

Deficient Emotional Self-Regulation in Children with Attention Deficit Hyperactivity Disorder: Mindfulness as a Useful Treatment Modality

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ABSTRACT: *Objective:* The aim of this study was to investigate the efficacy of a structured mindfulness group intervention program targeting deficient emotional self-regulation (DESR) in a sample of children with attention deficit hyperactivity disorder (ADHD). *Method:* Seventy-two children aged 7 to 12 years with ADHD were randomized in 2 groups (mindfulness and control). The dysregulation profile was measured using the Child Behavior Checklist (CBCL) Attention/Anxiety-Depression/Aggression scales. *Results:* Children with ADHD who received mindfulness-based group therapy showed lower levels of DESR after treatment, with a reduction in CBCL dysregulation profile ($F(1,63) = 4.81; p = 0.032$). All ADHD symptoms showed a moderately significant positive correlation with DESR ($p < 0.01$). Children with combined-type showed higher levels of DESR than children with inattentive-type ($p = 0.018$); however, no statistically significant changes were observed in the combined-type after mindfulness treatment. *Conclusion:* This study suggests that mindfulness in the form of structured group therapy might be clinically relevant in treating children with ADHD and thus make an impact on the overall clinical outcome, regardless of the ADHD subtype.

(J Dev Behav Pediatr 00:1–7, 2019) **Index terms:** children, ADHD, newly diagnosed, mindfulness, emotional dysregulation.

Deficient emotional self-regulation (DESR) is a theoretical concept characterized by poor modulation of emotional responses with such symptoms as mood lability, low frustration tolerance, impatience, impulsivity, and aggressive outbursts. It underlies difficulty in flexibly responding to and managing emotions in a modulated manner.^{1,2} DESR is generated by the confluence of neurobiological and psychological factors.^{3,4} Epidemiological research has found a strong association between attention deficit hyperactivity disorder (ADHD) and emotion dysregulation.^{5,6} Clinical studies suggest that 24% to 50% of children with ADHD

also have DESR.⁷ Recent work emphasizes the role of emotional dysregulation in the genesis of behavioral problems in children with ADHD,⁸ impacting on interpersonal relationships and causing peer rejection.⁹ In psychometric terms, a >1 SD in the Child Behavior Checklist (CBCL) Attention/Anxiety-Depression/Aggression (AAA) scales profile is congruent with the clinical concept of DESR.^{2,9} Recent studies have shown that 44% of children with ADHD also have an emotion dysregulation profile on the CBCL questionnaire AAA scales.^{9,10} AU4

Management of DESR in ADHD presents formidable therapeutic challenges, partly because clinical trials in ADHD either do not assess the change in emotion regulation (ER) or do so as a secondary outcome. Psychostimulants are highly effective in the treatment of core symptoms; however, efficacy of mental health comorbidities, such as emotion dysregulation, is more limited.¹¹

Regarding the role of psychotherapy, there is preliminary evidence that intervention specifically targeting emotional dysregulation, such as mindfulness, may be an effective therapeutic option.¹² Mindfulness training is associated with an increased ability to recognize oneself as an individual not enmeshed in the surrounding environment (self-awareness). It also has strategies for processing and managing emotions with appropriate control (self-regulation), increasing flexibility of attention, reducing emotional intensity and duration and secondary emotional responses, and reducing belief in automatic thoughts. Therefore, mindfulness can address self-adaptation by improving psychological functioning.¹² Mindfulness

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Ethical considerations: This study was approved by the Research Ethics Committee (SJD Barcelona Children's Hospital). All participants were informed of the purpose of the study and signed their informed consent prior to inclusion in the study.

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training is associated with improvements in executive functions,¹² and family-based mindfulness intervention has shown improvement in inattention and hyperactivity symptoms in children.^{13,14} There are also some biological factors associated with mindfulness. Several studies^{15,16} have suggested stronger signals in brain regions related to affect regulation and attentional control and increased dopamine release. Mindfulness meditation seems to increase grey matter in the left hippocampus, the posterior cingulate cortex, the temporo-parietal junction and the cerebellum and decrease amygdala activation. Environmental effects of mindfulness intervention are also observed in improved interpersonal relationships, which would be beneficial to social impairment associated with DESR in young adolescents with ADHD.¹⁷ Enhanced listening and focus on the essentials of interaction can in turn produce a positive feedback from others (parents, siblings, peers, etc.) and thus reinforce bilateral regulation and communication.

Emotion regulation (conscious and unconscious strategies for increasing, maintaining or diminishing one or more components of an emotional response) is considered a major component of mental health, and its imbalance could underlie psychopathological conditions,¹⁸ so clinical intervention focused on ER could have important benefits for mental health disorders.¹⁹ There is some evidence²⁰ that the use of ER strategies can reduce the intensity of negative emotional experiences.

In brief, although most of mindfulness intervention studies have an AB experimental design (a baseline period (A) is followed by a treatment (B)). If measurements between different periods show a significant effect the treatment may be said to have had an effect, evidence so far suggests that mindfulness intervention could be beneficial to self-regulation.²¹ However, few studies have evaluated the specific impact of mindfulness on emotional dysregulation in children under 12 with ADHD. Our study was a randomized controlled trial in a clinical setting, in which only children were given mindfulness treatment.

We hypothesized that a structured group mindfulness treatment program for children would be effective in reducing emotional dysregulation rates in children newly diagnosed with ADHD compared to a control group and thereby impact on the overall positive outcome of the disorder. The study's main goal was therefore to evaluate the usefulness of a structured mindfulness treatment program targeting emotional dysregulation in children newly diagnosed with ADHD. The children in the sample are described, identifying their emotional dysregulation profiles. The relationship between ADHD symptoms and emotional dysregulation in children is also examined.

METHOD

Design Randomized Controlled Trial

Participants

The study sample was composed of 72 children diagnosed with attention deficit hyperactivity disorder

(ADHD) randomized into 2 groups (mindfulness and control) of 36 patients each. Two patients passed the initial screening but were excluded after preintervention evaluation. One child was diagnosed with autism spectrum disorder (ASD) and clinical events showed the other required pharmacological treatment (Fig. 1). Participants were recruited from the ADHD unit of the child and adolescent mental health department of a pediatric hospital and also from a community child and adolescent mental health service (CAMHS). Inclusion criteria were: aged 7 to 12 years, diagnosed with ADHD according to DSM-5²² criteria, ADHD Rating Scale IV (Parent Version) T-score ≥ 1.5 SD for the total index standard age (Du Paul, Power, Anastopoulos, & Reid, 1998), currently not taking psychotropic medication for the treatment of ADHD. Exclusion criteria were diagnosis of ASD, psychosis or bipolar disorder, an intelligence quotient (IQ) score below 70, or receiving other psychological intervention. Other comorbidities such as anxiety disorders, oppositional defiant disorder, conduct disorder, and learning disorders were allowed.

Materials and Instruments

Assessment Included

Kiddie Schedule for Affective Disorders and Schizophrenia for school-age children-present lifetime version (K-SADS-PL), Spanish version (Soutullo, 1996): This is a semistructured diagnostic interview designed to assess current and past episodes of psychopathology in children and adolescents according to DSM-III-R and DSM-IV criteria.

Wechsler intelligence scale for children, fourth version (WISC-IV), (Wechsler, 2005): This scale is an intelligence test for children aged 6 to 16. It consists of 15 tests grouped in 4 index scores: Verbal Comprehension Index, Perceptual Reasoning Index, Working Memory Index, and Processing Speed Index and a total IQ is given.

ADHD Rating Scale IV, parent version (Du Paul et al., 1998) includes 18 items assessing DSM-IV-TR ADHD criteria. Responses are rated on a 4-point 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 over 1.5 SD from the score for the standard age for the diagnosis subtype.

Social Communication Questionnaire (SCQ); Rutter et al., 2008): This screening instrument evaluates communication skills and social functioning in children who may have ASD. The questionnaire is available in 2 forms (lifetime and current), each composed of 40 yes-or-no questions. It provides a total score with an ASD cutoff point at ≥ 15 points.

Child Behavior Checklist (CBCL); Achenbach & Rescorla, 2001): This is a 113-item broad-spectrum parent rating scale for assessing externalizing and internalizing problems for ages 4 to 18 years. Standard scores above 70 suggest clinical symptoms.

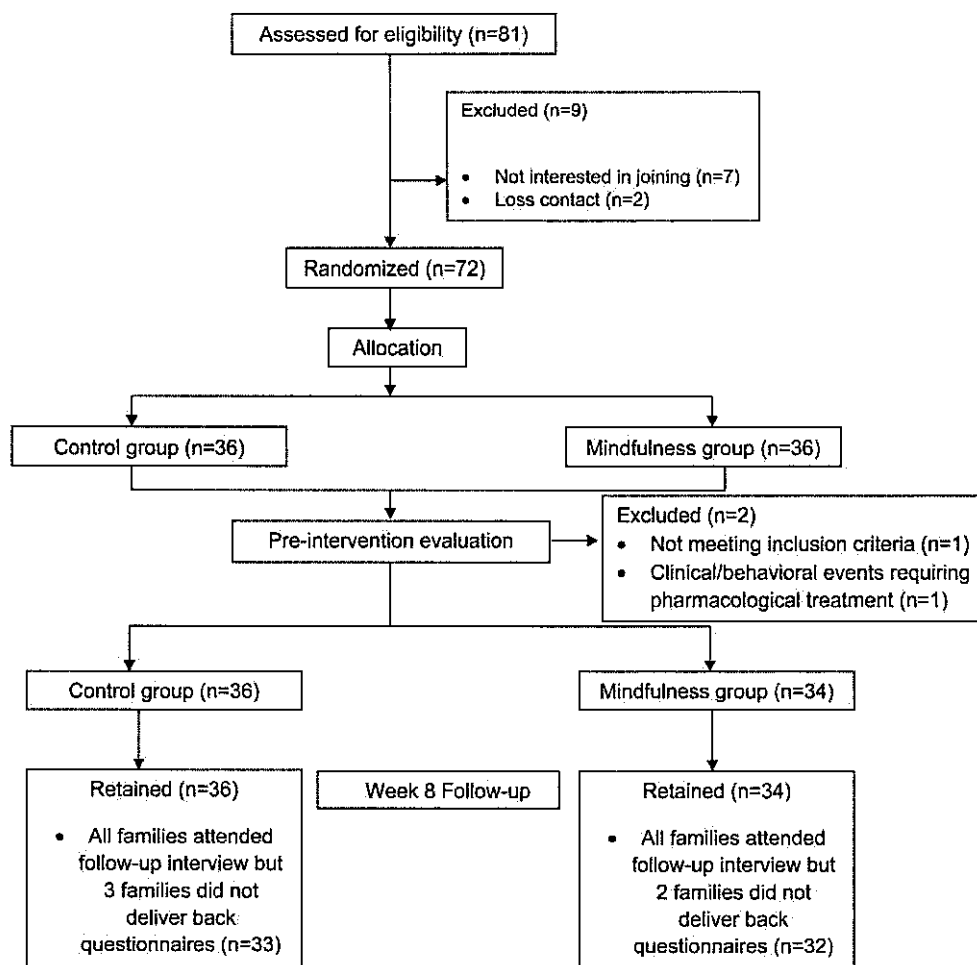


Figure 1. Consort diagram.

Child Behavior Checklist– Deficient Emotional Self-Regulation and Child Behavior Checklist–Severe Dysregulation Profiles

Emotional dysregulation was assessed using the sum of t-scores for the anxiety/depression, aggression, and attention (AAA) scales. These scales reflect intense emotions (anxiety/depression scale), aggression (aggression scale), and impulsive behavior (attention scale),⁸ providing a profile that identifies children with dysregulated mood, anxiety, aggression, and impulsivity. The reliability coefficients (Cronbach's alpha) were 0.82, 0.81, and 0.82, respectively. The deficient emotional self-regulation clinical construct may be adequately captured by T-scores ≥ 180 (1 SD) but < 210 (2 SD) on the AAA scale of the CBCL (Spencer et al., 2011; Biederman et al., 2012). AAA scale scores ≥ 210 (2 SD) are described as severe dysregulation associated with bipolar disorder (Faraone et al., 2005; Biederman et al., 2009).

Treatment

After evaluation, the treatment group received diagnosis counseling and mindfulness-based group intervention. The mindfulness program is based on mindfulness-based

stress reduction training²² and mindfulness-based cognitive therapy.²³ The protocol was designed ad hoc by the clinical team from existing activities and programs^{24,25} (session contents shown in Table 1). The program includes formal and informal exercises. The program lasted for 8 weeks, with 6 children per group and each session lasted 75 minutes. In order to enhance compliance, children and their parents met with the clinicians before starting the intervention to discuss the problems they faced, the potential benefits of mindfulness, to check their motivation, and to stress the necessity of practicing at home. In the first session, group rules were explained and mindfulness psychoeducation was provided. Each week, participants had mindfulness exercises to practice at home. The sessions were highly structured and always followed the same outline: at the beginning of each session, home practice was checked and discussed, and at the end, personal reflection and feedback on the session were promoted. At the end of each session, the therapist met with the parents and children and explained what had been worked on. All sessions were given by the same therapist and an observer was always included.

The control group received standard treatment including diagnosis counseling, parent behavior training

Table 1. Content of the Mindfulness Training Program for Children with ADHD

Session	Mindfulness Exercises	Homework
1	Mindfulness psychoeducation. Recognizing the present moment (what is mindfulness and benefits)	Breathing meditation (breathing stones)
2	Self-awareness sensory awareness exercise (auditory). Breathing meditation	Breathing meditation (breathing stones). Identifying emotions and situations
3	Body scan. Walking meditation	Breathing meditation (breathing stones). Attention routine activity
4	Attention to movements. Sensory awareness exercise (visual). Breathing meditation	Mandala painting. 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 (Difficulties). Integrating mindfulness to daily life	Awareness of difficulties. Breathing meditation (breathing stones)
8	Working with emotions. Awareness qualities	The weather forecast. Breathing meditation (breathing stones)

ADHD, attention deficit hyperactivity disorder.

counseling, and liaison with school and psychoeducational interventions were implemented when required; pharmacological treatment was not included.

Ethics Approval and Informed Consent

This study was approved by a Research Ethics Committee. All parents or guardians of the children who were included in this study gave their signed consent and children were asked for verbal agreement.

Procedure

AU7 Participants were recruited from the patients attended to in the ADHD unit and in CAMHS. The ADHD RS IV for parents was used for screening. Patients who scored ≤ 1.5 SD in relation to their age group were not included. SCQ was used as a screening device to rule out ASD. Families who agreed to participate signed their informed consent. Then, participants were randomized into 2 groups (mindfulness and control group). After that, K-SADS-PL, semistructured diagnostic interview, was administered to confirm the ADHD diagnosis and to find out whether there was any comorbidity. KSADS interview includes the assessment of child's functioning in different contexts (home, school, social). Parents were also asked to bring school reports of the previous year. On another visit while parents were completing the ADHD RS IV and the CBCL, participant cognitive abilities were assessed with the WISC-IV. The evaluation process took 3 weeks and then a feedback interview was conducted. Children with a score above 210 on CBCL dysregulation profile were excluded. A retest session was performed up to 1 week after treatment. No longer-term follow-up data were collected.

Statistical Analysis

Data were analyzed using SPSS 25.0. The analyses of qualitative variables were calculated using frequencies and percentages for each category. Demographic characteristics in the 2 groups were compared using *t* tests and Pearson's χ^2 . The effect of the treatment compared to the control was analyzed by analysis of variance with one between-subjects factor and one within-subjects factor of time. ADHD symptom severity (ADHD RS IV)

was added as a covariate. Correlation analysis was used to determine the associations between emotion dysregulation and ADHD symptoms. A *p* value of <0.05 was considered statistically significant.

RESULTS

Participant Characteristics

The mindfulness group consisted of 34 participants, of whom 24 were boys (71%) with a mean age of 9 years (SD 1.29) in a range of 7 to 11. The control group consisted of 36 participants, 27 of whom were boys (75%) with a mean age of 8.81 years (SD 1.65) in a range of 7 to 12. The percentage of cases diagnosed as combined-type attention deficit hyperactivity disorder (ADHD) was similar in the treatment group (64.7%) and the control group (63.9%). No significant differences between groups were observed in age, gender, comorbidity, ADHD subtype, or baseline dysregulation profile. Most of the children (88.3%) in the treatment group attended all the sessions or failed one at most. Sample sociodemographic and clinical characteristics are shown in Table 2. **T2**

In our sample, 57.1% of children showed deficient emotional self-regulation (DESR). Significant differences were found for ADHD subtypes and presence of DESR. Children with combined-type showed higher levels of emotional dysregulation than children with inattentive-type ($p = 0.018$). No differences were found in dysregulation profile depending on the presence or absence of comorbidity ($p = 0.114$). A significant moderate positive correlation was observed in inattention symptoms and DESR ($r = 0.420$, $p < 0.01$), hyperactivity-impulsive symptoms and DESR ($r = 0.407$, $p < 0.01$), total symptoms, and DESR ($r = 0.479$, $p < 0.01$) between ADHD RS fourth and emotional dysregulation.

In the mindfulness group, 51.9% of the children showed DESR at baseline according to their Child Behavior Checklist Attention/Anxiety-Depression/Aggression scale profiles. This proportion decreased after treatment to 48% [$\chi^2 = 0.023$; $p = 0.88$ ($df = 1$)]. There was no statistically significant difference in children regarding ADHD subtype after mindfulness treatment. No differences in response based on presence or absence of comorbidity in the mindfulness group was

Table 2. Sample Sociodemographic and Clinical Characteristics (Children with ADHD)

Characteristics	Mindfulness Group (n = 34)		Control Group (n = 36)		p
	Mean	SD	Mean	SD	
Age (yr)	8.79	1.29	8.81	1.65	0.975 ^a
Baseline dysregulation (AAA) profile	201.06	20.72	193.94	19.96	0.15 ^a
	Mindfulness Group (n = 34)		Control Group (n = 36)		p
	n	%	n	%	
Sex					0.678 ^a
Boys	24	70.6	27	75	
Girls	10	29.4	9	25	
ADHD presentation					0.865 ^b
Inattentive	10	29.4	12	33.3	
Hyperactive-impulsive	2	5.9	1	2.8	
Combined	22	64.7	23	63.9	
Comorbidity					0.477 ^a
Yes	18	52.9	16	44.4	
No	16	47.1	20	55.6	
Anxiety disorder		7			0.813 ^b
Yes	12	35.3	8	22.9	
No	22	64.7	28	77.1	
Oppositional defiant disorder					0.813 ^b
Yes	5	14.7	7	20	
No	29	85.3	29	80	
Tics disorder					0.813 ^b
Yes	1	2.9	1	2.9	
No	33	97.1	35	97.1	

p, significance level. ^aChi-square test. ^bGamma coefficient. AAA, attention/anxiety-depression/aggression; ADHD, attention deficit hyperactivity disorder.

observed in DESR profile [$\chi^2 = 0.083$; $p = 0.773$ (df = 1)]. Looking only at anxiety/depression, attention problems and aggressive behavior scales in the mindfulness group, a significant decrease in symptoms was observed on the attention scale ($p = 0.001$) and on the aggressive behaviors scale ($p = 0.001$). No statistically significant difference was observed in the anxiety/depression scale ($p = 0.77$).

In the control group, 48.1% of the children showed DESR at baseline, observing a higher percentage in DESR at posttest measure (52%) [$\chi^2 = 0.023$; $p = 0.88$ (df = 1)]. Regarding response based on presence or absence of comorbidity in the control group, 64.3% of the children with comorbidity showed more worsening in DESR emotion. Only 33.3% of the children without comorbidity showed more clinical DESR worsening [$\chi^2 = 3.03$; $p = 0.08$ (df = 1)]. Despite no significant differences were observed, results suggest that probably with a bigger sample size, the outcome would be significant. No significant differences were observed in the

anxiety/depression scale ($p = 0.56$), attention problems scale ($p = 0.14$), or aggressive behaviors scale ($p = 0.52$) when examined separately.

However, in the analysis of variance (ANOVA) model with one between-subjects factor (mindfulness vs control) and 1 within-subjects factor of time, a significant interaction time \times group was observed ($F(1,63) = 4.81$; $p = 0.032$), showing an effect of the treatment. In the ANOVA model with one between-subjects factor (mindfulness vs control) and with ADHD severity ratings as a potential moderator of outcomes, the interaction between time and group was statistically significant ($F(1,61) = 4.23$; $p = 0.044$) (Table 3).

T3

DISCUSSION

In line with previous research,^{10,11} a strong association was observed between children with attention deficit hyperactivity disorder (ADHD) and emotion dysregulation. Both inattention and hyperactive-impulsive symptoms correlated with the problems of deficient emotional self-regulation (DESR). This suggests that problems focusing attention make it difficult to recognize thoughts, emotions and sensations, whereas impulsivity hinders self-control and reflection, both areas being connected. Some of the clinical presentations reported by parents and teachers both at home and at school, such as emotional outbursts and general overreactivity, might be mistakenly tagged as the impulsive behaviors or inattentiveness typical of ADHD. This may be one reason why some of the usual treatment strategies fall short and are ineffective in dealing with a significant group of unstable children. Therefore, emotion regulation (ER) may well form a substantial part of a wider picture related to ADHD. Because of this, we propose, as suggested by Barkley,¹² that emotion dysregulation is a significant clinical entity often associated with ADHD. Characteristics of emotion dysregulation, such as low frustration tolerance, are also included as associated features of ADHD in DSM-5.¹³

We aimed to examine the effect on ER of an eight-week mindfulness training program for children newly diagnosed with ADHD. The changes observed in the Child Behavior Checklist dysregulation dimensional ratings profile suggest that our program may lead to improved emotional dysregulation in children with ADHD, and specifically, be effective in focusing attention and reducing impulsivity, aggressive behavior, and emotional impairment. However, results are tempered by lack of differences in percentages meeting criteria for a DESR profile. Nonetheless, the trend in the results suggests that it may be a useful tool, and leads to consideration of the number of treatment sessions needed to observe greater change or the inclusion of follow-up sessions.

Furthermore, the results suggest that ER should be a therapeutic target to be included in the intervention design. This study offers valuable information about possible effective new intervention strategies for children with ADHD and DESR. Mindfulness may be a useful

Table 3. Changes in DESR Profile Over Time

	DESR CBCL Profile		Time	Time \times Group	ADHD RS IV (Covariate)
	Baseline	After Treatment			
Mindfulness	201.06 (20.72)	190.59 (19.53)	$F = 10.53$ $p < 0.01$	$F = 4.81$ $p = 0.032$	$F = 4.23$ $p = 0.044$
Control	193.94 (20.08)	192.32 (23.08)			

ADHD RS IV, attention deficit hyperactivity disorder rating scale IV; CBCL, child behavior checklist; DESR: deficient emotional self-regulation.

and effective intervention tool increasing their capacity for attention and introspection and improving cognitive and emotional self-control. Furthermore, mindfulness stimulates and favors regulation by stimulating brain areas involved in emotions, promoting learning of ER strategies, and thereby favoring adequate ER^{28,29} (Fig. 2). One strength of this study is that the sample is composed of children newly diagnosed with ADHD and as yet untreated. In addition, it is one of the few studies that examine a large sample of children with ADHD randomized in 2 groups. The KSADS interview (gold standard in child psychiatric research) was used to assess the ADHD diagnosis and well-validated measures of ADHD and comorbidities were used. A weakness is that school data were only collected from the academic reports and collected from the information provided by the parents during the clinical interview, so in future research questionnaires should be delivered to the teachers. In addition, even though poor emotional control is prevalent in many psychiatric disorders,³⁰ the DESR theoretical construct is difficult to operationalize. However, its clinical reality is significant, and therefore, it must be measured and treated in these children. The results are also limited to the immediate posttreatment, and it remains to be seen if these effects are maintained over

time. Nevertheless, the decrease in the DESR profile suggests that this mindfulness program may be useful, and that mindfulness intervention alone in children with ADHD and DESR may reduce the problems of this disorder. So, mindfulness as a group intervention program can be recommended as an intervention strategy. Some findings,^{18,19} as well as our own clinical opinion, recommend that future research compare the combination of parallel training (children and parents) and mindfulness child training alone in a randomized controlled clinical trial to determine which aspects are most effective.

CONCLUSIONS

Our data suggest that mindfulness in the form of a structured group therapy may be an effective treatment for children with attention deficit hyperactivity disorder (ADHD) improving emotion regulation. Mindfulness practice is not learned in a day, but a brief knowledge of mindfulness skills allows children to attend and understand thoughts, feelings, and sensations from another perspective, from a healthy perspective. This study contributes an alternative nonpharmacological intervention therapy for emotion dysregulation prevention

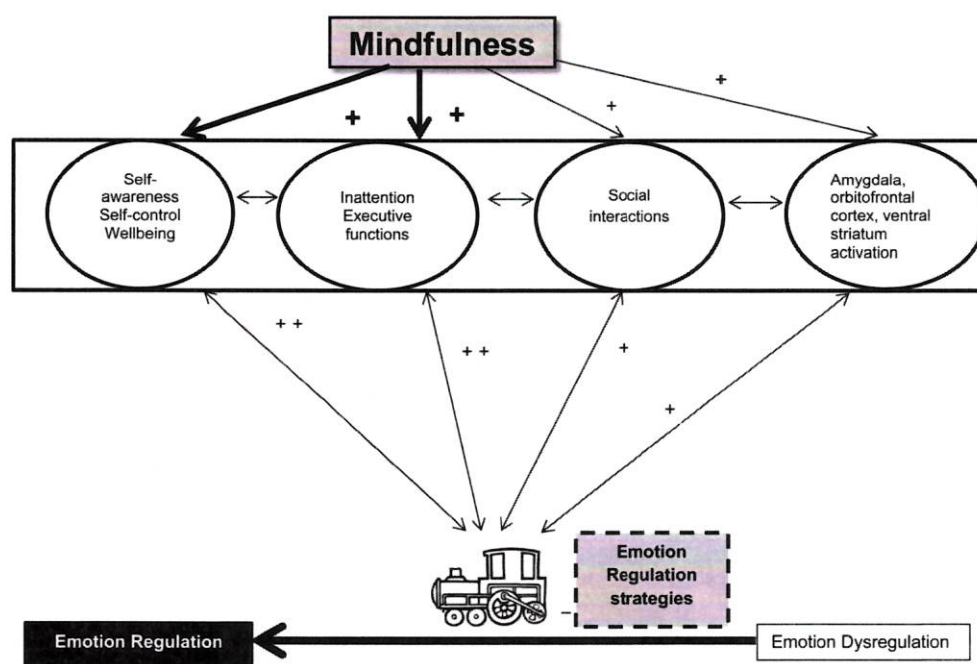


Figure 2. Mindfulness and emotion dysregulation improvements.

and treatment, providing a more versatile approach to the treatment of ADHD which would improve the quality of care and life of these children and their families.

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