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EFFICACY OF NEUROFEEDBACK TREATMENT IN REDUCING SYMPTOMS OF ATTENTION DEFICIT AND HYPERACTIVITY IN CHILDREN WITH ADHD

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ABSTRACT

The purpose of presenting this study was to determine the efficacy of neurofeedback treatment of attention deficit hyperactivity disorder in children suffered with ADHD. Neurofeedback consider as a safe and non-invasive method and research has shown that it's an effective treatment for diagnosed and treated of ADHD. For this purpose, 30 boys between 8 to 12-year-old with attention deficit hyperactivity disorder selected and matched in purposeful manner in psychiatric clinic and they categorize in two groups by names of control and experimental groups. At the end of this treatment period, both EEG and test CSI (csi-4) was tested again. The two groups were assessed by electroencephalography and then test CSI (csi-4) were taken from them. Children in experimental group were tested during 24 neurofeedback sessions (8 weeks, 3 sessions per week). At the end of the treatment period, both EEG and test again CSI (csi-4). ANCOVA results showed that the ratio of theta waves to beta test and control groups was

significantly higher than usual results and the provision of treatment in the experimental group was lesser than in the radiation pattern waves in the experimental group and shown significantly decreased in areas fz, cz, pz, c3, c4. Also the amount of attention and impulsiveness provide a significant improvement in the treatment group compared to the control group. Based on these findings, we can say that the changing pattern of brainwave neurofeedback therapy for reducing signs and symptoms of attention deficit hyperactivity disorder affecting children.

Keywords: Neurofeedback- attention deficit- hyperactivity disorder

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a kind of neurological disorder having three major specifications including attention deficit, hyperactivity, and impulsivity. This disorder is the most common childhood neurological-behavioral disorder one by which the world has been suffering (American Psychiatric association, 2000). People suffering from this disorder may have not capability to pay attention to the details or may make a mistake while doing their homework, jobs, or other activities. Most of the time there are disorders and tasks would be done carelessly and without the thought. To focus on the activity or homework which is being done to complete the task is most of the time a difficult process (Abikaf etal, 2009). Attention deficit hyperactivity disorder (ADHD) is referred to some issues such as inattention, impulsivity, hyperactivity, and offense. ADHD is a neurofeedback disorder which is being diagnosed based on the behavioral criteria. Signs of this disorder are being classified in two fields of disorder and impulsivity. Signs should be problematic or disharmonic with the growth and should occur at least at two situations and consequently result in the disorder in the person's performance. These signs should be observed by the age of 7 and should be included up to the age of 12 and they should not happen because of any other disorder (Davidos and Gastper, 2005). According to the statistical diagnostic guide of the psychopathy, 4th Revision, (DSM), to diagnose the signs of attention deficit hyperactivity disorder (ADHD) it should be considered that the signs should be chronic and should also be observed before the age of 7 and at least at two different situations. Three subgroups are defined for this disorder as Inattention, hyperactivity, and the combination of them. Attention deficit hyperactivity disorder (ADHD) includes 3 to

7 percent of students (Fabiano et al, 2009). ADHD is one of the most common psychopath disorders in children and juveniles and inattention which is being observed in ADHD may be resulting from the disorder in the reactions purpose as well as the disorder in frontal performance (Berkly et al, 1992, Cohen et al, 1993).

Explanatory efforts for attention deficit hyperactivity disorder (ADHD) have been done and emphasized in case of reasons such as brain injury, neurological disease, sensitivity to foodstuff and additives, brain chemical biology imbalance, environmental variations such as Pb, environmental limits and stresses (Schmitz et al, 2006). Among psychiatric diagnosis in childhood, attention deficit hyperactivity disorder (ADHD) is controversial. Setting separate signs for this disorder is something difficult because there is no difference between these signs and other behavioral and learning disorders, there is the least agreement between various tools of evaluation and since there is no united etiology as well as constant response to the treatment (Barkley, Rater, 1983, 1998).

Although the diagnosis of the attention deficit hyperactivity disorder (ADHD) is a behavioral diagnosis but abundant researches have been done to provide many witnesses to use neurometric tools in the diagnosis of this disorder. As an example tools such as quantitative electroencephalography (QEEG) can be named. Researchers in the field of neurology have achieved the witnesses in case of the reduction in the activity of frontal and middle central regions in approximately 83 to 91 percent of the patients of ADHD (Chabut et. al, 1996, Man et. al, 1992, Monstra et. al, 1999). In order to evaluate QEEG, the ratio of specific waves to other waves has been used to determine the amount of Cortex engagement in the requested activities. As an example, the ratio of theta to beta is the scale for evaluation of activity measurement of silent waves to fats ones. It has been determined in researches that in QEEG of the people suffering from ADHD there are changes and the ratio of theta to beta is higher than those ones are not suffering from this (White et al, 2005). Neurophysiological studies have shown that the optimized changes in the brain rhythm and frequency can make change in the people's psychological situations using the nerve therapy methods and through studying the relation between QEEG of the cortex, brain psychological mechanism, and psychological situation (Sterman, 1996).

When a group of neurons transfer the electricity current at the same time, the ripple effect would be created which is named brain wave (Otmer& Kiser, 1999). Human being brain is an organ having electrochemical properties in which each neuron has the electrical activity and these neuronal activities would be reflected in the skull surface. This electrical activity is so weak and is in Micro Volt level. QEEG device records this activity and shows as tapes with various shapes through electrodes attached to the skull (Johnson& Gankleman, 2005). Brain waves would be classified into four frequency bands as:

Delta wave (0-4 Hz), Theta wave (4-8 Hz), Alfa (8-13 Hz), and Beta (13-32 Hz)

Some researches support using QEEG tools in diagnosis and segregation of types of ADHD (Chabot, 1996). Unlike other brain imaging methods, QEEG has been invented to study the brain performance and activity (not brain structure). Therefore, it can be used for the purpose of recognition and diagnosis of brain activity disorder such as dependence on materials, hyperactivity with/without inattention, anxiety, depression, Alzheimer's, and etc (Hamond, 2006, Master Pasoca and Heli, 2003, Laurence, 2002). The fundamental assumption of such comparison is that various psychological diseases would result in meaningful abnormalities in the brain and would created changes in the brain waves (Chabot et al, 2001). The ratio of theta to beta has been used historically in ADHD researches (Man et al, 1992, Monastra et al, 1999). Researchers have shown changes in QEEG of the people suffering from ADHD and have proved the ratio of theta to beta in those ones is higher than the people who are not suffering (Lubar, 2004).

Limitations of medications as well as behavior therapy emphasizes on the need for an alternative and complementary treatment for ADHD with long term effectiveness and the least side effects. It is deemed that neurofeedback can be considered as such alternative which has decreased the behavioral signs of ADHD and would make diagnosis variables improve.

Neurofeedback is the process of recording and then sending data to the references (Demos, 2005). In this method, sensors which are named electrode would be in connection with the patient's head. These sensors record the respective information of activity level of the people's brain and would show them as the brain waves. The received information of the patient's brain activity would be observed by two monitors. Because of the brain waves

activities (like Alfa, beta, theta, delta, and gamma) which are unconscious and out of control processes, it is completely understandable by the patient and the therapist that by the help of the therapist or through receiving the visual-audio stimulus patient would be able to control each wave as alfa, beta, theta, delta, gamma, and etc. which have been diagnosed as the abnormalities in comparison with the normal data and make them normal by the educational sessions (Johnson, Gankleman, 2005). Neurofeedback can operate as the treatment nearly in all pathobiological cases and conditions in which brain cannot operate properly (Vilson et al, 2006). This method can result in the concentration enhancement, impulsivity decrease, excitement control improvement, increase in tolerating more workloads in a long term, improvement in psychological exhaustion period and decreasing them, enhancement in tolerating fiasco, and finally the increase in the self-confidence and person's performance in personal, social, and occupational situations. The most studies have been done in the field of the effectiveness of the neurofeedback treatment for improvement of disorders, for growth disorders, learning disorders, lack of focusing, and hyperactivity. Results of these studies proved the high level of effectiveness for this treatment (Focuz et al, 2003). Fundamental mechanism of the effectiveness for long term neurofeedback treatments in behavioral changes has been explained by the researches done in the field of neural flexibility (Feredrik et al , 2004).

The increased ratio of theta to beta can be correlated with the signs of ADHD like hyperactivity and inattention (Focuz et al, 2003). There are three main methods to treat children suffering from ADHD through using neurofeedback including training to decrease the strength of theta (4-8 Hz) and to increase beta (15-20 Hz), and increase the strength of SMR (12-15 Hz). Most research groups combine two or more therapeutic protocols such as inhibition of theta and increasing beta (Lubar, 2004) as well as inhibition of theta and SMR (Elhamra& Funler, 1995).

Research results dealing with the self-adjustment of theta, beta, and with SMR suggest that neurofeedback treatment would decrease the signs of ADHD and would cause the improvement of diagnosis scales such as attention and intelligence variables (Elhara et al, 1995, Focuz et al, 2003, Monstera& Jorge, 2002).

To sum up, based on the studies in the field of ADHD treatment it can be inferred none of

the treatments can produce stable and complete results by themselves. Therefore, there is such tendency to use several treatments and eclectic approaches simultaneously to treat such disorder.

Considering the lack of common treatment in ADHD disorder such as medication, observing neurological problems and confirmation of neurological interferences effectiveness by neurofeedback treatment this question is presented here that neurofeedback treatment can be applied beside other proved treatments such as medications as the complementary treatment to improve psychological and neurological signs?

It is required to do more studies to observe that neurofeedback would be able to improve psychological abnormalities in people suffering from ADHD. It should be determined whether neurofeedback can improve the neurological abnormalities which have been diagnosed by brain wave tomography. The following assumptions can be presented as:

First assumption: Neurofeedback treatment would decrease inattention disorder in children suffering from ADHD.

Second assumption: Neurofeedback treatment would decrease hyperactivity in children suffering from ADHD.

Third assumption: Neurofeedback treatment would decrease the ratio of theta to beta waves in children suffering from ADHD.

METHODOLOGY

Statistical society, Sample, and research method

The statistical society of this research has been selected among children between 8 and 12 which have been referred to psychiatric Clinic and have been diagnosed with ADHD based on the diagnosis criteria DSM.IV.TR.

First 30 children suffering from ADHD have been selected by the targeted method and have been put into two control and test groups. Then QEEG has been done on both groups. The children in test group have received 24 neurofeedback treatment sessions (8 weeks and 3 sessions each week). After the end of treatment sessions for test and control groups, QEEG test has been done.

The average age of the participants for both groups is 9.87 with the domain of 8 to 12 years and standard deviation of 1.36.

Measuring tools

Diagnosis interview

Diagnosis interview has been done in psychiatric Clinic and included visiting patient and parents by the psychiatrist and based on diagnosis criteria DSM-IV-TR (American Psychiatrist Association, 2000) for

45 minutes. Psychiatric checking included the patient situation, evaluation of previous diagnosis signs, and the patient's history. The patient's situation reports included the study of background from the aspect of the child's evolution and his/her performance at home or school, the study of the present situation, medical history including the used medicine, sleeping situation, physical activity, and diet, family situation including parent's jobs and the psychological situation of the whole family. Patients having diagnosis criteria DSM-IV-TR (American Psychiatrist Association, 2000) and could not be removed, have been selected as two test and control groups.

Quantitative electroencephalography:

Quantitative electroencephalography is a tool which is used to record the brain activity through using electrodes which are attached to head by international system 10-20. Brain waves would be recorded in this research using a NEXUS 20-bracch QEEG device and using a special hat and through 17 fixed pints. The time to do QEEG test is 45 minutes and the frequency 128 Hz. Brain waves have been recorded in three situations for doing homework (reading and writing), closed eyes, and open eyes and each one for 10 minutes. Chabot (2001) have obtained the sensitivity 88 percent and specification 94 percent for this technique.

To analyze QEEG after the record of brain waves in alfa, beta, theta, and SMR, the ratio of theta to beta on points FZ and CZ should be compared with the sound group.

RESULTS

Table 1 shows the average and standard deviation of descriptive indexes related to inattention and hyperactivity disorder as well as the ratio of theta to beta for test group and control group in pretest and posttest process.

Table 1: descriptive indexes of test scores of signs for patient children to evaluate the inattention and hyperactivity disorder in two test and control groups before and after the test

Sources of change	Total Squares	Degrees of freedom	Mean Squares	F	Significant	Coefficient Eta
Pretest attention deficit	42.16	1	42.16	91.05	1.00	0.77
Group	40.48	1	40.48	87.43	1.00	0.76
Error	131.46	29	0.46			
Total	1028.00	30				
Pretest hyperactivity	107.88	1	107.88	161.96	1.0	0.85
Group	57.55	1	57.55	86.40	1.00	0.76
Error	155.86	29	155.86			
Total	988.00	30				
Pretest Theta to beta ratio	5.27	1	5.27	44.47	1.00	0.62
Group	4.14	1	4.14	34.93	1.00	0.56
Error	13.08	29				
Total	444.08	30				

Table 2: Test results of covariance analysis test on the scores received from inattention and hyperactivity disorder as well as the ratio of theta to beta in two test and control groups

Variable	Stage	Experimental Group(N=15)		Control Group(N=15)	
		Standard deviation	mean	Standard deviation	mean
Attention deficit	Pretest	2.10	6.00	1.50	7.13
	Posttest	1.24	3.86	1.53	7.06
Hyperactivity	Pretest	2.03	7.46	2.89	6.40
	Posttest	1.09	4.26	2.78	6.26
Theta to beta ratio	Pretest	0.42	4.31	0.56	4.36
	Posttest	0.48	3.39	0.6	4.18

CONCLUSION

The aim of this research was to study the effectiveness of neurofeedback treatment on the reduction of signs related to inattention and hyperactivity disorders in children suffering from ADHD.

To sum up, the results of the present research showed that neurofeedback treatment would result in the reduction in signs of the inattention and hyperactivity disorders in children suffering from ADHD as well as the ratio of theta to beta in those children is higher in comparison with wave ratio pattern in people who are not suffering.

Research results dealing with the self-adjustment of theta, beta, and with SMR show that neurofeedback treatment would decrease ADHD and improve the diagnosis criteria such as attention and intelligence variables. These results have conformity with the results of researches done by (Elhamer et al, 1995, Focuz et al, 2003, Mostera and Jorge, 2002).

Studies using QEEG technique to diagnose ADHD disorder all present distinct results their specifications are the enhancement in the activity of slow waves (theta and delta) and the reduction in fast waves strengths (beta) (Beri et al, 2003, Klark et al, 1998). Researched showed that in QEEG of people suffering from ADHD changes have been observed and the ratio of theta to beta is higher for them in comparison with others (Lubar, 2004). Results have shown that the increase in theta activity from childhood to adulthood would remain constant (Bersenhan and Beri, 2002). Patients suffering from ADHD are not a homological group from the physiological aspect. (Arnes et al ,2008) have shown that ADHD patients may be divided into two groups with the increase in brain slow waves.

One groups is the one through decreasing the activity is being referred as the slow activity by mistake and the other one is the group theta activity has been increased (Arnes et al,

2008, Chabot and Serfontin, 1996, Klark et al, 2001). While brain slow waves like theta is in relation with cortex performance. Generally, it has been observed that frontal activity has been decreased in ADHD. Brain slow waves increase and decrease in fast brain waves activity in central and frontal regions possibly shows the low provocation of central nervous system (Beri et al, 2003).

Researches show that neurofeedback let the person produce waves which can be observed people who are not suffering from ADHD (Lubar, 1993) that's why this method has been selected as the effective one. Results also showed that neurofeedback treatment would change brain waves pattern in children suffering from ADHD. As an example, (Fatches et al ,2003) results, Chabot et. al (2001), Klark et. al (2001),Hiood and Bill (2003) showed that neurofeedback treatment caused the slow waves as theta to be decreased and fast waves as beta to be increased. It also caused the ratio of theta to beta to decrease and improved the disorder signs.

Most clinical studies have been done in the field of neurofeedback treatment effectiveness and disorders signs improvements, growing period disorders, learning disorders, lack of focusing and hyperactivity. The results showed the high effectiveness of this treatment for such disorders (Focuz et al, 2003).

One of the explanations is that brain stimulus increases the brain electrical activity, composition, secretion, and neuroterophins activity which result in more continuity and synaptic connection (Feredrik et al, 2004). Brain waves biofeedback can result in the changes in cortex activity and these changes would also result in tangible improvements in behavior (Sterman et al, 1979). The effectiveness mechanism is based on this method that brain is compatible, has the high capability to learn, can learn to change its performance, and to be improved in case it can get the things which are required for change. Proper stimulus of the brain can cause the growth of the brain and synapses, formation of new synapses, and start of normal activities. Generally, based on the results of previous studies and present study, neurofeedback is effective in the mental health in a long term as the self-adjustment mechanism (Laurence, 2002).

To sum up, Results of the present research showed that brain wave pattern in children suffering from ADHD to people who are not suffering is different and neurofeedback treatment would cause the decrease in

inattention and hyperactivity. According to these results, some theoretical and practical achievements can be considered. In practical level, this study showed the possibility of using quantitative electroencephalography in diagnosing ADHD disorder. In theoretical level, results can help more recognition of creating factors and ADHD disorder factors. Using these tools, the diagnosis would not be based on behavioral criteria and would be based on an accredited and objective criterion. Results of this research showed the effectiveness of neurofeedback treatment in ADHD disorder treatment. All studies showed the durability of this treatment effectiveness, lack of any side effect, and multi-dimensional effectiveness in treating ADHD disorder and can be used as the complementary treatment and in some cases as the alternative for medication.

Research society and sampling method would present and consider limits in the results generalization, interpretations and cause identification documents of studied variables.

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