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EFFECTIVENESS OF THREE METHODS OF DRUG THERAPY IN IMPROVING THE SYMPTOMS OF ATTENTION DEFICIT/ HYPERACTIVITY DISORDER

Mina Yazdanian[1*], Hassan Toozandehjani[1]

1. ***M.A. in Clinical Psychology, Department of Psychological Sciences, Faculty of Humanities, SHahrood Branch, Islamic Azad University, SHahrood, Iran.***
2. ***Assistant Professor of Psychology, Department of Psychological Sciences, Faculty of Humanities, Neyshabur Branch, Islamic Azad University, Neyshabour, Iran.***

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ABSTRACT

This research is a quasi-experimental study (pretest-posttest and follow-up test with a control group) which has been conducted with the aim of comparing the effectiveness of three methods of drug therapy with Ritalin, neurofeedback-based method and child control skills training in reducing the symptoms of attention deficit/ hyperactivity disorder (ADHD) among ADHD children aged between 6 and 12 years in the city of Neyshabour. To this end, a sample of 28 children suffering from ADHD was selected through available sampling method and was assigned into four groups (7 subjects in Ritalin treatment group, 7 subjects in child control skills training group, 7 subjects in neurofeedback training group and 7 subjects in the control group). For data collection, Conners questionnaire was applied. After implementing the independent variables, a posttest was conducted and after two months, a follow-up test was performed. The control group received no intervention. The data was analyzed using the analysis of covariance and analysis of variance with repeated measures. The results demonstrated that Ritalin consumption and training child control skills and neurofeedback method have been significantly effective in reduced symptoms of attention deficit/ hyperactivity disorder in children. But the neurofeedback method enjoys more durability and effect size compared to Ritalin consumption and training child control skills to parents.

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Introduction

One of the common childhood disorders which has attracted the attention of psychologists and psychiatrists is the attention deficit/ hyperactivity disorder. This disorder begins around the age of 2 to 4 years [9] and is among the most common neuro-behavioral disorders in childhood which has affected a large portion of the world population (3 to 7 percent of children). Attention deficit/ hyperactivity disorder is the sustainable pattern of inattention or hyperactivity and impulsive behaviors which is common and severe and is usually seen in children with similar developmental levels [11].

In the 1940s and 1950s, this label was pervasively used about the children who showed similar behaviors but did not display evidence of brain damage or mental retardation_ a situation which later became known as mild brain injury. Such terms provided a simple method for attributing behavioral problems to a physical cause.

In the late 1950s, attention deficit/ hyperactivity disorder was attributed to hyperactivity; a situation which was considered as a result of the brain's inability to filter information and input stimuli. Such an attitude to this disorder led to the formation of

Corresponding Author: Mina Yazdanian, Department of Psychological Sciences, Faculty of Humanities, Shahrood Branch, Islamic Azad University, SHahrood, Iran.E-mail: Mi.Yazdanian32@gmail.com

the definition of hyperactive children; a definition mainly characterized by physical hyperactivity[2-5]. Thus, attention to psychosocial treatments such as parent behavioral training has been highly considered due to their unique features. In this type of treatment, behavior modification is done at home and by parents. Further, this therapy enhances various aspects of parent and family functions and parenting stress and in the light of new information that parents obtain in this type of treatment towards their children's problems, they can better cooperate in the treatment of their children. On the other hand, it has been demonstrated that clinical behavior therapy in the form of parent training and classroom intervention about these children has led to the improvement of several cases at home and school.

The roots of parent training date back to the late nineteenth and early twentieth century. At that time, child study movement arose in Europe and children's needs and the role played by parents in response to those needs were studied. Over years, this issue was discovered that parental control style has great impacts on the full development and behavior of children in biological, psychological and social terms [8]. With regard to impulsiveness, carelessness, learning loss, interpersonal problems and risky behaviors in this disorder, parent management training treatment seeks to improve interpersonal relationships and reduce and control the symptoms and problems of the child by increasing the parents' awareness of the symptoms of the disorder and the manner of effectively dealing with the affected child. Due to greater influence and close contact with children and students, parents can play a crucial role in implementing the behavioral interventions in the natural environment of the child. For this reason, in recent years, increasing attention has been paid to the inclusion of behavior management training in the treatment plan of attention deficit/ hyperactivity disorder [6-7]. Danforth [13] in a study investigated the effect of parent training on the behavior of mothers and monitoring of disruptive behaviors of eight children with attention deficit/ hyperactivity disorder who simultaneously had oppositional defiant disorder. The result revealed that the training program has been effective in the modification of parents' behavior to monitor the child's behavior and on the other hand, it has reduced the mother's psychological pressure and the child's coping behavior. However, documentary research indicates the neurological principles of attention deficit disorders. Since 1930, abnormalities in the electroencephalogram (EEG) of ADHD patients were reported. EEG of these individuals shows high activity of gentle theta waves in central and frontal areas of the brain. Additionally, the results of PET and SPECT also report disorders in brain metabolism of these people in central and frontal areas. In children with this disorder, a reduction is seen in brain metabolism in prefrontal areas. In addition to higher frequency of gentle brain waves in EEG of these individuals, less activity of fast beta waves is also noticeable in them. This issue shows low arousal of the cerebral cortex.

One of the relatively new methods which has received multiple clinical approval and research along with other treatment methods is neuro-feedback therapy. Neuro-feedback is a kind of biofeedback and brain waves from the basis of its feedback. Hence, before explaining the neuro-feedback, a summary of biofeedback application is provided. Biofeedback or neuro-feedback includes mind – body treatment using electronic instruments in order to help people control and become aware of their psychobiological processes. Neuro-feedback therapies have been developed based on the theory of mind - body relationship and emphasize the mind's ability to restructure, change and heal itself in the natural way. This method provides the possibility of treating the attention deficit/ hyperactivity disorder through affecting brain waves and also increasing mental flexibility [11-12]. Neuro-feedback is a special form of a safe and painless method by the use of which self-control and function of the brain can be improved in different ways. Its underlying mechanism consists of strengthening the self-regulation needed for effective performance [1]. In the 1960s, Astroman, a researcher at UCLA University of California, found that hungry cats can increase SMR wave generation in their brain to get the reward (milk). In the research commissioned by NASA about the toxicity of rocket fuels, he and his team noticed that all the cats exposed to rocket fuel are affected by convulsion and then death after the appearance of a series of symptoms. In the meantime, only one group of cats which were previously able to increase their SMR wave remained healthy. Astroman conducted a study on humans and about patients with epilepsy who did not respond well to medical treatment and observed that the use of brain training technique for more SMR wave generation has a positive effect on this group of patients [2], [6] examined the effectiveness of neuro-feedback in the treatment of dyslexia disorder and found that students showed significant improvement in the reading test after 20 sessions of neuro-feedback. Internal studies also approve the effectiveness of neuro-feedback in the treatment of attention deficit/ hyperactivity symptoms. For example, Yaghoubi et al. demonstrated that training neuro-feedback to the rate of treatment with Ritalin is effective in reducing the symptoms of attention deficit/ hyperactivity disorder in affected students [7]. But a combination of two methods of neuro-feedback and Ritalin is more effective than each method alone. Moreover, this study suggested that the rate of parents' satisfaction with neuro-feedback method was greater than treatment with Ritalin. Bakhshayesh et al. also revealed in a study that 30 sessions of biofeedback (EEG theta/ beta) compared to EMG biofeedback have led to reduced symptoms of attention deficit/ hyperactivity disorder in affected students so that 55.6% (10 people) of children in the neuro-feedback group relative to 23.5% (4 people) of children in EMG biofeedback group did not have diagnosis of attention deficit/ hyperactivity. Use of stimulant drugs and other similar drugs to treat attention deficit/ hyperactivity syndrome in children has been always controversial discussions. Stimulant drugs were used since 1930 when their effectiveness was discovered in the treatment of attention deficit/ hyperactivity disorder; drugs like noradrenergic drugs, tricyclic antidepressants and anti-stress drugs. In addition to stimulant drugs, other drugs also exist for the treatment of this disorder such as Atomoxetine_ anti stimulant drugs_

and other methods which enter certain substances into the blood flow through the skin and veins using a narrow passage .[4] performed a study and compared the impact of behavior therapy, drug therapy and combined behavior-drug therapy on reduced symptoms of attention deficit/ hyperactivity disorder in children and came to the conclusion that ADHD symptoms significantly decreased in three groups of behavior therapy, drug therapy and combined behavior-drug therapy. But this reduction in symptoms was greater in the groups of drug therapy and combined behavior-drug therapy compared to the behavior therapy group.

Research method

This research is a quasi-experimental study (pretest-posttest and follow-up test with a control group) which aims to compare the effectiveness of three methods of drug therapy with Ritalin, neuro-feedback-based method and child control skills training in reducing ADHD symptoms among children aged between 6 and 12 years suffering from ADHD in Neyshabour. For this purpose, a sample comprising 28 ADHD children was selected by available sampling method. The subjects were assigned into four groups including Ritalin treatment group, child control skills training group, neuro-feedback training group and control group, each having 7 participants.

Research tool

Conners Parent Rating Scale (CPRS-48): This questionnaire is a 48-question form and was developed in 1973. This scale has been accepted as an appropriate screening tool to search for the children who are likely to be sick and also a measure of the severity of symptoms in patients with attention deficit/ hyperactivity disorder. This questionnaire is scored based on a Likert scale. Hence, scores of the parent form range between 0 and 144. In a study, the reliability of the parent form was reported to be 0.93 through Cronbach's alpha method. The overall reliability was estimated to be 0.93 based on Cronbach's alpha method. Test-retest reliability was reported to be between 0.70 and 0.90 [9]. The reliability of this questionnaire has been reported by the Institute of Cognitive Sciences to be 85% [10].

Implementation method of the research sessions

In the first stage, the subjects were initially selected and were then divided into four groups of 7 people including the drug therapy group, child control skills training group, neuro-feedback training group and control group.

In the second stage, a group of mothers with hyperactive children (7 people who have been chosen randomly) received Dongle-Polster child control skills training (1999) for 8 weeks in one and a half hour weekly sessions (one session per week). In child control skills training sessions, only mothers participated in the experimental group and at the end of the course, they took a posttest [11]. The program of training child control skills to parents which has been implemented in this study consists of eight sessions of group training with the mothers of ADHD children. The duration of each session was 90 minutes.

Description of the sessions is as follows:

First session: Familiarity with attention deficit/ hyperactivity disorder; expression of the main symptoms and related problems; explanation of attention deficit/ hyperactivity; expression of its associated problems; referring to the etiology.

Second session: Training the skills related to the encouragement of desirable behaviors.

Third session: Training how to order ADHD children.

Fourth session: Training the skills associated with reduced inappropriate behaviors (removal of bonuses and rewards).

Fifth session: Training the skills related to reduced inappropriate behaviors (corporal punishment).

Sixth session: Skills training (surrender or obedience).

Seventh session: Doing homework; training the parents to prepare a table for doing homework.

Eighth session: Summing up the learned materials

Table 1: Mean and standard deviation of Conners questionnaire scores

Symptoms	Experimental group		Number	Mean	SD	Mean standard error	Cohen's d statistic	Effect size
Impulsivity	Ritalin consumption	Before intervention	7	8.42	2.07	0.78	0.86	0.39
		After intervention	7	6.57	2.22	0.84		
	Family training	Before intervention	7	10	2	0.75	2.36	0.76
		After intervention	7	5.71	1.6	0.606		
	Neuro-feedback	Before intervention	7	8.75	1.66	0.59	2.87	0.81
		After intervention	7	4.14	1.45	0.51		
Anxiety	Ritalin consumpton	Before intervention	7	9.42	1.98	0.75	0.84	0.39
		After intervention	7	7.71	2.05	0.77		
	Family training	Before intervention	7	10.14	1.46	0.55	2.23	0.74
		After intervention	7	7.14	1.21	0.459		
	Neuro-feedback	Before intervention	7	9.75	1.48	0.52	2.73	0.80
		After intervention	7	5.28	1.77	0.628		
Hyperactivity	Ritalin consumpton	Before intervention	7	23	2.64	0.99	0.39	0.19
		After intervention	7	21.85	3.18	1.20		
	Family training	Before intervention	7	23.57	2.5	0.94	1.33	0.55
		After intervention	7	20.28	2.42	0.91		
	Neuro-feedback	Before intervention	7	22.5	2.87	1.01	3.05	0.83
		After intervention	7	15.28	1.72	0.61		

Total Conners	Ritalin consumpton	Before intervention	7	106.71	11.13	4.20	1.04	0.46
		After intervention	7	92.85	15.08	5.7		
	Family training	Before intervention	7	113.42	9.01	0.64	2.96	0.82
		After intervention	7	88.28	7.91	2.92		
	Neuro-feedback	Before intervention	7	108.27	10.78	3.81	3.96	0.89
		After intervention						

The main research hypothesis indicates that there is significant difference between the three treatment methods of Ritalin therapy, child control training and neuro-feedback training in reduced symptoms of attention deficit/ hyperactivity disorder.

To investigate this hypothesis, multivariate analysis of covariance test has been employed. Summary of these results has been provided in Table 2.

Table 2: Multivariate analysis of covariance related to the effectiveness of Ritalin-based therapy, family training and neuro-feedback training in clinical symptoms (impulsivity, anxiety, hyperactivity and total Conners)

	Test name	Value	Assumed degree of freedom	Error degree of freedom	F statistic	Significance level	
Group	Pillai's trace	1.53	12	57	4.88	0.001	0.507
	Wilks Lambda	0.017	12	45	13.66	0.001	0.741
	Hotelling's trace	26.51	12	47	34.61	0.001	0.89
	Roy's largest root	17.21	4	19	120.57	0.001	0.96

As can be observed in Table 2, the findings obtained from multivariate analysis of covariance suggest that multivariate F value is statistically significant at the level of $P<0.05$. Therefore, it is concluded that a significant difference exists between the experimental and control groups in dependent variables.

The secondary hypothesis indicates that each of the treatments alone is effective in reducing the symptoms of attention deficit/ hyperactivity disorder. To examine this hypothesis, univariate analysis of covariance test has been used. Summary of these results has been presented in Table 3. To assess the difference between the three intervention methods (Ritalin consumption, child control training and Neuro-feedback) in terms of their effectiveness in attention deficit/ hyperactivity disorder, pairwise comparisons have been used. The results are as follows:

Table 3: Multiple (pairwise) comparisons of the means related to the variable of attention deficit/ hyperactivity

	Treatment method	Experimental group	Mean difference	Standard error	Significance level
Hyperactivity	Ritalin consumption	Child control training	2.69	0.647	0.003
		Neuro-feedback	6.52	0.55	0.001
	Child control training	Neuro-feedback	3.83	0.602	0.001

As can be seen, the mean difference between the experimental group based on Ritalin consumption and the experimental group based on child control training and neuro-feedback is significant. Further, the mean difference between the experimental group based on child control training and the experimental group based on neuro-feedback is also significant [14-15].

Conclusion

This study aims to compare the effectiveness of Ritalin consumption, child control skills training and neuro-feedback method in reducing the symptoms of attention deficit/ hyperactivity disorder among children of 6 to 12 years. The research results demonstrate that the findings achieved from this research are consistent with the results of the study by [16], [3] and [4]. In explaining the result of this hypothesis, it can be stated that the results of cognitive behavioral therapy and its combination with drug therapy were generally more positive, which suggest the superiority of this solution. Since social adjustment is achieved in the long run, little or no difference in the effect of these methods on the dependent variable can be endured due to the short duration of this study. But success of the combined treatment in improving the level of social adjustment was significant.

Use of stimulant drugs is the most frequent type of medical treatment that is applied for ADHD children.

It is estimated that around 88% of children suffering from this disorder take Ritalin [7]. But the research results have shown that none of the treatment methods alone has been recognized to be effective and acceptable.

Accordingly, in explaining the findings of this study, it is argued that since this disorder has a strong physiological basis, drug therapy is highly prescribed based on the findings of many studies conducted. But cognitive behavioral therapy can also be used considerably in the treatment of such patients because this disorder embraces various aspects of physiological status and personal and social life of the child. So, each of the methods can lay stress on a certain part of the patient's physical and mental space.

In explaining the research findings, it can be said that training self-control skills to students enables them to give themselves feedback about their behavior. They learn to evaluate and monitor their actions and systematically give themselves rewards for effective and desirable behaviors. They also learn to act desirably and productively when the power source (teachers and parents) is not beside them for a long time. In other words, students are able to control their own inappropriate behaviors and regulate and adjust their negative emotions and further use problem-focused strategies rather than emotion oriented strategies in the face of stressful events and frustrating conditions since this training causes the students to internally monitor and assess their own behavior and consider its consequences and thus engage in self-reinforcement or self-punishment. Self-control is highly effective because it allows children and adolescents to manage their own behaviors in the absence of adult support and supervision and teaches them to assume responsibility in relation to their behavior. Consequently, this sense of responsibility causes them to be improved mentally. Thus, by training self-control techniques to students with conduct disorder, their self-control ability can be promoted. As a result, many of their problems such as difficulty in communication skills and annoying behaviors will be reduced and their social skills and mental health will increase [15].

The existence of self-control skills in students is one of the most important success factors in society which can lead to the individual's adjustment with the environment and society and make people achieve the necessary amount of independence and responsibility-taking. Through training self-control skills to children, they are able to give themselves feedback about their behaviors. We teach them to evaluate and monitor their actions and systematically give themselves rewards for effective and productive behaviors.

Researchers have taught parents to apply deprivation for various behaviors. In one case, Wahler (1969) taught parents to use deprivation for oppositional behaviors of their five-year-old child. In another research project, Christoffersen, Barish, and Christoffersen (1984) taught parents to apply deprivation for overall behavioral problems. Green, Clark and Raysly (1977) asked the parents to eliminate rewards and points so that they can help their children learn desirable behaviors in the course of family purchases. Patterson, Reid, Jones and Conger (1975) helped parents arrange a penalty program at home in which parents eliminate points. For example, when children show misconduct, they have to sleep earlier or should not be allowed to watch TV [8].

Training child control skills to parents is very important because they spend a lot of time with their children and possess the necessary power and authority to apply reward and punishment techniques for the child and are able to be effective in reduced problems of children and their treatment.

In explaining this finding, it can be mentioned that neuro-feedback training in Cz concurrently affects sensorimotor cortex, motor cortex and cingulate cortex. Sensorimotor cortex is the boundary between parietal and frontal lobes. Given the widespread effects of sensorimotor cortex, it is understandable that early pioneers in the field of neural therapy have started the training process along the sensorimotor cortex. Further, Rieti (2001) has stated that sensorimotor cortex helps the cerebral cortex in the encoding of physical and cognitive tasks. He adds that brain circuits are used for ordering, sequencing and timing of a mental act.

Neuro-feedback training in Cz simultaneously affects sensorimotor cortex, motor cortex and cingulate cortex. In cingulate, systems that deal with emotions/ feelings, attention and working memory interact closely with each other so that they form the energy source of external actions (movement) and internal actions (reasoning, thinking).

In another explanation for the findings of this research, it can be said that increased SMR in Cz area activates the neuronal circuit involved in working memory.

Previous studies have demonstrated that working memory is based on a neuronal circuit that is the result of an interaction between the attention control system located in prefrontal cortex and sensory information storage in posterior association cortex (Sarasin & Van Steen, 1998). Herman (Vernon, 2003) has demonstrated that during the semantic working memory task, an increase is seen in bond coherence of 10-14 between frontal and posterior areas. Hence, it can be said generally that increased SMR wave in Cz area leads to the improvement of working memory and vision.

One of the explanations is that brain stimulation increases the electrical activity of the brain and combination, secretion and activity of neurotrophins, which itself leads to more continuity and synaptic connections (Frederick, Timmerman, Russell & Lobar, 2004). Indeed, the mechanism of the effectiveness of this method is based on the fact that the brain is constantly adaptable and has high capability for learning and can learn to change and improve its function if only clues are made available to it about what should be changed. Correct and timely stimulation of the brain can lead to the growth and non-degeneration of the brain and synapses and even the formation of new synapses and beginning of normal activities and can be effective in improving the existing psychological disorder. Overall, based on the results of previous studies and present research, neuro-feedback as a self-regulatory brain mechanism is effective in promoting the mental health in the long run.

The underlying mechanism of this change may be explained based on the operant conditioning theory so that if the stimulus change (brain waves amplitude) based on a predetermined contract is accompanied and reinforced by favorable outcomes (motion of video images or sound production), it will lead to learning and this learning will be more effective when simpler stimuli (neuro-feedback training) are used which lead to the reception of reinforcement (Narimani et al.).

In this study, hypotheses were raised and generally, the researcher sought to answer the question as to whether there is significant difference between the effectiveness of treatment with Ritalin, child control training and neuro-feedback training in reducing the symptoms of attention deficit/ hyperactivity disorder and which method is more effective and durable. The research results revealed that all treatment methods (Ritalin consumption, child control training and neuro-feedback) have been effective in attention deficit/ hyperactivity disorder and in scales of impulsivity, anxiety and total Conners. Neuro-feedback method is more effective compared to two other methods, i.e. Ritalin therapy and child control training. One of the limitations of this study was that this treatment is very costly and needs laboratory equipment (neuro-feedback devices) and this research would not be fulfilled without the help of officials. Besides, considering the effectiveness of this approach in the treatment of many mental problems, there is a need for the attention of the government and insurance companies regarding the patent support in order to supply a major part of treatment costs so that the use of this treatment approach becomes possible for all.

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