible that we missed one or more eligible papers. Reference lists of reviews and included papers were searched for additional papers to reduce the likelihood of missing eligible studies. Finally, we were unable to include non-English-language databases and studies, due to lack of funds for translation. Ideally, all relevant studies, whether published in English or not, would be located, and translated if necessary, allowing the entire universe of research on the topic to be included in the meta-analysis. This indicates a possible direction for future, perhaps grant-funded, research. To conclude, this meta-analytic study provides initial evidence that nonpharmacological treatments have considerable potential in the treatment of children with ADHD and that more and better outcome research is necessary.

Declaration of Conflicting Interests

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Bios

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