

A Pilot Study of the Efficacy of a Mindfulness Program for Children Newly Diagnosed with Attention-Deficit Hyperactivity Disorder: Impact on Core Symptoms and Executive Functions

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ABSTRACT

Mindfulness has emerged as a new approach for treating mental disorders. The aim of this study is to investigate preliminary efficacy of group-based mindfulness meditation training for children on core symptoms, executive functioning and comorbidity symptoms in a children naïve Attention-Deficit Hyperactivity Disorder (ADHD) sample. Five children aged 7-12 years newly diagnosed with ADHD received an eight-week group-based mindfulness treatment. The program consisted of once-per-week sessions lasting 75 minutes and daily homework assignments. The study assessments included pre- and posttest measure of psychiatric symptoms and cognitive functioning. Data were analyzed using Wilcoxon signed-rank test. Pre-post improvements in ADHD symptoms and test performance on tasks measuring executive functioning were noted. Significant results were observed in total ADHD symptoms ($p = .042$), anxiety symptoms ($p = .042$), cognitive inhibition ($p = .042$) and processing speed ($p = .043$). In summary, although the sample size was small, our pilot study suggests that mindfulness training for children is a feasible intervention in at least a subset of ADHD children and may improve behavioral and neurocognitive impairments.

Key words: ADHD, children, mindfulness, executive functions.

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Novelty and Significance

What is already known about the topic?

- Some studies suggest that mindfulness is effective for the treatment of ADHD in adults and adolescents.
- Mindfulness may be a feasible intervention strategy for children newly diagnosed with ADHD.

What this paper adds?

- The results suggest that mindfulness group treatment may be an effective modality of psychological intervention for children with ADHD.
- An advance in the treatment of ADHD and the group format would mean a reduction in the cost of treatment.

Attention-deficit hyperactivity disorder (ADHD) is a complex and heterogeneous neurodevelopmental childhood disorder that is characterized by three core symptoms: inattention, hyperactivity and impulsivity (American Psychiatric Association, 2013).

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Inattention and disorganization involve difficulties in sustaining attention continuously, especially in tasks that are not highly motivating. They show difficulties in remembering and following instructions, struggle to perform and concentrate on the explanations given in the classroom, being unable to finish the tasks they start. They have difficulty resisting distractions when performing a task and lack of persistence. They are absent-minded children that often lose objects and materials at levels that are incompatible with age or developmental level (American Psychiatric Association, 2013). Studies suggest that inattentive symptoms tend to remain relatively stable throughout adolescence and adulthood (Biederman, Petty, Clarke, Lomedico, & Faraone, 2011).

Hyperactivity refers to observed excessive and continuous motor activity showing difficulties to self-regulate their behaviour, such as sitting or continuously changing from one activity to another. These difficulties arise even in situations where there is an explicit demand for self-control, being excessive symptoms for age or developmental level and/or when it is not appropriate depending on the situation and/or context (American Psychiatric Association, 2013). Studies suggest that symptoms of hyperactivity usually decrease with age (Biederman *et alii*, 2011).

Impulsivity refers to the failure to inhibit both behaviourally and cognitively impulses, actions and hasty cognitions that occur at the time, without reflection, that are excessive for age or developmental level (American Psychiatric Association, 2013). Interference in the activities of others, a tendency to interrupt others excessively, impatience, inability to wait turn, socially inappropriate verbalizations and multiple errors by precipitation in performing schoolwork is observed. Impulsivity is also undoubtedly linked to risk-taking. Note that harming others is not a characteristic of children with this disorder; they are children who usually repent those disrespectful and harmful behaviours they have performed. Studies suggest that impulsivity symptoms can persist into adulthood (Biederman *et alii*, 2011). As noted, ADHD is associated with profound adverse effects on the educational and social development of those affected (Harpin, 2005).

Regarding epidemiological data, there is great variability in prevalence values. It is considered that prevalence is influenced by various factors such as age, gender, cultural and geographical aspects, clinical subtype, diagnostic instruments used in the evaluation and the diagnostic classification used. Studies suggest (Skounti, Philalithis, & Galanakis, 2007) that the prevalence of ADHD in children ranges between 2.2 and 17.8%. The latest study to date of global prevalence suggests that ADHD affects approximately 3.4% of school-aged children around the world (Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015).

Different studies suggest that individuals suffering from ADHD have frequently other concurrent mental disorders (65% of the cases) (Biederman & Faraone, 2005). The type of comorbidity varies and includes learning problems, mood disorder, anxiety disorders, oppositional defiant disorder, behavior disorder, substance use disorders in adolescence, among others. The scientific evidence (Cortese, 2012; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005) also suggests that most children with ADHD have deficits in executive functions.

Executive functions (EF) are a set of cognitive processes that can transform thoughts into decisions, plans and actions. They allow starting an action and regulating the goal-directed behavior avoiding distractions and rejecting interferences, thus acting flexibly ahead of changing circumstances. So, they are relevant to address new situations or complex problems that require the development of strategies and appropriate solutions adapting to changes flexibly (Del Campo, Chamberlain, Sahakian, & Robbins, 2011;

Willcutt *et alii*, 2005). In this regard, the EF are essential in everyday aspects of life ranging from physical and mental health to psychological, social and cognitive development (Diamond, 2013).

The neurological substrate of the EF is the frontal lobe, especially the prefrontal cortex and its connections to the basal ganglia, the amygdala, the limbic system and the cerebellum. The prefrontal cortex has different areas and pathways. The dorsolateral prefrontal cortex is responsible and participates in selective attention, working memory and in cognitive and planning flexibility. The prefrontal orbitofrontal cortex is related to social behaviour and the ventromedial prefrontal cortex contributes to emotional processing. Thus the normal development of EF is crucial for cognitive functioning and the child's social and emotional development. Several authors and studies (Barkley, 2012; Willcutt *et alii*, 2005) have proposed that ADHD symptoms (hyperactivity, impulsivity and inattention) are due to a deficit in the EF however not all the people with the disorder show deficits on executive functioning. The most frequent manifestations of EF alterations in ADHD are: Attention deficits in alert/orientation, focused attention, divided attention and sustained attention/vigilance, difficulties in working memory, inhibition and planning.

Mindfulness is described as the act of being present consciously, paying attention intentionally to what happens here and now, with an open-minded, curious, friendly and compassionate attitude, without rejecting, judging or criticizing, simply accepting what is happening in the present moment (Kabat-Zinn, 2003). Clinical mindfulness training is intended to increase awareness helping us act consciously without being drawn into our thoughts, emotions and sensations thus reducing automatic responses. It allows us to develop skills and increase our repertoire of resources to respond with greater choice, choosing our behaviours and solving situations and daily difficulties with greater skill. In turn, it improves the ability to maintain attention and concentration, decrease impulsivity, help calm down and relax, increase frustration tolerance, reduce stress and therefore improve our quality of life.

In the last few years, mindfulness research has grown rapidly. In general, mindfulness-based interventions have been shown to be effective in treating internal focused disorders but it is still unclear if they are useful in treating externalizing disorders. However a meta-analytic review suggests that mindfulness-based therapies are useful in ADHD (Cairncross & Miller, 2016). Furthermore, some studies (Zylowska *et alii*, 2008; Mitchell, Zylowska, & Kollins, 2015) suggest that EF improves in adults and adolescents with ADHD, after mindfulness interventions. For this reason, we consider that mindfulness may be a new intervention strategy to be taken into account for the treatment of children with ADHD. We hypothesized that ADHD symptoms, comorbidity symptoms, especially anxiety and mood symptoms, executive functions and quality of life would improve after receiving the mindfulness training.

Mindfulness meditation training has received preliminary support as an effectiveness treatment for ADHD in teens and adult (Cairncross & Miller, 2016). Few studies nowadays have evaluated the impact of this novel intervention in ADHD-diagnosed children under twelve in clinical settings. The few studies include a parallel mindful parenting training (Van der Oord, Bögels, & Peijnenburg, 2012). However the findings do suggest that mindfulness may be a useful intervention for children with ADHD. The study's main goal is to know the effect on the core symptoms of ADHD and the executive functions and comorbidity symptoms of an intervention program based on mindfulness in untreated children newly diagnosed with ADHD.

METHOD

Participants

The sample consisted of 6 children diagnosed with ADHD. One participant dropped out during the treatment. Participants were recruited from an ADHD Unit from a Child and Adolescent Health Department of a Pediatric Hospital. Inclusion criteria: age 7-12 years; met DSM-5 (American Psychiatric Association, 2013) criteria for ADHD; diagnosed with ADHD; T-score ≥ 1.5 SD for the standard age for total index in the ADHD Rating Scale IV (parents' version) (Du Paul, Power, Anastopoulos, & Reid, 1998); currently not taking any drug approved in Spain for the treatment of ADHD. Participants were not required to have received a diagnosis of ADHD prior to study participation. Exclusion criteria included: met criteria for Autism Spectrum Disorder, Psychosis or Bipolar Disorder, intellectual functioning ≤ 70 ; participating in another ongoing psychological intervention; not having signed parental or guardian informed consent. Comorbidity (Oppositional Defiant Disorder -ODD-, Conduct Disorder, Anxiety Disorders, and Affective Disorders) was not an exclusion criteria provided that ADHD symptoms were the primary concern and target for treatment according to the clinician performing the assessment (child psychiatrist or psychologist). The study was approved by the Clinical Investigation-Ethics Committee of Hospital Sant Joan de Déu (Barcelona, España). All participants were informed of the purpose of the study and signed their informed consent prior to inclusion in the study.

Participants were primarily male (80%) ranging in age from 7 to 12 years (mean age = 9.2, $SD = 1.30$). All participants were Hispanic and had no experience with mindfulness practices. Among participants, 60% presented an ADHD-combined presentation, the rest showed ADHD-inattentive presentation. 40% had a comorbid disorder, being ODD. On exploratory pretraining assessment two participants endorsed current moderate to severe depression symptoms (CDI score greater than 19) and three reported significant levels of anxiety (SCARED score greater than 30) but symptoms were not so severe as to drop them out of the study.

The study was approved by the Hospital' Ethics Committee. All parents or guardians of the children included in this study provided agreement and children were asked if they wanted to participate in the study.

Instruments

Assessment included the *Kiddie Schedule for Affective Disorders and Schizophrenia for School-age Children*, a diagnosis interview to assess the presence of ADHD, determine its subtype, and to assess comorbidity; Self-report rating scales evaluate general psychopathology (*Children's Depression Inventory*, *Child Anxiety Related Emotional Disorder*, *Child Behavior Checklist*) and ADHD clinical symptoms (*ADHD Rating Scale IV*, *Conners Rating Scales Revised*). In addition, laboratory tasks to evaluate executive functions were performed (*Stroop Test*, *Continuous Performance Test-3*, *Coding*, *Digit Span* and *Arithmetic subtests of Wechsler Intelligence Scale for Children*). Furthermore, quality of life was also explored (*Child Health and Illness Profile*). Versions of the instruments validated for Spanish population were used. Background information including age, gender and grade level was collected.

- Kiddie Schedule for Affective Disorders and Schizophrenia for School-age Children* (Present Lifetime version; K-SADS-PL, Spanish version; Soutullo, 1996). A semi-structured diagnostic interview designed to assess current and past episodes of psychopathology in children and adolescents according to DSM-III-R and DSM-IV criteria. Probes and objective criteria are provided to rate individual symptoms.
- ADHD Rating Scale IV* (Parent's version; Du Paul *et alii*, 1998). Includes 18 items that assess the ADHD criteria from the 4th revised edition of the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-IV-TR). Respondents used a Likert scale ranging from 0 to 3 points (0= rarely or never, 3= always or very often). Higher scores are indicative of problem behavior. ADHD is considered to exist when the score is greater than 1.5 standard deviations from the standard age for diagnosis subtype. Cronbach's α coefficient for inattention scale was .95 and for hyperactive-impulsive scale was .85.
- Conners Rating Scales Revised* (Parents' version; Conners, Sitarenios, Parker, & Epstein 1998). Screening and assessment scales of ADHD and other disruptive behaviours. In this study we used the short parents' version (27 items). The scale is divided into 4 subscales: oppositional, inattention, hyperactivity -impulsivity and ADHD Index. Each item is scored from 0 to 3 (0= not true, 3= is always true). A typical score ≥ 70 indicates the presence of alterations in the subscale. Cronbach's α coefficients vary from .74 to .94.
- Children's Depression Inventory* (CDI; Kovacs, 1992). A 27-item self-report measure that examines the level of depression. Items are rated 0 to 2 with higher scores representing more severe depressive symptoms. Total CDI scores >19 are considered indicative of moderate to severe depressive symptoms. Cronbach's α coefficient obtained was .85.
- Child Anxiety Related Emotional Disorder* (SCARED, Parents' and Child's version; Birmaher, Khetarpal, & Cully, 1997). A 41-item self-report anxiety measure designed for youth (ages 6-18 years). The instrument measures anxiety using five domains: panic/somatic, separation anxiety, generalized anxiety, school phobia and social phobia. Items are scored on a Likert scale: 0 (not true), 1 (sometimes true), or 2 (often true). A total score >30 indicates presence of clinical symptoms. An individual total score for each domain can also be obtained. For total anxiety scores alphas were excellent (all $>.80$) for each age group and between gender. For subscale scores, alphas across the sample were acceptable (all $>.60$).
- Child Behavior Checklist* (CBCL; Achenbach & Rescorla, 2001). A 113-item broad-spectrum scale for the assessment of externalizing and internalizing problems by parent's ratings, giving rise to 8 syndromes (anxious/depressed; withdrawn/depressed; somatic complaints; social problems; thought problems; attention problems; rule-breaking behavior; aggressive behavior). Standard scores ≥ 70 suggest clinical symptoms.
- Subtests that compose the freedom from Distractibility Factor of the *Wechsler Intelligence Scale for Children* (WISC; Wechsler, 2004). Coding-Digit Symbol subtest (child has 120 seconds to go through a grid of 90 numbers/shapes and place the correct symbol below each one. Test measures visual-motor speed and complexity and motor coordination), Digit Span subtest (contains two parts: Digit Span Forward (DSF) and Digit Span Backward (DSB). For Digit Span Forward, children are required to recall a series of numbers presented to them by the examiner; for Digit 6 Span Backward, the examinee is presented with a series of numbers and is required to repeat them in reverse order. Test measures short-term memory, attention, and concentration) and Arithmetic subtest (arithmetic problems similar to those encountered in elementary math courses are performed. Problems are administered orally and must be solved without paper and pencil. Test measures concentration and systematic problem-solving ability). Cronbach's α between .86 and .95 have been found.
- Stroop Test* (Golden, 2007). Consists of three cards: a word card, a colour card, and a word-colour. The test reports about cognitive flexibility, attention deployment and cognitive inhibition. Cronbach's α between .75 and .87 have been found.

Continuous Performance Test 3 (Parent's version, CHIP-CE/PRF; Estrada *et alii*, 2010).

A task-oriented computerized assessment of attention-related problems. Provides 4 indexes: inattentiveness, sustained attention, vigilance and impulsivity. Cronbach's α vary from .80 to .98.

Child Health and Illness Profile (Golden, 2007). A 75-item report, each item valued with a Likert scale with five response options ranging from 0 (never) to 5 (always). The instrument consists of five dimensions (satisfaction, comfort, resilience, risk avoidance, achievement) and 12 associated subdomains. The instrument is scored in the positive meaning of health. The raw scores are standardized to t-scores ≤ 41 indicate poor quality of life in the domain or subdomain and t-scores ≥ 57 indicate excellent quality of life). The internal consistency was good for all domains, alphas $>.7$.

Ad hoc Questionnaire of Satisfaction with Treatment. A 3-item self-report questionnaire. The first item asked about the degree to which they had liked participating in the program. The second item asked about motivation to do more sessions and the third item referred to whether they would recommend the program to a friend. Respondents used a Likert scale ranging from 1 (nothing) to 5 (very much).

Measure Procedure

A first visit was made to confirm that the patient was naïve. In the affirmative cases ADHD IV RS parent's version was administrated as screening tool. Inclusion and exclusion criteria mentioned above were reviewed. In the affirmative cases, the study was explained and the family was invited to participate. Families who accepted signed informed consent. Verbal assent was also requested from all children. In a second visit, K-SADS-PL was administered to confirm the diagnosis of ADHD and to know the absence or presence of comorbidity. The cases in which the diagnosis of ADHD was confirmed continued in the study. WISC-IV was started. Parents and children's questionnaires were given. On the third visit, WISC-IV was finished and questionnaires were collected. On the fourth visit, CPT-3 and STROOP test were administrated. Once the evaluation process was completed, the questionnaires were corrected and a return interview was conducted. On the same week (or a week after) the mindfulness treatment was finished, the retest session was performed and a return interview was conducted.

Treatment

The mindfulness-based intervention program was designed ad hoc by means adaptations for children of existing programs. It is based on mindfulness-based cognitive therapy (Segal, Williams, & Teasdale, 2002) and mindfulness-based stress reduction training (Kabat-Zinn, 1982). A protocol was prepared by the principal investigator and collaborators (session contents shown in Table 1). The program includes formal and informal practices. The program lasted for 8 weeks, included 6 children per group and each session lasted 75 minutes. Each week, participants had mindfulness exercises to practice at home (homework completion forms were delivered). The sessions were highly structured and followed the same outline: at the beginning of each session homework was checked out and discussed, and at the end personal reflection and feedback of the session were promoted. On the first session group rules were established and mindfulness psychoeducation was provided. Also, the training room was as free as possible from distractors. In addition, on the last session a satisfaction questionnaire ad hoc was administrated to the children to evaluate their satisfaction with the mindfulness treatment.

Table 1. Contents of the Mindfulness Training Program.

Session	Mindfulness exercises	Homework
	Recognizing the present moment (what is mindfulness)-psychoeducation	
1	Hearing meditation with bell Breathing meditation	Breathing meditation (breathing stones)
2	Sensory awareness exercises Breathing meditation	Breathing meditation (breathing stones) Identifying emotions and situations
3	Mindful listening Walking meditation	Breathing meditation (breathing stones) Mandala painting
4	Bodyscan Sensory awareness exercise Breathing meditation	Focus on sounds Breathing meditation (breathing stones)
5	Mindful eating Automatic pilot	Mindful eating Breathing meditation (breathing stones)
6	Working with thoughts and emotions Exploration of unpleasant and pleasant events	Awareness of pleasant moments-events Breathing meditation (breathing stones)
7	Working with thoughts and emotions Integrating mindfulness to daily life	Attention for a routine activity Breathing meditation (breathing stones)
8	Awareness exercise Working with emotions Breathing meditation	The weather forecast Breathing meditation (breathing stones)

Data analysis

Data were analyzed using SPSS 23.0. The analyses of qualitative variables were calculated using frequencies and percentages for each category. Quantitative variables analyses were performed using parametric or non-parametric test (*T* or *U*-Mann Whitney tests) that allow comparison of means. The changes from pretest to posttest were tested by Wilcoxon test ($p < .05$ was considered statistically significant).

RESULTS

Results from the Satisfaction with Treatment Questionnaire suggest that children who completed the program report satisfaction with the training. 90% of the participants liked very much participating in the mindfulness program. Furthermore, 80% of children indicated that they would recommend the program to their friends, and many families asked for further mindfulness training after the follow-up meeting.

Feasibility of treatment research has shown that once children are enrolled in mental health services, there is generally a high potential for dropping out (Wierzbicki & Pekarik, 1993). One patient dropped out the study, which represents a 16.7%, similar dropout rates are found in the literature. In addition, the attendance rate of 87.5% among all participants provided further support for treatment feasibility. Acceptability of Treatment Program evaluations were highly positive, as both parents and their children endorsed the benefits of mindfulness training in terms of affective and behavioral outcomes.

Regarding clinical symptoms, pre- to posttest reductions in scores were observed in all core symptoms of ADHD (inattention, hyperactivity and impulsivity) and in oppositional behavior. There was a significant reduction of total ADHD symptoms evaluated on the ADHD Rating Scale-IV ($p = .042$) and Conners Rating Scale parents version ($p = .042$). Regarding hyperactivity/impulsivity symptoms, statistically significant differences were shown on the parent-rated Conners Rating Scale ($p = .043$).

On anxiety symptoms, referred by parents, statistically significant improvements were found in total scores in the SCARED scale ($p = .042$). Also significant changes were observed in social phobia (SF) scores ($p = .042$). Reductions on total scores on SCARED anxiety symptoms referred by children were observed, but were not statistically significant. One child showing clinically significant depression at baseline (CDI score greater than 19) no longer reported it after the training; however one participant, previously not reporting significant depression, showed some symptoms of depression after treatment.

Comorbidity symptoms measured with the CBCL suggest a reduction in clinical symptoms in the following scales: anxious/depressed, withdrawn/depressed, somatic complaints, thought problems, attention problems, rule-breaking behavior and aggressive behavior. A slight increase was observed in social problems. However no statistically significant differences were observed in pre- to post measures with the CBCL. Clinical and statistically significant improvements pre- to posttest are shown in Table 2.

Regarding cognitive task performance, significant improvements were found for measures that involve cognitive flexibility, automatic response inhibition, attentional capacity (Stroop colour-word card) ($p = .043$) and processing speed (coding subtest WISC and Stroop colour card), respectively ($p = .043$; $p = .042$). But not for measures of working memory, however scores increased in task performance related to working memory concepts (Digit span and arithmetic subtests of the WISC-IV). No significant difference was observed on the results of the four measures of the CPT-3 (inattentiveness, sustained attention, vigilance and impulsivity). Results are summarized in Table 3.

Table 2. Pre to Posttraining changes in clinical symptoms (ADHD and comorbid symptoms).

		Pre		Post		Z	p
		M	SD	M	SD		
ADHD Rating Scale IV ¹	Inattention	18.00	5.24	14.60	5.89	-1.09	0.27
	Hyperactivity/Impulsivity	18.00	4.84	14.20	4.08	-1.82	0.06
	Total symptoms	36.00	9.13	28.80	9.93	-2.03	0.04
Conners Rating Scales Revised ²	Inattention	73.00	11.02	62.00	9.92	-1.75	0.08
	Hyperactivity/Impulsivity	80.40	11.67	67.00	13.32	-2.03	0.04
	Total symptoms	74.60	8.82	60.60	15.72	-2.02	0.04
	Oppositional conduct	66.80	10.13	59.80	14.37	-1.47	0.14
CBCL ²	Anxious/depressed	66.60	5.72	61.40	5.72	-1.35	0.17
	Withdrawn/depressed	59.40	11.82	57.80	11.82	-1.00	0.31
	Somatic complaints	59.20	8.87	54.40	8.87	-1.08	0.27
	Social problems	62.60	5.27	64.80	5.27	-1.13	0.25
	Thought problems	60.60	9.37	54.60	9.37	-1.21	0.22
	Attention problems	73.80	17.10	62.80	17.10	-1.48	0.13
	Rule-breaking behavior	62.60	6.10	57.20	6.10	-1.62	0.10
	Aggressive behavior	65.00	8.63	59.00	8.63	-0.96	0.33
SCARED parents ¹	Panic/somatic separation	8.20	6.57	6.00	6.51	-1.28	0.19
	Anxiety	8.60	3.20	7.20	3.11	-0.13	0.89
	Generalized anxiety	8.60	4.39	8.00	4.63	-.677	0.49
	School phobia	1.60	2.07	0.80	1.78	-1.63	0.10
	Social phobia	7.00	3.53	3.60	3.78	-2.03	0.04
SCARED children ¹	Total score	34.20	17.28	25.60	16.69	-2.03	0.04
	Panic/somatic separation	4.60	4.21	3.40	2.30	-1.13	0.25
	Anxiety	9.80	4.60	9.60	4.09	-0.36	0.71
	Generalized anxiety	10.80	6.38	7.80	5.02	-1.08	0.27
	School phobia	1.40	1.51	0.40	0.89	-1.89	0.05
CDI ¹	Social phobia	7.40	4.15	7.40	2.51	0.00	1.00
	Total score	34.00	18.80	28.60	12.48	-0.40	0.68
		13.40	7.36	12	5.78	-0.73	0.46

Notes: M= Mean, SD= Standard Deviation; ¹= Raw score; ²= Typified score; p= Significance level.

In relation to quality of life parents reported clinical (but not statistically significant) improvements, in all domains except for comfort domain, showing higher satisfaction, more resilience, higher achievement and more risk avoidance (Table 4).

Table 3. Pre to Postraining Changes in Executive Functions.

	Pre		Post		Z	p
	M	SD	M	SD		
Digit Span ¹	11.60	1.14	12	1.58	-1.84	0.85
Digit Span backward ¹	5.40	1.14	5.60	0.54	-0.37	0.70
Digit Span forward ¹	6.20	0.44	6.40	1.14	-0.44	0.65
Arithmetic ¹	18.40	3.05	18.80	2.49	-0.68	0.49
Coding-Digit Symbol ¹	33.80	7.05	40.20	6.76	-2.02	0.04
Stroop word ¹	96.60	15.42	102.40	14.91	-1.62	0.10
Stroop colour ¹	68.60	8.87	74.60	8.79	-2.03	0.04
Stroop colour-word ¹	39.60	1.81	44.80	5.02	-2.02	0.04
Detectability ²	59.20	3.56	61.00	3.93	-1.21	0.22
Omissions ²	68.60	14.18	73.80	14.16	-0.67	0.49
Commissions ²	52.20	5.80	50.40	8.87	-0.54	0.58
Perseveration ²	63.80	16.81	69.00	13.69	0.00	1
Hit Reaction Time score ²	65.80	10.40	73.00	13.05	-1.75	0.08
Variability ²	66.00	9.08	67.00	15.87	-0.53	0.59
HRT Block Change ²	57.80	7.98	51.00	9.97	-0.73	0.46
HRT Inter-Stimulus Interval Change ²	57.80	18.26	65.60	10.40	-0.67	0.49

Notes: M= Mean; SD= Standard Deviation; ¹= Raw score; ²= Typified score; p= Significance level.

Table 4. Pre-to Postraining Changes in Quality of Life.

	Pre		Post		Z	p
	M	SD	M	SD		
Satisfaction ²	33.67	9.41	34.53	14.31	-0.67	0.50
Comfort ²	44.52	13.49	42.66	11.10	-0.36	0.71
Resilience ²	35.41	12.92	36.89	9.52	-0.67	0.50
Risk avoidance ²	31.91	13.74	34.16	16.61	-0.13	0.89
Achievement ²	32.69	12.73	39.14	10.81	-1.48	0.13

Notes: M= Mean; SD= Standard Deviation; ²= Typified score; p= Significance level.

DISCUSSION

We report the results of a pilot study of a mindfulness training program for children with ADHD to examine the effect on psychopathology and cognitive functions of an 8-week mindfulness training program for children newly diagnosed with ADHD. The comparison of results before and after treatment suggest that the program may lead to reduce ADHD children’s symptoms, and suggests improvement in performance on tasks associated to executive functioning. Besides, the mindfulness training program submits to improve wellbeing, general health and quality of life of children. In summary, the study supports the feasibility and potential utility of mindfulness training in at least a subset of children newly diagnosed with ADHD.

We hypothesized that a mindfulness group training program could improve core ADHD symptoms, executive functioning and comorbidity symptoms in children with ADHD, in addition to increasing the children’s quality of life. Regarding ADHD symptoms and consistent with previous research (Van der Oord *et alii*, 2012) we found evidence that mindfulness training had a positive influence in general ADHD primary symptoms, as rated by parents. Reduction in hyperactivity/impulsivity behavior was noticed but we did not find a significant reduction of inattention measures reported

by parents specifically. These results are congruent with clinical knowledge and could be explained because the improvement in hyperactivity is observed immediately, but improvement in inattention requires more time to be observed.

In line with previous research developed with anxious children (Semple, Reid, & Miller, 2005), and young and adult patients with ADHD (Haydicky, Wiener, Badali, Milligan, & Ducharme, 2012; Zoogman, Goldberg, Hoyt, & Miller, 2014, Zylowska *et alii*, 2008) the mindfulness training-group program showed an improvement of anxiety symptoms and provides a general tendency to decrease other associated internalizing symptomatology. In our study these changes are observed. Thus, mindfulness training could be an effective intervention for children.

Regarding neurocognitive findings, consistent with previous research conducted with adolescents and adults with ADHD (Zylowska *et alii*, 2008), we found that mindfulness could enhance processing speed so, it may specially improve conflict attention (related to the development of inhibition and self-regulation) (Rueda, Posner, & Rothbart, 2004). In contrast, there was less evidence for changes in working memory (ability to memorize and manipulate information to produce some result) (Tang, Yang, Leve, & Harold, 2012). However, it is important to note that working memory and processing speed are two related concepts. A number of studies (Mitchell *et alii*, 2015, Van de Weijer-Bergsma, Formsma, Bruin, & Bögels, 2012) have reported that increased processing speed can decrease the amount of information a child can hold and work with; however lower processing speed can impair the effectiveness of working memory. Results are inconclusive and further research in this field is needed.

This study offers valuable information about possible and effective new intervention strategies for children with ADHD. In addition, well-validated measures of ADHD and comorbidities were used. Furthermore no side effects were observed and treatment was well accepted by families and patients. The results must be viewed and interpreted with caution because our study has methodological limitations, for example a small sample and no control group. In addition the results are limited to posttreatment without follow-up, therefore the study findings have limited generalizability. However the decrease in ADHD symptoms observed in such a small sample are promising results that suggest that a mindfulness program can be a useful intervention tool in the treatment of children with ADHD. Available treatments focus on reducing symptoms and improving functioning across settings (Guideline, 2011). A multimodal treatment (pharmacological, psychological, educational interventions) is recommended for children with ADHD (Guideline, 2011; Sibley, Evans, Waxmonsky, & Smith, 2014). The only scientifically valid psychological treatment so far in the treatment of children with ADHD is parent training. For this reason it is necessary to study other effective psychological interventions that can improve ADHD symptoms, executive functions and the wellbeing of these children. Therefore we consider conducting a study with higher methodological rigor and scientific validity.

This study suggests that mindfulness could be effective in treating children with ADHD. Furthermore, it adds an alternative therapy for those parents who reject stimulant treatment, for patients who have side effects or who do not show a response with stimulant treatment. Therefore, these findings suggest possible new non-pharmacological intervention strategies, contributing to the advance of the treatment of these patients and improving the quality of life of these children and in turn reducing the potential effects and costs associated with drug treatment, and ultimately we will be increasing the quality of care of these patients.

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