

Treatment Programs for Students With Attention Deficit Hyperactivity Disorder: A Meta-Analysis Study

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Context: The aim of this study was to determine the experimental evidence of treatment/intervention programs for deficits in social skills, attention, and behavioral disorder in children and adolescents with attention deficit hyperactivity disorder (ADHD).

Evidence Acquisition: Meta-analysis procedures were employed to investigate whether children and adolescents with ADHD exhibit deficits in attention and social skills. A total of 17 empirical research studies published between 2000 and 2013 met our inclusion criteria. Attention and social skills measures were categorized according to both modality and type of processing required.

Results: Children with ADHD exhibited deficits in multiple components of attention and social skills that were not related to language-learning disorders and weaknesses in general intellectual abilities. The overall percentage effect for attention and social skills in students with ADHD was calculated (effect size = 0.79, confidence interval = 0.57 - 1.08). This meta-analysis study showed that treatment programs reduced attention deficit and social skills in ADHD children and adolescents.

Conclusions: The evidence of attention and social skills deficits in children with ADHD supports recent studies in ADHD deficits. Further research is required to explain in detail the nature, severity, and specificity of the deficits in individuals with ADHD.

Keywords: Adaptation; Behavior Control; Brain Damage Chronic; Neurobehavioral Manifestations; Mental Competency

1. Context

Attention-deficit/hyperactivity disorder (ADHD) is a psychobiological disorder that is described by attention deficit, hyperactivity, and reduced impulse control. Based on the diagnostic and statistical manual of mental disorders, Fifth edition (DSM-V), ADHD is a "persistent pattern of inattention and/or hyperactivity and impulsivity that interferes with functioning or development. The inattention manifests behaviorally in ADHD as wandering off task, lacking persistence, having difficulty sustaining focus and being disorganized, and is not due to defiance or lack of comprehension. Hyperactivity refers to excessive motor activity (such as a child running about) when it is not appropriate, or excessive fidgeting, tapping, or talkativeness (1)." Based on DSM-V results, several symptoms appear before the age of 7. The 3 subtypes that are related to ADHD include predominantly hyperactive, predominantly inattentive, and a combination of one or more of the afore-

mentioned types.

A child must demonstrate at least 6 of the 9 symptoms and adolescents must demonstrate at least 5 of the 9 symptoms in a cluster form before the 3 subtypes (1). Past research illustrated that symptoms related to hyperactivity may decrease as the child grows older, while the child's inattentiveness remains relatively unchanged (2, 3). Barkley defined the main characteristic of ADHD as difficulty in behavioral inhibition (4).

Unintentional behavior possessed by the child diagnosed with ADHD appeared to affect their academic achievement throughout their academic career. In addition, these children displayed problems with their social skills and difficulty communicating, due to the apparent frustrations with their academic performance (5). The DSM-V shows that the rate of ADHD was greater in males than in females, with a ratio of nearly 2:1 in children and 1.6:1 in adults (1).

There are dissimilar theories on the subject of the causes of attention deficit. Attention deficit includes the combination of biologically determined reactivity of the nervous system and failure to self-regulate, and environmental disturbances (6, 7). Students who cannot centralize their thoughts are impatient and evoke negative responses from their environment, which can provoke a perception of social refusal. The continued experience of refusal at school mixed with the vulnerability of the child/adolescent nervous system is thought to produce negative perceptions, evoking compensatory behaviors, such as, aggressive comic behavior, feeling alone, and/or a depressive status. To decrease such symptoms, the creation and protection of a supportive and caring home situation would appear to be an important factor. Students must have a feeling of being accepted, the ability to develop trusting relationships, and also a belief that there are methods that can help them. This situation can be quite difficult to achieve if the parents displays symptoms similar to their child. ADHD indicators are not just limited to childhood, and the relative dynamics of this disorder may cause the condition to persevere.

Based on previous studies, the principal treatments of ADHD have focused on the use of medication, behavioral, cognitive, cognitive-behavioral, and neural treatments (8-16). A review of the literature between 2000 and 2013 identified the multimodal treatment of ADHD for the ADHD child and/or adolescent. These combination treatments include self-control, self-regulation, cognitive, cognitive-behavioral, cognitive play, behavioral play, motor-perceptual rehearsal, functions management training, verbal self-education training, education of children by parents, positive therapy, training of parents, parental constructive program, and training of stress coping skills. These studies demonstrated that the mentioned treatments were more successful and had longer lasting effects on attention deficit, social skills, and behavioral problems in ADHD than the singular medication treatment or behavioral therapy (17-28).

2. Evidence Acquisition

In this meta-analysis study, the researcher used published journal articles and theses on the topic of the effectiveness of intervention/treatment programs on ADHD from the scientific information database (SID), the Iranian research institute for information science and technology (IRANDOC), the national library and the archives of the Islamic Republic of Iran (NLAI), and the United States national library of medicine (NLM) and national institutes of health (PubMed) websites during 2000 - 2013. Database search was performed with the following keywords: treatment program and

ADHD, intervention program and ADHD, and instruction. In the preliminary database search, 72 related articles were obtained from SID, 64 dissertations and abstracts from the IRANDOC website, 23 dissertations and articles from the NLAI website, and 175 dissertations and articles from the PubMed website. All findings were screened for inclusion, based on the title and abstract, using the following restrictions regarding the treatment/intervention program on ADHD. This study's concern was interventions/treatments intended to improve ADHD. After reviewing the preliminary articles and theses on ADHD, a total number of 17 articles were screened for possible inclusion (Table 1).

These articles had to meet each of the subsequent criteria: the article must have been an original investigated report (experimental, quasi-experimental research), included treatment of at least one independent variable, and the students must have been diagnosed with ADHD. Articles excluded if they did not meet the above criteria, and if the students' Intelligence quotient scale (IQs) were below 90, or if data for the ADHD students could not be separated from data of the group without ADHD. A total of 17 articles were screened for inclusion in this meta-analysis.

In the present study, the researcher employed coding procedure (40). A coding structure and operational definitions were made to record quantitative information from each of the 17 studies. The following areas were employed for coding purposes. In this study, the research design was classified as experimental and quasi-experimental. The specific kind of design was recorded (e.g. pretest or posttest).

Treatment type was divided into 9 categories:

1. Preparation training treatments were categorized as either content area preparation or self-regulation preparation.
2. Direct training treatments included teacher-led, explicit, and systematic training.
3. Behavioral treatments included treatments in which the employment of positive reinforcement was dependent on the successful completion of an assignment.
4. Practical treatments contained treatments in which the child was candidate for reiterative performance of an ability that was intended to be already within the student's repertoire, for example: the student would stay for an extra 20 minutes to read the task.
5. Textbook modification included any treatment that modified an original textbook to decrease its stage of difficulty.
6. Combination treatments included the combination of two or more of the treatments.
7. Play treatment (such as aerobic activity and yoga).
8. Pharmaceutical treatments used were Ritalin, methylphenidate, and dextroamphetamine.
9. The final category included any intervention that did not fit in the above-mentioned categories such as cognitive treatment, cognitive-behavioral treatment, and short-term executive function training.

Table 1. Design and Treatment Characteristics of Studies Included in the Meta-Analysis ^a

Topic	Author	Type of Research	Treatment/Session
Effectiveness of self-control treatment on social skills in ADHD students	Beh Pajooch et al. (18)	Quasi-experimental	Self-control/4 sessions
Effectiveness of self-regulation of attentive behavior, self-regulation of motivational behavior, and verbal self-instruction on symptoms of attention deficit/hyperactivity	Moradi et al. (29)	Quasi-experimental	Self-regulation of attention behavior, self-regulation of motivational behavior, and verbal self-instruction/10
Effectiveness of cognitive behavioral therapy on self-perception in ADHD students	Salehi et al. (21)	Experimental	Cognitive behavioral/19
Effectiveness of early play treatment on ADHD students' attentive-inattentive behaviors	Shoshtari et al. (30)	Experimental	Play treatment/12
The effectiveness of using perceptual-motor practices on behavioral disorder among five to eight year old children with ADHD	Dehghan et al. (24)	Quasi-experimental	Perceptual-motor practices/18
The efficacy of short-term executive functions training on the reduction of symptoms of attention deficit and hyperactivity of elementary boy students in Isfahan metropolitan area	Saheban et al. (26)	Experimental	Short-term executive functions training/9
The efficacy of neurofeedback, compared to retalin, and combined neurofeedback and ritalin for the reduction of ADHD symptoms	Yaghubi et al. (17)	Quasi-experimental	Neurofeedback, retalin, & drug combination/10
Which symptoms of ADHD would improve with play therapy and yoga?	Saadat (31)	Quasi-experimental	Play therapy and yoga
The effect of narrative therapy on increase of attention and decrease of hyperactivity in children with attention deficit hyperactivity disorder	Shafieian (32)	Quasi-experimental	Narrative therapy/11
The effects of training neurofeedback on decreasing the intensity of ADHD symptoms in primary students	Hagighi (33)	Experimental	Neurofeedback therapy/40
Effectiveness of cognitive-behavioral therapy in reducing symptoms in children with ADHD	Rahmanzadeh (34)	Experimental	Cognitive-behavioral therapy/12
The effect of aerobic exercises on the visual and auditory attention of pre-school boys with ADHD in Isfahan in 2009-2010	Abedi et al. (35)	Quasi-experimental	Aerobic exercise training therapy/12
Impact of training self-regulation of attentional and motivational behaviors, and verbal self-instruction on ADHD symptoms amelioration	Hashemi Nosrat Abad et al. (36)	Quasi-experimental	Self-care behaviors, self-stimulation behaviors, verbal self-instruction
Few effects of far transfer of working memory training in ADHD: a randomized controlled trial	Egeland et al. (37)	Experimental	Working memory training/25
Effectiveness of a school-based multicomponent program for the treatment of children with ADHD	Miranda et al. (38)	Experimental	Multicomponent program/6
Comparing therapeutic effects of reboxetine with placebo in adult patients with ADHD: A randomized placebo-controlled clinical trial	Riahi et al. (39)	Clinical trial	Reboxetine & placebo/6
Comparative effectiveness of three treatments in reducing hyperactivity disorder in third and fourth levels of male primary school children in Shiraz, Iran	Hadianfard et al. (28)	Experimental	Verbal self-education and mother verbal self-education/8

^a Abbreviation: ADHD, attention deficit hyperactivity disorder.

3. Results

In this study, the researcher employed 17 ADHD studies. The data collection of each study is illustrated in Tables 1 and 2. Moreover, the mean and standard deviations of

pretests for the 17 ADHD studies are illustrated in Table 3. Furthermore, mean and standard deviations of posttests for the 17 ADHD studies are provided in Table 4.

Table 2. Dependent Variables, Instruments, and Sample Size in 17 Studies ^a

Author	Dependent Variable	Instrument	Sample/Type of Sample	Age	The Atudy Area
Beh Pajooch et al. (18)	Social skills	Cannors ^b Parent and Teacher Rating Scale, DSM-IV, Social Skills Rating System (SSRS), Raven's Progressive Matrices ^a	20/Available sampling	12-Jul	Iran/Tehran
Moradi et al. (29)	Symptoms of attention deficit/hyperactivity	DSM-IV-TR and Children Pathological Symptoms	40/Cluster sampling	12-Sep	Iran/Tabriz
Salehi et al. (21)	Self-perception	CSI-4, The Harter perceived competence scale	40/ Multi-stage sampling	11-Sep	Iran/Tehran
Shoshtari et al. (30)	Attention	DSM-V or DSM-IV, Clinical Interview	30/Random cluster sampling	6-May	Iran/Isfahan
Dehghan et al. (24)	Behavioral disorder	DSM-IV-TR; American Psychiatric Association	26/Random sampling	8-May	Iran/Tehran
Sahebanet al. (26)	Reduction symptoms of attention deficit and hyperactivity	DSM-IV ADHD Symptom on the ADHD Checklist and clinical interview	40/Random selection sampling	12-Jul	Iran/Isfahan
Yaghubi et al. (17)	Reducing ADHD	Cannors Continuous Performance Test (CPT), Iran Tova, WISC-R, Cannors Parents Rating Scale (CPRS), IVA, DSM-IV-TR	16/Available sampling	8 - 9.6 months	Iran/Did not Specify the area
Saadat. (31)	Improvement of ADHD symptoms	Child symptom Inventory (CSI-4)	80/Available sampling	12-Sep	Iran/Shiraz
Shafieian (32)	Increase attention and decrease hyperactivity	Child symptom Inventory (CSI-4)	14/Available sampling	11-Aug	Iran/Tehran
Hagighi (33)	Decreasing intensity of ADHD	Child symptom Inventory (CSI-4)	24/Available sampling	12-Jul	Iran/Isfahan
Rahmanzadeh. (34)	Reducing ADHD symptoms	Cannors Parent & Teacher Rating Scale, CSI-4	30/Random sampling	12-Jun	Iran/Javanrod
Abedi et al. (35)	visual and auditory attention of pre-school boys	Nepsy, Snap-IV scales and Clinical Interview	30/Cluster sampling	6	Iran/Isfahan
Hashemi Nosrat Abad et al. (36)	Reducing ADHD symptoms and inattention	DSM-4, CSI-4	60/Screening method	10-Sep	Iran/Did not specify the area
Egeland et al. (37)	Working memory in ADHD	F-90 ICD-10, DSM-IV, Neuropsychological Test Performance, Cannors Continuous Performance, Trail Making Test,	67/Randomized controlled trial	12-Oct	Norway/ Departments for Child and Adolescent Psychiatry
Miranda et al. (38)	ADHD	DSM-IV, Matching Familiar figures Parents and Teacher Ratings of Child Behavior, Progressive Colored Matrices Test, Battery Scale, Behavioral Observation, Behavioral Rating Scales, Low a Conners Teacher Rating scales, Self-Control Rating Scale, WIS-R	52/Available sampling	8 - 9.4 months	Spain/Valencia
Riahi et al. (39)	Attention deficit hyperactivity disorder	DSM-IV-TR, Cannors Rating Scale, Clinical Global Impression Severity (CGI-S), Global Assessment Function (GAF)	40/Available sampling	18 and above	Iran/Tehran
Hadianfard et al. (28)	Reducing ADHD	Male Great Three and Four CSI-4	160/Multi-stage random sampling	12-Aug	Iran/Shiraz

^a Abbreviations: ADHD, attention deficit hyperactivity disorder; CGI-S, clinical global impressions-severity; CSI-4, children symptom inventory-4 (screens for ADHD and other emotional and behavioral problems); DSM-IV, diagnostic and statistical manual of mental disorders; GAF, global assessment of functioning; SSRS, social skill rating system; WIS-R, wechsler intelligence scale for children-revised.

^b A test to measure ADHD children.

Table 3. Pretest Mean and Standard Deviation for 17 Attention Deficit Hyperactivity Disorder Studies

Study	Experimental	Control
Pretest		
Beh Pajooch et al. (18)	23.50 (3.92)	24.20 (3.67)
Moradi et al. (29)	24.67 (2.13)	24.10 (3.33)
Salehi et al. (21)	18.73 (4.16)	18.73 (3.35)
Shoshtariet al. (30)	15.98 (5.28)	16.29 (3.67)
Dehghan et al. (24)	71.69 (3.44)	072.58 (4.40)
Saheban et al. (26)	35.10 (2.79)	35.25 (02.01)
Yaghubi et al. (17)	20.03 (7.63)	6.68 (2.54)
Saadat (31)	06.71 (1.86)	6.30 (1.45)
Shafieian (32)	09.81 (1.61)	10.00 (1.61)
Hagighi (33)	27.42 (1.67)	26.91 (2.09)
Rahmanzadeh (34)	45.13 (3.35)	45.00 (3.85)
Abedi et al. (35)	07.07 (2.18)	6.93 (2.17)
Hashemi Nosrat Abad et al. (36)	24.20 (4.84)	23.80 (5.06)
Egeland et al. (37)	29.56 (6.18)	29.68 (6.52)
Miranda et al. (38)	19.84 (8.54)	18.69 (12.27)
Riahi et al. (39)	46.00 (6.00)	45.00 (5.00)
Hadianfard et al. (28)	11.12 (1.31)	132.02 (1.82)

^a Abbreviation: mean ± SD, standard deviation.

Table 4. Posttest Mean and Standard Deviation for 17 Attention Deficit Hyperactivity Disorder Studies

Study	Experimental	Control
Posttest		
BehPajooch et al. (18)	29.40 (3.20)	23.30 (4.08)
Moradi et al. (29)	18.76 (2.14)	24.50 (1.51)
Salehi et al. (21)	14.65 (2.44)	19.67 (4.48)
Shoshtariet al. (30)	10.74 (4.26)	14.61 (3.04)
Dehghanet al. (24)	54.92 (4.53)	67.80 (6.18)
Saheban et al. (26)	27.85 (1.75)	34.10 (1.38)
Yaghubi et al. (17)	12.00 (8.18)	30.25 (2.73)
Saadat (31)	4.32 (2.15)	5.98 (1.69)
Shafieian (32)	4.67 (3.66)	7.91 (3.61)
Hagighi (33)	13.67 (5.44)	26.75 (2.08)
Rahmanzadeh (34)	28.53 (3.35)	45.27 (3.84)
Abedi et al. (35)	11.21 (1.18)	7.08 (2.65)
Hashemi Nosrat Abad et al. (36)	20.20 (2.39)	24.80 (1.73)
Egeland et al. (37)	29.38 (6.55)	29.94 (6.67)
Miranda et al. (38)	16.88 (6.02)	19.04 (5.91)
Riahi et al. (39)	61.00 (6.33)	53.33 (5.00)
Hadianfard et al. (28)	136.70 (1.85)	133.80 (1.83)

^a Abbreviation: SD, standard deviation.

To facilitate statistical analysis, the researcher used continuous means as a part of unmatched group from comprehensive meta-analysis software. The results are separated into 3 parts: a) mean, b) standard deviation, and c) sample size for each group. To test treatment results of experimental and control groups which were different, the effect size on all samples of each group was calculated. Significance testing was performed. Means, standard deviations, and Cohen's d are given in Table 5.

Table 5. Cohen's D and Weighting for 17 Attention Deficit Hyperactivity Disorder Studies

Study	d	w ^a	wd ^b
BehPajooch et al. (18)	1.68	0.37	0.62
Moradi et al. (29)	-3.15	2.63	-8.28
Salehi et al. (21)	-1.45	0.10	-0.15
Shoshtariet al. (30)	-1.06	0.55	-0.58
Dehghan et al. (24)	-2.40	0.21s	-0.48
Saheban et al. (26)	-3.99	4.03	-16.09
Yaghubi et al. (17)	-3.35	0.14	-0.47
Saadat (31)	-0.86	4.45	-3.83
Shafieian (32)	-0.89	0.27	-0.24
Hagighi (33)	-3.48	0.35	-1.22
Rahmanzadeh (34)	-4.66	0.58	-2.70
Abedi et al. (35)	2.16	1.79	3.80
Hashemi Nosrat Abad et al. (36)	-2.23	3.03	-6.76
Egeland et al. (37)	4.66	0.38	1.77
Miranda et al. (38)	-0.36	0.34	-0.12
Riahi et al. (39)	1.33	0.31	0.41
Hadianfard et al. (28)	1.58	9.09	14.36
Summation	$\sum d = -16.47$	$\sum w = 28.62$	$\sum wd = -19.51$

^a Weight.

^b Weight × d.

Table 6. Statistical Parameter for Each Study^a

Studies	Statistics For Each Study						
	SD ^a	SE	S ²	LL	UL	Z	P Value
Beh Pajooch et al. (18)	1.660	0.52	0.27	0.650	2.690	3.210	0.001
Moradi et al. (29)	-2.04	0.43	0.19	-1.99	2.89	-4.74	0.001
Salehi et al. (21)	-1.65	0.41	0.17	-2.45	-0.85	-4.03	0.001
Shoshtariet al. (30)	-1.05	0.39	0.15	-1.81	-0.28	-2.69	0.007
Dehghan et al. (24)	-2.37	0.53	0.26	-3.38	-1.37	-4.64	0.001
Saheban et al. (26)	-3.97	0.55	0.30	-5.03	-2.89	-7.28	0.001
Yaghubi et al. (17)	-2.48	0.73	0.53	-3.90	-1.06	-3.42	0.001
Saadat (31)	-0.81	0.27	0.07	-1.33	-0.28	-3.05	0.002
Shafieian (32)	-0.89	0.56	0.31	-1.99	0.21	-1.59	0.112
Hagighi (33)	-2.69	0.56	0.32	-3.79	-1.59	-4.78	0.001
Rahmanzadeh (34)	-4.45	0.70	0.49	-6.02	-3.27	-6.62	0.001
Abedi et al. (35)	-1.99	0.45	0.20	-1.12	2.88	-4.47	0.001
Hashemi Nosrat Abad et al. (36)	-2.05	0.35	0.12	-2.74	-1.36	-5.82	0.001
Egeland et al. (37)	-0.09	0.24	0.06	-0.56	0.39	-0.35	0.73
Miranda et al. (38)	-0.10	0.29	0.08	-0.46	0.66	-0.36	0.72
Riahi et al. (39)	-1.35	0.35	0.12	-0.66	2.03	-3.84	0.001
Hadianfard et al. (28)	-1.57	0.20	0.04	-1.76	1.97	-7.76	0.001
	-0.13	0.09	0.008	-0.30	0.05	-1.45	0.148

^a Abbreviations: LL, low limited; SD, standard deviation; SE, standard error; UL, upper limited.

The results of the study illustrated that there is a difference between the mean scores of the experimental and control groups. The overall meta-analysis of these studies illustrated a statistical significance (Figures 1 and 2). In addition, overall standardized differences in means ranged between 0.79% and 95%, confidence interval ranged between 0.57 and 1.08, and Z-value was equal to -1.45 ($d = \text{mean } d = -0.68$ (look at below of Equation 1 and Equation 2)). Furthermore, the Q statistic for heterogeneity of 347.74 is statistically significant ($P < 0.001$); in addition, $I^2 = 95.40$, $T^2 = 9.44$, $SE = 4.30$, $s^2 = 18.41$, and $\text{Tau} = 3.07$.

Moreover, in this study, Table 4 indicated that the ADHD symptoms are reduced more in the experimental groups compared to the control groups. Based on this table posttest means of the experimental groups were lower than the posttest means of the control groups in 12 studies. In addition, d average is -0.97 and d ($d = \text{mean } d = -0.68$), (look at below of Equation 1 and Equation 2.) is -0.68 which were obtained in Equations 1 and 2

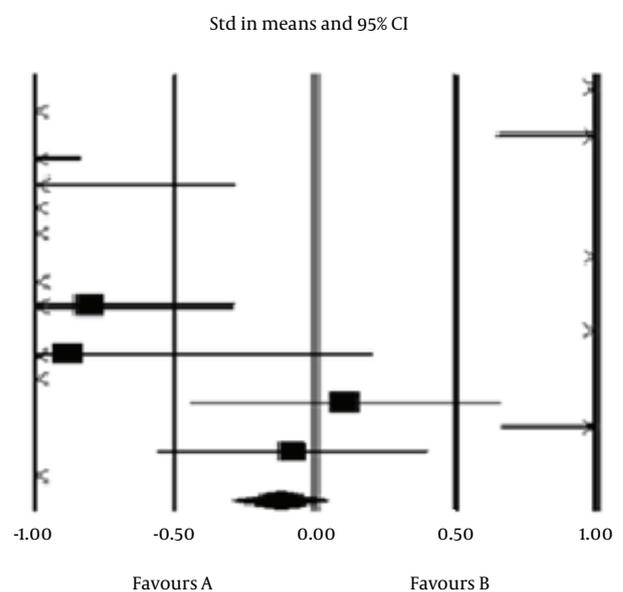
(1)

$$d_{\text{average}} = \frac{\sum d}{n}, d_{\text{average}} = \frac{-16.47}{17} = -0.97$$

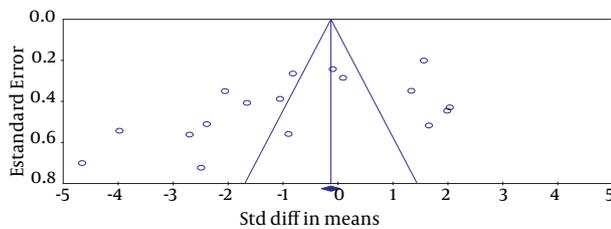
(2)

$$\bar{d} = \frac{\sum wd}{\sum w}, \bar{d} = \frac{-19.51}{28.62} = -0.68$$

Figure 1. Forest Plot of 17 Attention Deficit Hyperactivity Disorder Studies



(Summary data of standardized differences in means of the fixed-effect model). The standardized differences in means is -0.128 and the 95% confidence interval is -0.301 - 0.046 and $P = 0.148$.

Figure 2. Funnel Plot of 17 Attention Deficit Hyperactivity Disorder Studies

The horizontal line represents the primary standardized differences in means for each study, and the vertical lines represent the standard error where available.

4. Discussion

This study found several interventions that can reduce symptoms of ADHD in children and adolescents. Based on pooled effects, the mentioned treatments can reduce social skills difficulty and behavioral problems. According to the study by Cohen, low effect is below 0.20, median effect is 0.50, and high effect is 0.80 (41). This should be taken into consideration, as there were a range of intervention and evaluation methods. These overall results described that about 75% of children and adolescents in the experimental groups showed a greater reduction in symptoms of ADHD than children and adolescents in the control groups. Effects from studies on far transfer of working memory therapy, cognitive-behavioral therapy and neuro-feedback, and ritalin and the combinations of drugs prescribed reduced the symptoms of ADHD in higher percentages of children compared to the control group.

The aim of this study was to perform a comparative study on the effects of treatment programs in reducing ADHD symptoms in children. Results of this study demonstrated that treatments with the highest levels of effectiveness (> 0.80) included cognitive-behavioral therapy, pharmacological treatment, and combinational treatment. This study, like the meta-analysis by Nigg et al. showed that treatment programs reduced symptoms of ADHD in children and adolescents (42).

The difference between overall mean change for treatment and control groups ranged from -0.08- to 4.45. This showed that the groups receiving treatment programs illustrated significantly larger improvements in term of ADHD symptoms. Consistent evidence from both experimental and quasi-experimental studies suggests that treatment programs had desirable effects for the majority of ADHD studies (43, 44). Effective treatment programs for ADHD students reduced problems in social skills and academic performance, and behavior disorders, which are the cause of the disruption of daily life functioning. These treatment programs are a necessity for children with ADHD in order to overcome the challenges that accompany an ADHD diagnosis over the course of their education.

Consequently, improvements in daily life functioning and decreasing of functional disorders are the important, socially suitable standards against which treatment results must be evaluated. The majority of studies regarding effective treatment programs on ADHD illustrated that treatment programs are effective on ADHD.

4.1. Conclusions

In this meta-analysis, the treatment programs used included cognitive treatments, cognitive-behavioral treatments, behavioral treatments, pharmacological treatments, and combinational treatments. Previous studies have demonstrated that students, who received treatment in the various therapy programs, had a higher potential of being mainstreamed into society and showing improvement in their academic and social skills in comparison to students who did not receive some types of therapy. Based on the findings of this research, it is recommended that cognitive-behavioral treatment and pharmacological treatment be used for a higher rate of success in aiding with the ADHD symptoms in children and adolescents.

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Authors' Contributions

Zeinab Mihandoost conceived and designed the study, collected and interpreted the data, drafted, and revised the manuscript, and approved the final version of the manuscript.

Declaration of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

1. Association AP. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*. American Psychiatric Publishing; 2013.
2. Sandson TA, Bachna KJ, Morin MD. Right hemisphere dysfunction in ADHD: visual hemispatial inattention and clinical subtype. *J Learn Disabil*. 2000;**33**(1):83-90.
3. Marshall RM, Schafer VA, O'Donnell L, Elliott J, Handwerk ML. Arithmetic disabilities and ADD subtypes: implications for DSM-IV. *J Learn Disabil*. 1999;**32**(3):239-47.
4. Barkley RA. Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychol Bull*. 1997;**121**(1):65-94.
5. Nussbaum NL, Grant ML, Roman MJ, Poole JH, Bigler ED. Attention deficit disorder and the mediating effect of age on academic and behavioral variables. *J Dev Behav Pediatr*. 1990;**11**(1):22-6.
6. Lauth GW, Heubeck BG, Mackowiak K. Observation of children with attention-deficit hyperactivity (ADHD) problems in three natural classroom contexts. *Br J Educ Psychol*. 2006;**76**(Pt 2):385-404.
7. Majorek M, Tuchelmann T, Heusser P. Therapeutic Eurythmy-movement therapy for children with attention deficit hyperac-

- tivity disorder (ADHD): a pilot study. *Complement Ther Nurs Midwifery*. 2004;**10**(1):46-53.
8. Chronis AM, Jones HA, Raggi VL. Evidence-based psychosocial treatments for children and adolescents with attention-deficit/hyperactivity disorder. *Clin Psychol Rev*. 2006;**26**(4):486-502.
 9. A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. The MTA Cooperative Group. Multimodal Treatment Study of Children with ADHD. *Arch Gen Psychiatry*. 1999;**56**(12):1073-86.
 10. Butnik SM. Neurofeedback in adolescents and adults with attention deficit hyperactivity disorder. *J Clin Psychol*. 2005;**61**(5):621-5.
 11. Hinshaw SP. Treatment for children and adolescents with attention-deficit/hyperactivity disorder. In: Kendall, editor. *Child and adolescent therapy: Cognitive-behavioral procedures*. New York: Guilford Press; 2006.
 12. Nigg JT. *What causes ADHD?: Understanding what goes wrong and why*. New York: Guilford Press; 2006.
 13. Sonuga-Barke EJ. Psychological heterogeneity in AD/HD—a dual pathway model of behaviour and cognition. *Behav Brain Res*. 2002;**130**(1-2):29-36.
 14. Barkley RA, Murphy KR. *Attention-deficit hyperactivity disorder*. New York: Guilford Press; 2006.
 15. Chhabildas N, Pennington BF, Willcutt EG. A comparison of the neuropsychological profiles of the DSM-IV subtypes of ADHD. *J Abnorm Child Psychol*. 2001;**29**(6):529-40.
 16. Castellanos FX, Tannock R. Neuroscience of attention-deficit/hyperactivity disorder: the search for endophenotypes. *Nat Rev Neurosci*. 2002;**3**(8):617-28.
 17. Yaghubi H, Jazayeri A, Khooshabi K, Dolatshahi B, Niknam Z. [The efficacy of "neurofeedback", compared to "Ritalin" and "combined neurofeedback and Ritalin" for the reduction of ADHD symptoms.]. *Daneshvar Raftar*. 2008;**31**(15):71-84.
 18. Beh Pajoo A, Ghojari B, Alizadeh H, Hemati Alamdar G. [Impact of training self-control techniques on enhancement of social skills in students with attention deficit/hyperactivity disorder.]. *Res Except Child*. 2007;**7**(1):1-18.
 19. Jafari BS, Mosavi R, Fathi Ashtiani A, Khoshabi K. [The effectiveness of positive parenting program on the mental health of mothers with children suffering from attention deficit/hyperactivity disorder.]. *Iran J Fam Res*. 2011;**6**(24):497-510.
 20. Moradi A, Hashemi T, Farzad V, Beyrami M, Keramat H. [The effectiveness of third folds instructional interventions (self-regulation of attentional behavior, self-regulation of motivational behaviors and verbal self-instruction) on attention deficit and hyperactivity.]. *J Psychol*. 2011;**4**(13):191-214.
 21. Salehi M, Poushaneh K, Nazmi F. [Effectiveness of cognitive-behavioral on self-perception of attention deficit hyperactivities disorder.]. *J Psychol Res*. 2010;**2**(8):73-85.
 22. Houshvar P, Behnia F, Khoshabi K, Mirzaei H, Ragozar M. [Effectiveness of group treading for parents of children 4 to 10 years with attention deficit hyperactivity disorder on behavioral disorders of children.]. *J Rehab*. 2009;**10**(3):24-30.
 23. Shoushtari M, Malek Pour M, Abaei A, Ahromi R. [Effectiveness of early interventions based on attention games on the rate attention of preschool children with attention deficit-hyperactivity/impulsivity disorder.]. *J Clin Psychol*. 2011;**3**(3):17-27.
 24. Dehghan F, Behnia F, Amiri N, Pishyareh E, Safarkhani M. [The effectiveness of using perceptual-motor practices on behavioral disorder among five to eight year old children with attention deficit hyper activity disorder.]. *J Adv Cogn Sci*. 2010;**12**(3):82-96.
 25. Moharreri F, Shahrivar Z, Tehrani-Dust M. [Effect of the positive parenting program on parents of children with attention deficit hyperactivity disorder.]. *J Fundam Ment Health*. 2009;**11**(41):31-40.
 26. Sahebani F, Amiri S, Kajbaf M, Abedi A. [The efficacy of short-term executive functions training on the reduction of symptoms of attention deficit and hyperactivity of elementary boy students in Esfahan metropolitan area.]. *Adv Cogn Sci*. 2010;**12**(1):52-8.
 27. Meftaqh D, Mohammadi N, Ghanizada A, Rahimi C, Najimi A. [Effectiveness of different intervention program on attention deficit hyperactivities disorders.]. *J Isfahan Med Sch*. 2011;**29**(148):965-76.
 28. Hadianfard H, Najarian B, Shokrkon H, Mehrabzadeh Honarmand M. [Comparative effectiveness of three treatments in reducing hyperactivity disorder third and fourth levels of male primary school children in Shiraz Iranian.]. *J Edu and Psychol*. 2000;**7**(1-2):29-54.
 29. Moradi A, Hashami T, Farzad V, Karamati H. [Effectiveness of self-regulation of attention behavior, self-regulation of motivational behavior and verbal self-instruction on symptoms of attention deficit/hyperactivity.]. *Res Psychol Health*. 2009;**2**(1):5-16.
 30. Shoshtari M, Abedi A, Golshani F, Ahrami R. [Effectiveness of early interventions based on Child-oriented games on the rate of hyperactivity/Impulsivity of Preschool children.]. *J Psychol Except Indiv*. 2011;**1**(2):103-18.
 31. Saadat M. [Which symptoms of ADHD would improve with play therapy and yoga?]. *J Except Child*. 2011;**11**(1):45-56.
 32. Shafeian R. [The effect of narrative therapy on increase of attention and decrease of hyperactivity in children with attention deficit hyperactivity disorder.]. Tehran: Islamic Azad University; 2009.
 33. Hagighi K. [The effects of training neurofeedback on decreasing the intensity of attention deficit/hyperactivity disorder symptoms in primary students.]. Tehran: Alamah Tabatabaieii University; 2012.
 34. Rahmanzadeh S. [Effectiveness of cognitive-behavioral therapy in reducing symptoms in children with ADHD.]. Kermanshah: Razi University, School of Society Sciences; 2012.
 35. Abedi A, Kazemi F, Shooshtari M, Golshani Monazzah F. [The effect of aerobic exercises on the visual and auditory attention of pre-school boys with ADHD in Isfahan in 2009-2010.]. *J Psychol Except Indiv*. 2012;**2**(7):133-51.
 36. Hashemi Nosrat Abad T, Moradi A, Farzad V, Kaviani H. [Impact of training self-regulation of attentional and motivational behaviors, and verbal self-instruction on ADHD symptoms amelioration.]. *J Except Child*. 2014;**7**(2):129-54.
 37. Egeland J, Aarli AK, Saunes BK. Few effects of far transfer of working memory training in ADHD: a randomized controlled trial. *PLoS One*. 2013;**8**(10):e75660.
 38. Miranda A, Presentacion MJ, Soriano M. Effectiveness of a school-based multicomponent program for the treatment of children with ADHD. *J Learn Disabil*. 2002;**35**(6):546-62.
 39. Riahi F, Shahrivar Z, Tehrani Doost M. [Comparing therapeutic effects of reboxetine with placebo in adult patients with attention-deficit/hyperactivity disorder: A randomized, placebo-controlled clinical trial.]. *Jundi Shapur J Med Sci*. 2010;**9**(5):483-93.
 40. Mooney P, Epstein MH, Reid R, Nelson JR. Status of and trends in academic intervention research for students with emotional disturbance. *Remedial Special Educ*. 2003;**24**(5):273-87.
 41. Cohen J. *Statistical power analysis for the behavioral sciences*. New York: Academic Press; 1997.
 42. Nigg JT, Lewis K, Edinger T, Falk M. Meta-analysis of attention-deficit/hyperactivity disorder or attention-deficit/hyperactivity disorder symptoms, restriction diet, and synthetic food color additives. *J Am Acad Child Adolesc Psychiatry*. 2012;**51**(1):86-97 e8.
 43. Waschbusch D, Hill GP. Empirically supported, promising, and unsupported treatments for children with Attention-Deficit/Hyperactivity Disorder. In: Lilenfeld, Lynn SJ, Lohr JM, editors. *Science and pseudoscience in clinical psychology*. New York: Guilford Press; 2003. pp. 333-62.
 44. Schachar R, Jadad AR, Gauld M, Boyle M, Booker L, Snider A, et al. Attention-deficit hyperactivity disorder: critical appraisal of extended treatment studies. *Can J Psychiatry*. 2002;**47**(4):337-48.