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Effectiveness of Clinic-Based Brief Behavioral Intervention (BBI) in Long-term Reduction of ADHD Symptoms Among Preschoolers

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Abstract

Preschoolers commonly experience symptoms of ADHD and disruptive behavior problems. Behavioral parent management training (PMT) is an evidence-based intervention for addressing both ADHD and disruptive behaviors in this population; however, many PMT programs are burdensome in length and have limited data regarding long-term effectiveness for ADHD specific outcomes. This study examined outcomes up to 1 year following completion of a brief behavioral intervention ($M = 6.51$ sessions) for preschoolers. Participants were children aged 2–6 years with clinically significant disruptive behaviors and their parents. Results demonstrated significant improvements in parent-reported child hyperactivity and inattention from pre-to-post intervention, with sustained improvement at 6 months and 1 year post intervention. Teacher-reported hyperactivity and inattention also showed significant improvements from pre-to-post intervention, which were maintained across time points. These results were also found among a subset of participants with clinically significant ADHD symptoms at baseline. This study highlights the long-term effectiveness of a brief PMT program to address symptoms of ADHD and disruptive behaviors in preschoolers. Findings support the recommendation to offer PMT as a first-line intervention for preschoolers with ADHD symptoms to reduce the need for early intervention with stimulant medication and address comorbid disruptive behaviors.

Keywords Parent management training · Behavioral intervention · Preschool · ADHD · Disruptive behavior

Introduction

In preschool-age children, Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms are among the most common presenting concerns in pediatric primary care and mental health clinics (Leslie et al., 2000). The DSM-5 criteria for ADHD include two separate symptom clusters: inattention and hyperactivity/impulsivity (American Psychiatric Association, 2013). In the broad population of typically developing preschoolers, these symptoms are fairly common, though hyperactivity and impulsivity are more prevalent than inattention (Smidts & Oosterlaan, 2007). Preschoolers with a clinical diagnosis of ADHD exhibit significantly more impairment related to these symptoms, and they are more likely to demonstrate difficulties with both inattention and hyperactivity/impulsivity (Martel et al., 2016). The literature supports that a diagnosis of ADHD can be reliably made in preschool-age children when developmental norms are taken into account, with persistence of symptoms into middle childhood and adolescence (Law et al., 2014).

Importantly, preschoolers with ADHD are highly likely to exhibit comorbid problems with oppositional behaviors (Harvey et al., 2016), such as outbursts, refusal to follow instructions, aggression, and irritable mood. The diagnosis of ADHD in preschool-age children may sometimes be clouded by the presence of oppositional behaviors due to overlap in symptoms and difficulty ascertaining the causal source of the presenting problem (e.g., failure to follow through with instructions due to either inattention or oppositional defiance) (American Psychiatric Association, 2013; Harvey et al., 2016). Young children with ADHD are more likely to present for clinical services when they also demonstrate oppositional behaviors (Novik et al., 2006), thereby indicating the importance of accurate diagnostic assessment and a treatment approach that addresses both areas of concern. Additionally, it is often helpful to defer a diagnosis of ADHD in preschoolers until after treatment completion to minimize the influence of oppositionality on symptom ratings of inattention and hyperactivity/impulsivity.

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Young children with ADHD most often present first to their pediatricians for diagnosis and treatment (Rushton et al., 2004; Visser et al., 2015). Diagnosis is typically made through a clinical interview and standardized measures administered to multiple informants. At times, young children are referred to mental health professionals for a more thorough assessment of symptoms, especially when other potential concerns are present (e.g., disruptive behavior, anxiety, or mood).

The American Academy of Pediatrics recommends behavioral intervention (e.g., parent behavior management training), as the first-line treatment for ADHD in children under 6 years old (American Academy of Pediatrics, 2011). Stimulant medication is recommended for preschoolers with ADHD only if there is not significant improvement in inattention and hyperactivity/impulsivity symptoms following behavioral intervention, and moderate-to-severe impairment persists (American Academy of Pediatrics, 2011). Behavioral intervention is also strongly supported as the treatment of choice for disruptive behaviors (Comer et al., 2013), which is critical for preschoolers presenting with symptoms of disruptive behavior in addition to core symptoms of ADHD.

While stimulant medication has demonstrated effectiveness in treating ADHD, these medications may be less effective in preschoolers compared to school-aged children, according to data from the Preschool ADHD Treatment Study (PATS; Greenhill et al., 2006). Providing behavioral intervention prior to prescribing stimulants has been shown to increase parental engagement in behavioral intervention and result in greater reduction of disruptive school behavior and lower doses of stimulant medication necessary to achieve significant reduction in symptoms (Pelham et al., 2016). Parent behavioral intervention is an efficacious treatment for ADHD in preschoolers (Mulqueen et al., 2015) and may also be more cost effective than medication management (Page et al., 2016). Given concerns about adverse side effects and poor adherence to stimulant medication (Gajria et al., 2014), behavioral treatment may offer fewer risks for families of preschool-age children with ADHD. Notably, adverse side effects of stimulant medication occur at high rates in preschoolers (Ghuman & Ghuman, 2013). Furthermore, behavioral intervention may have a broader impact than stimulant medication, which is time-limited in its effect and does not address additional behavior problems, such as oppositionality (Rajeh et al., 2017).

The goals of parent behavior management training (PMT) include increasing desirable child behaviors, reducing disruptive child behaviors, and improving parent–child interactions. These goals may apply to preschoolers with ADHD by targeting increased focus and compliance, while also managing hyperactive-impulsive behaviors through the use of effective parenting strategies. Most existing PMT interventions range in length from approximately 10–20 sessions. Treatment typically includes psychoeducation about child development and behavioral theory; introduction of strategies to increase rewarding parent–child interactions (e.g., child-directed play), promotion of desirable behaviors (e.g., praise and rewards), establishing rules and structure (e.g., effective commands), and implementation of consistent use of discipline strategies to reduce misbehavior (e.g., active ignoring and time out from reinforcement); and both modeling by the therapist and role-playing/practicing behavioral strategies.

Although most behavioral intervention research does not specifically report ADHD outcomes, particularly among preschoolers, there is some promising evidence. The Incredible Years program has demonstrated post-treatment reductions in parent-rated inattention and hyperactivity, following a 20-week combined parent and child group intervention (Webster-Stratton et al., 2011), with maintenance of outcomes at 12- and 18-month follow-ups (Jones et al., 2008). In another study of an eight-session home-based behavioral intervention, as compared to a clinic-based intervention, results showed that treatment in both settings produced post-treatment changes in parent-rated ADHD symptoms, some of which were sustained at follow-up; however, teacher ratings and objective observations did not corroborate these outcomes, suggesting parental bias in reporting treatment effects (Abikoff et al., 2015). Yet another common behavioral treatment, Parent–Child Interaction (PCIT), while well studied in populations of preschoolers with ADHD (Wagner & McNeil, 2008) has not been evaluated on a large scale for outcomes with regard to inattention and hyperactivity/impulsivity. Instead, disruptive behaviors are most often the primary treatment outcome in studies of PCIT. Some preliminary evidence indicates that PCIT may be effective in reducing attention problems among preschoolers with ADHD in an average of about 17 sessions (Leung et al., 2017). Given the limited present literature, measurement of specific symptoms of inattention and hyperactivity/impulsivity is necessary to demonstrate that behavioral treatments effectively address core symptoms of ADHD in preschoolers.

In the Preschool ADHD Treatment Study (PATS), an intensive 10-week course of behavioral intervention for preschool-age children diagnosed with ADHD demonstrated initial declines in symptoms for one-third of child participants (Lubberstedt et al., 2007); however, the vast majority of preschoolers with moderate-to-severe ADHD who received parent behavior management training continued to meet criteria for ADHD based on parent and teacher reports at 6-year follow-up (Riddle et al., 2013). While this evidence appears disheartening, it perhaps highlights the persistence of ADHD as a neurodevelopmental diagnosis. Still, meaningful gains have been demonstrated at shorter intervals, which may have the benefit of delaying the need for stimulant medication.

Present Study

The purpose of this study is to examine the maintenance of parent-reported ADHD outcomes of the Brief Behavioral Intervention at 6-months and 1-year post-intervention in a sample of preschoolers with significant behavioral difficulties, as well as to examine post-intervention teacher-reported ADHD outcomes within the school setting. The Brief Behavioral Intervention (BBI; Axelrad & Chapman, 2016) is a manualized PMT program aimed at treatment of disruptive behavior among preschoolers. BBI was designed specifically to have fewer sessions to limit treatment attrition associated with attending many repeated sessions. It was also conceptualized to be easily implemented in hospital and outpatient settings, while allowing flexibility to address individual concerns. Research hypotheses are that (1) children who participate in BBI treatment will demonstrate a clinically significant reduction in parent-reported symptoms of inattention and hyperactivity, (2) parent-reported treatment gains will be maintained over time, (3) reduction in symptoms of inattention and hyperactivity will also be present in the school setting, and (4) teacher-reported treatment gains will be maintained over time.

It is also hypothesized that preliminary analyses of children with clinically significant parent-reported ADHD symptoms at baseline will also (1) demonstrate a clinically significant reduction in parent-reported symptoms of ADHD, (2) demonstrate a significant reduction in parent-reported impairment, (3) that these treatment gains will be maintained over time, and (4) reduction in ADHD symptoms will also be present in the school setting.

Methods

Brief Behavioral Intervention (BBI)

The rationale and session content for BBI are thoroughly detailed in the treatment manual (Axelrad & Chapman, 2016). BBI is rooted in behavioral theory and consists of five core sessions, each of which includes introduction and practice of a specific behavioral management skill. The first session focuses on identification of antecedents and consequences of problem behavior within the child's daily routine, following which parents are encouraged to adopt developmentally appropriate expectations and routines while keeping a weekly behavior log. The second session introduces child-directed play, with opportunities for modeling and practice. Parents are encouraged to spend some time each day engaging in this type of play with their child. In the third session, parents learn about behavioral reinforcement, specifically labeled praise for positive or neutral behaviors and active ignoring of attention-seeking negative behaviors, and the therapist provides modeling and coaching opportunities. Parents are taught that consistently shifting their attention toward positive behaviors and reducing attention to problem behaviors will increase desired prosocial behaviors (e.g., independent play, politeness) and decrease disruptive behaviors (e.g., interrupting, whining, tantrums). The fourth session focuses on teaching parents to use effective commands and reduce use of yelling, repeated questions, and nagging, to increase child compliance. Finally, in the fifth session, time out is introduced as a discipline strategy for aggression, and the therapist models how to utilize time outs effectively. Parents are encouraged to eliminate other discipline strategies they may be using, such as corporal punishment. Importantly, session content is individualized across treatment to address specific concerns presented by the family. For example, parents may be coached to praise and ignore ADHD-related target behaviors (e.g., praise for focusing or staying in the seat, and ignoring interrupting) and break down commands into small steps to accommodate the child's needs and increase likelihood of compliance.

BBI sessions are conducted on a weekly basis with sessions lasting approximately 50 min each. To complete treatment, all skills must be introduced, and a parent must indicate that treatment goals were met to their satisfaction. Following completion of the core sessions, families are offered follow-up sessions when they need extra guidance in use of a particular skill, as evidenced by difficulty with that skill or continued difficulty with a specific child problem behavior, based on parent report or observation. Follow-up sessions could also be offered if the family requires assistance with applying the behavioral management strategies to additional areas of concern (e.g., sleep problems, toilet training). These follow-up sessions generally occur one to 2 weeks following the last of the core sessions. Booster sessions may be provided more than 1 month following completion of treatment, at a family's request, to address maintenance of parental use of behavioral management strategies and any changes in child behavior.

Clinicians providing BBI include advanced psychology graduate students, interns, postdoctoral fellows, and attending psychologists. All clinicians receive live supervision from a licensed clinical psychologist or postdoctoral fellow, as well as consultation from other team members who observe sessions. Individual supervision by a licensed clinical psychologist is also provided to all trainees. Prior to providing the intervention, all clinicians are required to demonstrate competency in delivering the intervention using a standardized checkout procedure for each core session (Axelrad & Chapman, 2016). Live supervision further ensures treatment fidelity, and clinicians are required to take a 2–5 min break about halfway through each session

to receive feedback from a licensed psychologist or post-doctoral fellow.

Participants

Institutional Review Board approval was obtained for this study. Participants in the BBI program are children between the ages of 2–6 years old (M = 4.67, SD = 0.96) and their families, who presented to our clinic via self-referral or referral from another medical provider (e.g., pediatrician). Following a diagnostic intake, study eligibility was determined by completion of baseline measures prior to the first treatment session and a T-score cutoff of 60 or greater on the Eyberg Child Behavior Inventory (ECBI) Intensity Scale (Eyberg, 1999), which is indicative of clinically significant behavioral difficulties. Recruitment and data collection for this study began in September 2009, and data collection for follow-up measures was completed in October 2020.

Although some participants with clinically significant symptoms of inattention and hyperactivity/impulsivity receive an ADHD diagnosis at intervention baseline, diagnosis is deferred for most children presenting to BBI. The rationale is that these symptoms are sometimes related to oppositionality rather than ADHD in preschoolers (American Psychiatric Association, 2013; Harvey et al., 2016). While treatment is expected to result in clinically significant reductions in symptoms of oppositional behavior, inattention, and hyperactivity/impulsivity for the majority of participants, children with ADHD may be less likely to experience reductions significant enough to fall within normal limits in the areas of inattention and hyperactivity/impulsivity upon treatment completion.

Measures

Eyberg Child Behavior Inventory (ECBI)

The ECBI (Eyberg, 1999) is a 36-item narrow-band measure of disruptive behavior. It is comprised of two scales, including the Intensity Scale and the Problem Scale. The Intensity Scale reflects the frequency of various disruptive behaviors on a seven-point scale ranging from "never" to "always." Sample items include "acts defiant when told to do something," "cries easily," and "has difficulty entertaining self alone." The Problem Scale reflects the number of disruptive behaviors that the child's caregiver perceives as problematic, with each item being scored "yes" or "no." T-scores of 60 or higher indicate the presence of clinically significant disruptive behavior. Internal consistencies for the Intensity and Problem Scales are 0.93 and 0.98, respectively (Eyberg & Pincus, 1999). The ECBI was utilized only as a study inclusion criterion in this study. ECBI data for a portion of this sample are analyzed elsewhere (Axelrad et al., 2013).

Behavior Assessment System for Children—Second and Third Editions (BASC-2 and BASC-3), Parent Rating Scales

The BASC-3 and its previous version, BASC-2, (Reynolds & Kamphaus, 2004, 2015) is a well-validated broad-band measure of child symptomatology. Data collection for this study began with the BASC-2 and adopted the BASC-3 upon its release in 2015. This study focused on the subscales pertaining to ADHD symptoms, including Hyperactivity and Attention Problems scales. Items are rated on a four-point scale for frequency ("never," "sometimes," "often," or "almost always"). Sample items on the Hyperactivity scale include "is in constant motion" and "acts without thinking." Sample items on the Attention Problems scale include "listens carefully" and "has a short attention span." Internal consistencies reported in the manual for these scales are between 0.80 and 0.88 on the BASC-2 and between 0.81 and 0.90 on the BASC-3. T-scores for these scales were derived from the age-appropriate, same-sex, general norm sample. On the BASC, T-scores less than 60 represent within normal limits, T-scores between 60 and 69 are considered at-risk, and T-scores of 70 and higher are clinically significant.

Disruptive Behavior Rating Scale (DBRS), Parent Version

The DBRS (Barkley & Murphy, 1998) is a narrow-band measure of symptoms of ADHD and Oppositional Defiant Disorder (ODD), consistent with DSM-5 criteria. Parents rate the frequency with which their child exhibited symptoms for each disorder over the past 6 months ("never," "sometimes," "often," or "very often"). The Hyperactivity/Impulsivity and Inattention subscales each include nine items, and a symptom count for each scale is derived by summing the number of items endorsed as occurring "often" or "very often." Sample items measuring Hyperactivity/Impulsivity include "fidgets with hands or feet or squirms in seat" and "has difficulty awaiting turn." Sample items measuring Inattention include "is easily distracted" and "doesn't listen when spoken to directly." Internal consistencies for individual scales of the DBRS range from 0.80 to 0.87 (Friedman-Weieneth et al., 2009). Parents also rate the frequency ("never," "sometimes," "often," or "very often") with which their child exhibited impairment associated with hyperactivity/impulsivity and inattention symptoms across eight areas, such as "in his/her home life with immediate family" and "in his/her social interactions with other children." The number of areas of impairment is calculated by summing items endorsed as "often" or "very often".

Teacher Measures

Participants enrolled in daycare/preschool or school were provided with the teacher versions of the BASC (Reynolds & Kamphaus, 2004, 2015) and the DBRS (Barkley & Murphy, 1998). Internal consistencies for the Hyperactivity and Attention Problems scales of the teacher BASC-2 are between 0.88 and 0.93, and internal consistencies for the teacher BASC-3 are between 0.87 and 0.94. The teacher form of the DBRS has internal consistencies between 0.78 and 0.96 when used with preschoolers (Pelletier et al., 2006). Sample items for Hyperactivity/Impulsivity on the DBRS include "leaves his/her seat in classroom or other situations in which seating is expected" and "blurts out answers before questions have been completed." Sample items for Inattention include "has difficulty sustaining his/her attention in tasks or fun activities" and "doesn't follow through on instructions and fails to finish work".

Demographic Form

A brief questionnaire was included with 6-month and 1-year follow-up measures. The form asks questions pertaining to additions or changes in the child's medication status, changes in the child's school/teachers, family changes, and whether additional treatment has been received. The purpose of this form is to assess which factors outside the study intervention may have impacted participant outcomes.

Procedure

Participants who qualified and provided informed consented for the research study completed several measures, including the BASC and DBRS prior to their first treatment session. Parents with a child in preschool or school were provided with the teacher versions of the BASC and DBRS to be completed and returned at baseline (T1). Teacher measures were provided in an envelope with a brief note about the treatment program and the option to seal the envelope to be returned directly via mail, or by giving the envelope to parents to return. All treatment sessions were provided in-person in our clinic at a large children's hospital. The parent and teacher measures were repeated upon completion of the core intervention sessions (T2). At 6 months (T3) and 1 year (T4) post-intervention, participants who returned baseline and post-intervention measures were mailed a packet with all parent and teacher measures, a demographic form, and a cover letter asking parents to complete and return the measures. Participants were provided with a pre-addressed, stamped envelope to facilitate returns. Each family was also provided with feedback regarding the results via letter, phone, or during a scheduled booster session.

Attrition and Overview of Analyses

Two-hundred eighty-four ($N = 284$) parent–child dyads met inclusion criteria and consented to the study. A power analysis was not conducted as the treatment and clinical measures were provided as part of standard clinical care and program evaluation. Of the 284 dyads, 156 (55%) completed the intervention and T2 measures (intervention completers), 103 (36%) completed the intervention but did not complete T2 measures (intervention completers), and 25 (9%) did not complete the intervention after attending at least one session (intervention dropouts). Not completing the intervention was defined as attending less than 4 of the core intervention sessions. The average number of sessions for those who completed intervention and T2 measures was 6.51 ($SD = 1.64$; range = 4–16). See Fig. 1 for an overview of participant allocation and attrition.

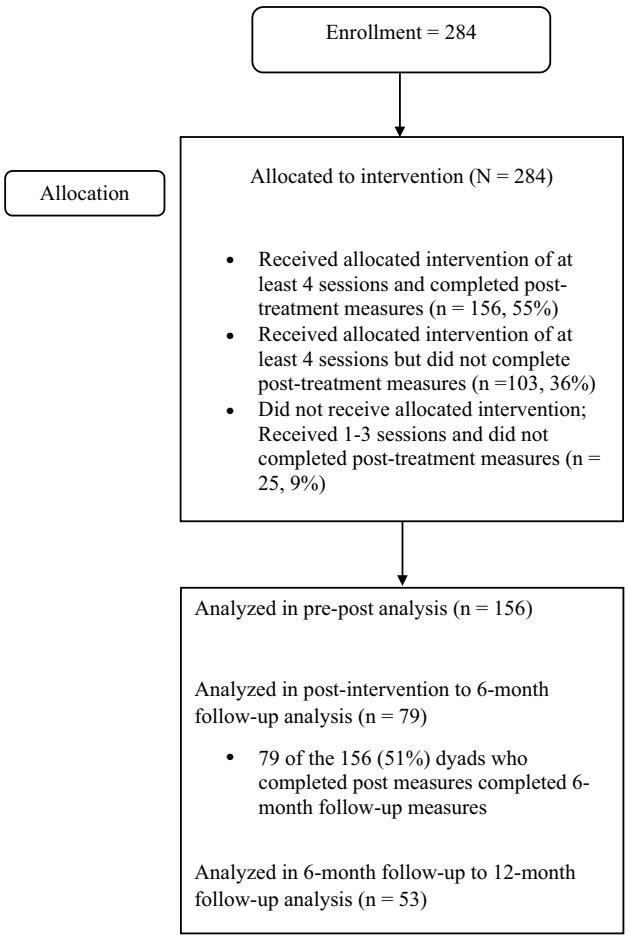

Fig. 1 Participant flow chart. This figure outlines participant allocation to the intervention and attrition

Descriptive Analyses

All analyses were performed in SPSS, Version 27. *T*-tests were conducted to examine pre-intervention differences in child age, parent-reported hyperactivity/impulsivity and inattention, and the number of sessions attended between intervention completers, those who completed intervention but did not complete T2 measures, and intervention drop-outs. Furthermore, Chi square statistics were conducted to examine pre-intervention differences in child gender, race/ethnicity, and medication status. See Table 1 for sample characteristics.

Pre-intervention differences were also assessed in children who were taking stimulant medication at any time point ($n=43$) and those who never took stimulant medication during the study ($n=230$). *T*-tests were conducted to examine differences in child age, parent-reported inattention and hyperactivity/impulsivity, and number of sessions completed. Chi square statistics were conducted to examine differences in child gender, race/ethnicity, and treatment completion status.

Of participant parents who completed T2 measures, differences in number of sessions, child medication status, race/ethnicity, child age, child gender, and parent-reported hyperactivity/impulsivity and inattention at post-intervention were examined between participants who completed T3 data ($n=79$) and those who did not ($n=77$). Of dyads who completed T3 measures, differences in number of sessions, child medication status, race/ethnicity, child age, child gender, and parent-reported hyperactivity/impulsivity and inattention at T3 were examined between parents who completed T4 data ($n=53$) and those who did not ($n=26$). Significant differences are reported below.

Parent-Report Pre-, Post-, 6-Month, and 1-Year Analyses

Pairwise t-tests were conducted to examine pre-to-post intervention (T1 to T2), post-to-6-month follow-up (T2 to T3), and 6-month-to-1-year follow-up (T3 to T4) changes in parent-reported child hyperactivity/impulsivity and inattention, based on relevant BASC and DBRS scales. The analyses were run with the entire group of intervention completers and separately with children who took medication at any time point excluded. There were no differences in outcomes between these groups, with one exception reported below, so results for the entire group of intervention completers are reported. A significance value of $p=.01$ was used for the four analyses conducted at each of the three time points due to the multiple comparisons. See Table 1 for descriptive information at each time point, including number of participants for analyses at each time point. A significance value of 0.05 was used to describe differences in the sample that completed intervention as compared to those who dropped out.

Teacher-Report Pre-, Post-, 6-Month, and 1-Year Analyses

Pairwise t-tests were also conducted to examine pre-to-post intervention (T1 to T2), post-to-6-month follow-up (T2 to T3), and 6-month-to-1-year follow-up (T3 to T4) changes in

Table 1 Sample characteristics at each assessment time point

Characteristic	Pre ($n=256$)	Post ($n=156$)	6-month ($n=79$)	12-month ($n=53$)
T1 Age in months (range)	56 (27–81)	56 (31–79)	56 (36–79)	56 (38–79)
Male gender (%)	77	79	85	87
Race/ethnicity				
Caucasian (%)	69	70	76	85
Hispanic/Latino (%)	15	16	10	10
African American (%)	7	5	5	0
Other (%)	10	10	9	6
Child diagnosis				
DBD (%)	57	61	58	56
ADHD (%)	25	21	22	23
ODD (%)	7	7	9	9
ADHD + ODD (%)	6	6	6	6
ADHD + DBD (%)	3	4	5	6
Child not taking medication at T1 (%)	91	93	92	93
Child not taking medication at assessment point (%)	91	85	80	75

Some percentages may not add up to 100 due to rounding

DBD Disruptive Behavior Disorder, *ADHD* Attention-Deficit/Hyperactivity Disorder, *ODD* Oppositional Defiant Disorder

teacher-reported child hyperactivity/impulsivity and inattention, based on relevant BASC and DBRS scales.

Post-Hoc Analyses

Post-hoc analyses were conducted for intervention completers with clinically significant parent-reported ADHD symptoms ($n = 123$), defined by a T-score ≥ 70 on either the parent Behavior Assessment System for Children-Second or Third Edition (BASC-2; BASC-3) Hyperactivity or Attention Problems subscales, or a raw score ≥ 6 on either of the parent Disruptive Behavior Rating Scale (DBRS) Inattention or Hyperactivity/Impulsivity subscales. For this subset, pairwise t-tests were conducted to examine pre-to-post intervention (T1 to T2), post-to-6-month follow-up (T2 to T3), and 6-month-to-1-year follow-up (T3 to T4) changes in parent-reported child hyperactivity/impulsivity and inattention, based on relevant BASC and DBRS scales. Pairwise *t*-tests were also conducted to examine pre-to-post intervention (T1 to T2) changes in parent-reported number of areas of impairment on the DBRS, as well as teacher-reported child hyperactivity/impulsivity and inattention, based on BASC and DBRS scales.

Results

Descriptive Statistics

Of the examined pre-intervention differences between intervention completers and those who completed intervention but did not complete T2 measures, intervention completers attended slightly more sessions ($M = 6.51$) than intervention completers who did not return measures ($M = 5.76$), $t(257) = 3.68$, $p < .01$. Furthermore, the proportion of child intervention completers taking stimulant medication at pre-intervention (7%) was lower than the proportion of intervention completers without T2 data taking medication (14%), χ^2 (2) = 6.83, $p = .03$.

Of the examined pre-intervention differences between intervention completers and dropouts, dyads who dropped out of the intervention completed fewer sessions ($M = 3.92$, $SD = 2.18$) than intervention completers ($M = 6.51$, $SD = 1.64$), $t(179) = 6.97$, $p < .01$. Parents who dropped out of the intervention also reported higher child attention problems on the BASC ($M = 70.40$, $SD = 5.58$) and higher child hyperactivity problems on the BASC ($M = 77.08$, $SD = 10.00$), as compared to intervention completers ($M = 65.11$, $SD = 7.57$), $t(174) = -3.34$, $p < .01$ and ($M = 72.15$, $SD = 10.40$), $t(174) = -2.21$, $p = .03$, respectively.

Among the 156 dyads who completed T2 measures, participants who completed T3 measures attended slightly more sessions (M = 6.84, $SD = 1.92$) than those who did not complete T3 data (M = 6.17, $SD = 1.22$), $t(154) = 2.58$, $p = .01$. Among the 79 dyads who completed T3 measures, those who completed T4 measures were more likely to be Caucasian (76%) as compared to those who did not have T4 data (24%), χ^2 (4) = 13.47, $p < .01$.

When comparing children who were taking stimulant medication at any time point to children who never took stimulant medication during the study, children who received stimulant medication were reported to be more inattentive and more hyperactive/impulsive by parents and teachers on the BASC and DBRS at pre-intervention. Children who took stimulant medication at any time point were also slightly older at baseline ($M = 5.22$, $SD = 0.88$) than children who never took stimulant medication during the study ($M = 4.59$, $SD = 0.95$), $t(271) = -4.023$, $p < .01$. There were no differences in child gender, race/ethnicity, number of sessions completed, or treatment completion status.

Pre-to-Post Outcomes

Parent-Reported Outcomes

Scores on the parent report BASC subscales suggested significant improvement from T1 to T2 in child hyperactivity $t(144) = 9.51$, $p < .01$, $d = 0.79$ and attention problems $t(144) = 8.33$, $p < .01$, $d = 0.69$. Parent-reported DBRS scores showed significant improvement from T1 to T2 in child hyperactivity/impulsivity $t(109) = 6.09$, $p < .01$, $d = 0.58$ and inattention $t(109) = 4.99$, $p < .01$, $d = 0.48$. See Table 2 for means and standard deviations.

Teacher-Reported Outcomes

Scores on the BASC subscales from the teacher report suggested significant improvement from T1 to T2 in child hyperactivity $t(81) = 3.97$, $p < .01$, $d = 0.44$ and attention problems $t(80) = 3.53$, $p < .01$, $d = 0.39$. Teacher-reported DBRS scores showed significant improvement from T1 to T2 in child hyperactivity/impulsivity $t(65) = 3.46$, $p < .01$, $d = 0.43$. There was not a significant change in child inattention on the teacher report of the DBRS from T1 to T2 $t(65) = 2.35$, $p = .02$ in the group of all intervention completers. See Table 3 for means and standard deviations.

Notably, when excluding the group of children who took medication at any time point, teacher-reported hyperactivity on the DBRS showed only a borderline statistically significant change from T1 ($M = 4.83$, $SD = 3.23$) to T2 ($M = 3.96$, $SD = 3.03$), $t(53) = 2.66$, $p = .01$, $d = 0.36$.

Table 2 Parent-reported child hyperactivity/impulsivity and inattention at pre-to-post intervention, post-to-6-month follow-up, and 6-month-to-12-month follow-up

Measure	Pre-to post-intervention		Post- to 6-m follow-up		6-m to 12-m follow-up	
	Pre *M* (*SD*)	Post *M* (*SD*)	Post *M* (*SD*)	6-m *M* (*SD*)	6-m *M* (*SD*)	12-m *M* (*SD*)
BASC Hyperactivity	72.06 (10.50)[a]	63.31 (12.65)[a]	62.91 (12.16)	63.13 (10.56)	62.59 (10.55)	63.47 (10.78)
BASC Attention Problems	65.06 (7.63)[b]	59.94 (8.48)[b]	59.58 (8.97)	59.32 (10.25)	59.88 (10.01)	59.71 (8.46)
DBRS Hyperactivity/Impulsivity	5.98 (2.50)[c]	4.47 (3.05)[c]	4.67 (3.04)	4.40 (2.87)	4.36 (3.13)	4.32 (2.88)
DBRS Inattention	4.44 (2.65)[d]	3.03 (2.91)[d]	3.00 (2.80)	2.79 (2.63)	2.68 (2.63)	3.16 (2.87)

Means with same superscript are statistically different at $p < .01$

Table 3 Teacher-reported child hyperactivity/impulsivity and inattention at pre-to-post intervention, post-to-6-month follow-up, and 6-month-to-12-month follow-up

Measure	Pre-to post-intervention		Post- to 6-m follow-up		6-m to 12-m follow-up	
	Pre *M* (*SD*)	Post *M* (*SD*)	Post *M* (*SD*)	6-m *M* (*SD*)	6-m *M* (*SD*)	12-m *M* (*SD*)
BASC Hyperactivity	66.78 (12.81)[a]	61.88 (12.28)[a]	59.07 (11.10)	60.20 (11.06)	61.41 (11.26)	61.59 (9.17)
BASC Attention Problems	58.86 (9.62)[b]	55.11 (10.28)[b]	52.56 (10.78)	55.54 (9.35)	55.93 (9.14)	56.24 (8.14)
DBRS Hyperactivity/Impulsivity	5.44 (3.27)[c]	4.27 (3.16)[c]	3.69 (3.07)	4.08 (3.12)	5.08 (3.20)	4.77 (3.06)
DBRS Inattention	3.97 (3.26)	3.00 (3.18)	2.88 (3.30)	2.81 (2.97)	3.15 (2.88)	2.61 (2.60)

Means with same superscript are statistically different at $p < .01$

Post- to 6-Month Follow-Up

Parent-Reported Outcomes

Scores on the parent report BASC subscales suggested no changes from T2 to T3 in child hyperactivity $t(75) = -0.20$, $p = .84$ and attention problems $t(75) = 0.27$, $p = .79$. No changes were found in parent-reported DBRS hyperactivity/impulsivity $t(41) = 0.57$, $p = .57$ or inattention $t(41) = 0.50$, $p = .62$ from T2 to T3. See Table 2 for means and standard deviations.

Teacher-Reported Outcomes

Scores on the teacher report BASC subscales suggested no changes from T2 to T3 in child hyperactivity $t(40) = -.60$, $p = .55$ and attention problems $t(40) = -1.34$, $p = .19$. No changes were found in teacher-reported DBRS hyperactivity/impulsivity $t(25) = -0.45$, $p = .65$ or inattention $t(25) = 0.09$, $p = .93$ from T2 to T3. See Table 3 for means and standard deviations.

6-Month to 1-Year Follow-Up

Parent-Reported Outcomes

Scores on the parent report BASC subscales suggested no changes from T3 to T4 in child hyperactivity $t(50) = -0.62$, $p = .54$ and attention problems $t(50) = 0.15$, $p = .88$. No changes were found in parent-reported DBRS hyperactivity/impulsivity $t(24) = 0.07$, $p = .95$ or inattention $t(24) = -0.65$, $p = .52$ from T3 to T4. See Table 2 for means and standard deviations.

Teacher-Reported Outcomes

Finally, scores on the teacher report BASC subscales suggested no changes from T3 to T4 in child hyperactivity $t(28) = -0.08$, $p = .94$ and attention problems $t(28) = -0.18$, $p = .86$. No changes were found in parent-reported DBRS hyperactivity/impulsivity $t(12) = 0.25$, $p = .81$ or inattention $t(12) = 0.51$, $p = .62$ from T3 to T4. See Table 3 for means and standard deviations.

Post-Hoc Analyses

Pre-to-Post Outcomes

Among children ($n = 123$) with clinically significant levels of parent-reported ADHD symptoms at baseline who completed treatment, there were significant improvements from T1 to T2 on BASC subscales for child hyperactivity $t(114) = 9.10$, $p < .01$, $d = 0.85$ and attention problems $t(114) = 7.42$, $p < .01$, $d = 0.69$. Scores on the parent report DBRS also showed significant improvement from T1 to T2 in child hyperactivity/impulsivity $t(87) = 4.92$, $p < .01$, $d = 0.53$ and inattention $t(87) = 4.22$, $p < .01$, $d = 0.45$. Furthermore, there was a significant improvement in

parent-reported number of areas of impairment on the DBRS $t(76) = 4.11$, $p < .01$, $d = 0.47$ from T1 to T2. See Table 4 for means and standard deviations.

On teacher report BASC subscales, there was significant improvement from T1 ($M = 68.46$, $SD = 12.05$) to T2 ($M = 63.64$, $SD = 12.32$) in child hyperactivity $t(64) = 3.47$, $p < .01$, $d = 0.43$. There was also significant improvement from T1 ($M = 60.84$, $SD = 9.02$) to T2 ($M = 56.55$, $SD = 10.33$) in attention problems $t(63) = 3.44$, $p < .01$, $d = 0.43$. In addition, teacher-reported DBRS scores showed significant improvement in child hyperactivity $t(51) = 3.34$, $p < .01$, $d = 0.46$ from T1 ($M = 6.23$, $SD = 2.90$) to T2 ($M = 4.90$, $SD = 3.04$). There were no changes found in child inattention $t(51) = 2.03$, $p = .05$, as reported by teachers on the DBRS from T1 ($M = 4.56$, $SD = 3.21$) to T2 ($M = 3.52$, $SD = 3.15$).

Post- to 6-Month Follow-Up

Scores on the parent report BASC suggested no changes from T2 to T3 in child hyperactivity $t(59) = -0.04$, $p = .97$ and attention problems $t(59) = 0.48$, $p = .63$. Parent-reported DBRS scores did not change from T2 to T3 for child hyperactivity/impulsivity $t(34) = 1.66$, $p = .13$ or inattention $t(34) = 1.05$, $p = .30$. There was a significant reduction in parent-reported DBRS impairment $t(33) = 0.39$, $p < .01$, $d = 0.15$ from T2 to T3. See Table 4 for means and standard deviations.

6-Month to 1-Year Follow-Up

Scores on the parent report BASC suggested no changes from T2 to T3 in child hyperactivity $t(39) = 0.09$, $p = .93$ and attention problems $t(39) = 0.56$, $p = .58$. Parent-reported DBRS scores did not change from T2 to T3 for child hyperactivity/impulsivity $t(19) = -0.15$, $p = .88$, inattention $t(19) = -1.12$, $p = .28$, or impairment $t(18) = 0.265$, $p = .07$. See Table 4 for means and standard deviations.

Discussion

The purpose of the study was to evaluate the long-term effectiveness of a brief PMT program, the Brief Behavioral Intervention (BBI), for reducing ADHD symptoms in preschoolers between the ages of 2–6 years old presenting with disruptive behaviors. As hypothesized, BBI was effective in significantly reducing inattention and hyperactivity/impulsivity symptoms from pre-to-post intervention and outcomes were maintained at follow-up points up to 1 year. Importantly, the results were similar across parent and teacher ratings of inattention and hyperactivity/impulsivity, although teacher-reported reductions in inattention were observed only on one measure. In addition, similar parent- and teacher-reported outcomes for inattention and hyperactivity/impulsivity were obtained from pre-to-post intervention for a subset of children with clinically significant symptoms of ADHD at baseline, and these improvements were sustained at long-term follow-up based on parent report. Furthermore, this subset of preschoolers exhibited significant reductions in the level of impairment associated with their symptoms, which continued to improve at 6-month follow-up and were maintained at 1 year after treatment completion.

Concordance across multiple raters supports the importance of the current results, as previous studies have demonstrated possible parent bias in ratings of child outcomes following participation in PMT (Abikoff et al., 2015; Kohut & Andrews, 2004). The lack of statistically significant change on one measure of teacher-reported inattention may reflect the limited sensitivity of the DBRS to change when calculating scores as symptom counts due to use of categorical responses and restriction of range of scores (Lipsey, 1990). At the same time, doing so allows researchers to easily categorize subjects by diagnostic severity and assess whether individual subjects meet the necessary symptom count for a diagnosis of ADHD. Greater attrition for teacher measures, as compared to parent measures in this study may also be a factor that affected results. Future studies would benefit from

Table 4 Parent-reported child hyperactivity/impulsivity and inattention for ADHD group at pre-to-post intervention, post-to-6-month follow-up, and 6-month-to-12-month follow-up

Measure	Pre-to post-intervention		Post- to 6-m follow-up		6-m to 12-m follow-up	
	Pre *M* (*SD*)	Post *M* (*SD*)	Post *M* (*SD*)	6-m *M* (*SD*)	6-m *M* (*SD*)	12-m *M* (*SD*)
BASC Hyperactivity	75.18 (9.04)[a]	65.99 (11.72)[a]	65.40 (12.26)	65.45 (9.69)	64.60 (9.62)	64.45 (11.12)
BASC Attention Problems	66.98 (6.69)[b]	61.64 (8.19)[b]	61.67 (7.91)	61.67 (9.25)	61.60 (9.03)	60.90 (8.39)
DBRS Hyperactivity/Impulsivity	6.75 (2.07)[c]	5.27 (2.85)[c]	5.26 (2.88)	4.54 (2.64)	4.35 (2.85)	4.45 (2.98)
DBRS Inattention	5.09 (2.46)[d]	3.65 (2.91)[d]	3.34 (2.74)	2.83 (2.41)	2.55 (2.11)	3.45 (3.07)
DBRS Impairment	4.88 (2.15)[e]	3.56 (2.73)[e]	3.38 (2.71)[f]	3.06 (2.53)[f]	2.84 (2.43)	3.63 (3.04)

Means with same superscript are statistically different at $p < .01$

providing alternative ways for teachers to provide responses (e.g., online surveys) to increase receipt of teacher measures.

The current findings are particularly important given the brevity of the BBI program. PMT programs generally range from 8 to 20 or more sessions and sometimes include additional components, such as school consultation or behavioral training for teachers. These programs may not be feasible across settings or for all families due to treatment length or burden. By contrast, the BBI program averages about six sessions, with some patients requiring as few as four sessions to complete treatment. This is achievable due to the ability to tailor the treatment components to address each family's presenting concerns. Therefore, implementation of the BBI program may significantly reduce patient attrition as compared to other PMT programs (Chacko et al., 2016; Fernandez & Eyberg, 2005; Lanier et al., 2011) and preserve resources to serve as many patients as possible. The dropout rate of 9% in the present study suggests that families find BBI to be an acceptable treatment. Those who dropped out of the BBI program had higher levels of inattention and hyperactivity/impulsivity at baseline, which may suggest that families chose to leave treatment to seek higher levels of care.

Furthermore, although many PMT programs are effective at reducing disruptive behaviors in preschool-age children, few have examined ADHD-related outcomes or demonstrated maintenance of these outcomes at long-term follow-up (Abikoff et al., 2015; Jones et al., 2008; Leung et al., 2017; Wagner & McNeil, 2008). The present study thus adds to the literature by demonstrating that PMT is capable of producing significant long-term improvements in ADHD symptoms for preschoolers. The BBI program in particular has previously been shown to produce clinically significant improvements in disruptive behavior problems over time (Axelrad et al., 2013), thereby demonstrating robust effectiveness of a brief intervention across targets of interest in preschool populations.

Importantly, this study further supports the utility of PMT as a first-line intervention for ADHD symptoms. While stimulant medication offers benefits for preschool-age children with ADHD (Greenhill et al., 2006), adverse side effects, time-limited effectiveness, parental reluctance, and cost are factors which may reduce the appeal of their use for this population (Ahmed et al., 2013). Here, we build upon existing PMT research to show clinically significant improvements in ADHD symptoms following treatment, based on medium effect sizes across most variables and reduction of inattention and hyperactivity/impulsivity symptoms into lesser categories of severity (i.e., from clinically significant to at-risk, or at-risk to average levels). Additionally, the group of children most vulnerable for ADHD in this study demonstrated significant reduction in the number of areas of impairment associated with their symptoms. The subsequent long-term maintenance of symptom reduction following treatment completion is especially important, as stimulant treatment has minimal support for long-term benefits, particularly after being discontinued (Buitelaar et al., 2015; Matthijssen et al., 2019). Of note, intervention outcomes were similar regardless of whether preschoolers took stimulant medication at any point during the study. One exception occurred in which there appeared to be an enhanced effect of BBI treatment on teacher-reported reductions in hyperactivity/impulsivity for children who were taking stimulant medication at any point in the study; however, the outcomes were still significant in the non-medicated group. Thus, the sum of the evidence supports that a brief behavioral treatment can effectively treat ADHD symptoms in preschoolers and delay the need for stimulant medication.

This study benefited from a large sample of preschoolers and measurement of outcomes across several times points, up to 1 year following treatment. It also included multiple raters and multiple forms for measurement of child inattention, hyperactivity/impulsivity, and associated impairment, which allowed for a thorough assessment of child symptoms. Furthermore, children in the study represented a typical clinical population with comorbid disruptive behavior problems, which are very common in preschoolers with ADHD (American Psychiatric Association, 2013; Harvey et al., 2016). Recruitment from an outpatient clinic, in which participants accessed and paid for services of their own accord, also supports conclusions about feasibility, generalizability, and effectiveness of this treatment in other clinical settings.

Limitations of the study include a primarily white male sample of preschoolers, although the proportion of males in the study is similar to prevalence rates of disruptive behavior disorders and ADHD across genders in the broad population (American Psychiatric Association, 2013). It is possible that the limited racial/ethnic diversity of the sample reflects differences in socioeconomic status which may impact families' ability to attend daytime appointments. Future studies should gather more demographic information to more adequately assess the representativeness of their samples and possible differences in patient outcomes. In addition, while 91% of participants completed treatment, we experienced loss to follow-up in measure completion across time points, with 55% of families initially enrolled returning post-intervention measures, 28% returning 6-month follow-up data, and 19% returning 1-year follow-up data. Although these rates are slightly higher than other long-term studies of PMT, they may reflect limitations of real-world effectiveness studies in a clinical setting (e.g., lack of incentives provided to complete the measures, reduced resources to contact families to encourage returning measures) (Singal et al., 2014). It is possible that families who returned measures are more conscientious, and thus also maintained skills learned in treatment. Alternatively, it is possible that families that did not

return their measures did not due to improved behavior and no longer needing feedback about behavior. Another limitation is the lack of a control group to ensure that changes were the result of the intervention, rather than extraneous variables; however, this seems unlikely due to the extensive data supporting effectiveness of PMT more broadly and the very short passage of time between treatment initiation and completion. Finally, neither parents or teachers were blinded to intervention status, which could potentially bias their ratings of the child's symptoms at each time point.

Conclusions

Overall, this study demonstrates the long-term effectiveness of a PMT program for reducing ADHD symptoms among young children, thereby eliminating or delaying the need for additional treatments. This further reinforces the American Academy of Pediatrics recommendation (2011) that behavioral intervention should be the first-line treatment for ADHD in young children. This study also builds upon prior research to provide support for brief versions of PMT, such as the BBI program, as an effective intervention for treating preschoolers who present with disruptive behaviors and ADHD symptoms in outpatient clinical settings.

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Declarations

Conflict of Interest Ashley E. Teasdale, Petra A. Duran, Marni E. Axelrad have not disclosed any competing interests.

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