Studying the Effect of Neurofeedback Training on Reducing Anxiety Symptoms in Females

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Abstract

Background:

Anxiety is the most prevalence psychological disorder and it was regarded as an adaptive response versus stimulations. This study sought to determine in reducing anxiety symptoms on female in *Kermanshah city. The present study is based on a PhD thesis from the first author.*

Materials and methods:

This research used a quasi-experimental methods of pretest-posttest follow-up with a control group. The sample consisted 24 women with anxiety disorders in counseling center in Kermanshah selected by available sampling and randomly assigned to the control and experimental groups. The experimental group received neurofeedback training for 30 sessions and 30 minutes for per session. While the control group did not receive any intervention until the end of the project. The data were collected by Beck anxiety questionnaire and e-view neurofeedback system. The data were analyzed using analysis co-variance (ANCOVA).

Results:

The results indicated that there were significant differences between the anxiety scores subject of the experimental and control and follow-up group.

Conclusion:

Neurofeedback training provides useful applied practices in the treatment of anxiety disorders.

Keywords: Neurofeedback Training, Anxiety, Alpha Brain Wave.

Introduction

Anxiety disorders are considered as one of the most common mental health problems in the United States. After collecting data from various mental health centers, researchers estimated the prevalence of each anxiety disorder over a year. Results suggest that the prevalence of anxiety disorders in adults aged 18-54 years is 13.1%. These disorders can become chronic. The rate of recovery from social phobia, generalized anxiety disorder, fear of open places, and panic varies from 16 percent to 23 percent. Considering the prevalence and chronic nature of the disease and the costs associated with anxiety disorders, it is not surprising that a great deal of effort has been made to develop effective and efficient treatments [1]. In the current century, human beings have been affected by this psychological disorder more than ever due to industrialization impacts [2]. This disorder causes helplessness, frustration, restriction and inefficiency, leading to decreased motivation, attention and effort. Hence, it

leads to many problems in relationships, education, reduced productivity and even death [3]. There are various treatments for anxiety disorders, including biological and psychological therapies. One of the biological therapies is the use of neurofeedback method. Neurofeedback is a comprehensive patient education system that modifies, strengthens, modulates, and increases the efficiency of brain cells. In fact, neurofeedback is a science that does not require a special laboratory and is done exclusively by a specialist therapist in this field. Neurofeedback is a technology that helps patients who need psychotherapy and cognitive rehabilitation or those who suffer poor mental skills [4].

The goal of this technique is to correct neuronal or chemical dysfunction in the patient's central nervous system. Recording brainwaves (EEG), neurofeedback therapy prepares brain function in the form of computer information and provides us the physiological information that is displayed through brainwaves. The output obtained by the computer is based on the theory of operant conditioning and positive and negative reinforcement. Electrical impulses are prepared by neurotherapy and their amplitude is received in separate filtered frequency bands. As a result, this information is provided visually and audibly to the client and helps the patient to adjust his or her brainwaves via a computer. In the neurofeedback training session, clients can learn to condition their brainwave pattern and increase the optimal level [5]. Neural biofeedback is a type of biofeedback that works directly on the brain. We are not normally able to control and change our brainwaves because we are not aware of them. The neurofeedback method tries to build this awareness through training and the brain learns to produce waves, leading to the person's recovery by providing brainwave feedback to the person and by continuing the training [6]. The application of neurofeedback in the treatment of a wide range of disorders such as hyperactivity / attention deficit, depression, bipolar disorder, anxiety disorders, sleep disorders, brain injury, tort, obsessive-compulsive disorder has been confirmed [7].

In the study conducted by Mohammadi et al. (2016) on a number of people with panic disorder, the results showed that neurofeedback therapy was effective in reducing symptoms and had good effects and a clinically significant difference was observed between the two groups [8]. In a study entitled EEG and neurofeedback in children and adolescents with anxiety disorders and depressive disorders, Simkin et al. (2014) showed that the effects of neurofeedback on these disorders are significant [9]. Nainian et al. (2009) examined the effect of neurofeedback training and medication on reducing anxiety symptoms and quality of life in patients with generalized anxiety disorder. Results revealed that the effect of neurofeedback training in reducing the symptoms of generalized anxiety disorder in these groups was significantly higher than group therapy [10]. Jahanian Najafabadi et al. (2013) investigated the effect of neurofeedback training on reducing anxiety in 18 males with a mean age of 34.44 years [11]. Ghayour Kazemi et al. (2016) showed that neurofeedback could significantly reduce anxiety in girls with social anxiety [12]. Ashoori (2015) conducted a study on students and the results showed that neurofeedback training method significantly reduced anxiety and depression in students with attention deficit/hyperactivity disorder [13]. The cost of psychiatric care in different countries has increased significantly in the recent years. The controlled care approach has been developed in recent decades in the area of psychiatric services in developed countries with the aim of reducing treatment costs [14]. Various studies have been conducted in the area of anxiety treatment using neurofeedback, indicating the high efficiency of this method in the treatment of anxiety [15].The goal of neurofeedback is treatment of problems to manage the symptoms of medical disorders. Comprehensive trainings such as neurotherapy address the causes of the disorders [5]. Due to a limited number of studies on the effect of neurofeedback in Iranian society on psychiatric disorders such as anxiety, which can be a key factor in promoting health and reducing psychological problems, as well as drug side effects and slow recovery rate in some patients, the researcher aims to examine patients' anxiety levels before and after treatment with neurofeedback. Thus, the aim of present study was to investigate neurofeedback training on reducing anxiety symptoms and the persistence of this treatment method on reducing anxiety symptoms.

Materials and Methods

The present study is a clinical trial conducted with the code of IR.kums.REC.1398.936. The present study is a quantitative study in terms of nature of the collected data, a fundamental study in terms of aim and a quasi-experimental with a pre-test and post-test design with a control group in terms of method. The statistical population of the present study included all women with anxiety disorder, who

referred to the Welfare Counseling Center in Kermanshah in 2019. The participants of this study included 24 women selected by a convenient sampling method and were randomly divided into control and experimental groups (12 in each group). Then, the initial diagnosis was made by a psychiatrist and clinical psychologist, a clinical interview based on DSM-5, and a Beck anxiety test. Thus, two homogeneous groups were obtained and the dependent variables were measured in both groups at the same time and under the same conditions. At the beginning of the study, after holding a briefing session, all subjects in the experimental groups (the group under neurofeedback training and the control group) signed the informed consent form and were entered to study in compliance with all ethical issues.

Tools

Clinical interview: Clinical interview is a tool for diagnosing mental disorders based on the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association) [16].

The Beck Anxiety Test: Beck Anxiety Inventory was developed by Aaron Beck et al. (1990). It measures the severity of clinical anxiety symptoms in individuals. The Beck Anxiety Inventory is a self-report questionnaire designed to measure the severity of anxiety in adolescents and adults. This questionnaire is a 21-item scale in which the subject selects one of the four options in each item that indicates the severity of anxiety. The four options for each question are scored on a four-point Likert scale ranging from 0 to 3. Studies show that this questionnaire has high validity and reliability. Its internal consistency coefficient (alpha coefficient) has been obtained at 0.92, its reliability by test-retest method with one-week interval has been reported at 0.75, and the correlation of its items has been reported from 0.30 to 0.76.

Kaviani and Mousavi (1999) examined psychometric properties of this test in the Iranian population and reported the validity coefficient, test-retest reliability with one-month interval and Cronbach's alpha at 0.72, 0.83, and 0.92, respectively. Each test item describes one of the most common symptoms of anxiety (mental, physical, and panic symptoms). The total score of this questionnaire is in the range of zero to 63 and a score above 26 indicates the severity of anxiety [17]. Neurofeedback equipment: Neurofeedback is a tool equipped with a computer system used to teach neurofeedback. It records the brainwaves and then the data are carefully compared with the basic data in this equipment. This assessment method allows us to significantly and scientifically compare the reference brainwave pattern with the normal brainwave pattern and determine the differences. This equipment can significantly assess conditions such as brain injuries, attention deficit / hyperactivity disorder, learning disabilities, depression, obsession, anxiety and other disorders [18].

Neurofeedback therapy is implemented in 30 half-hour sessions and three sessions per week. Neurofeedback therapy uses E-view hardware made by Science Beam Company or Parto Danesh Institute and eprove software. This equipment can reinforce and suppress brainwaves in different parts of the brain. Neurofeedback equipment is a tool equipped with a computer system used to train neural feedback. Subjects sit in a comfortable chair in a quiet room. One active electrode is placed on the head, a reference electrode is placed on the right earlobe, and one ground electrode is placed on the left earlobe. Then, using computer equipment and based on the person brainwaves, a visual and auditory feedback, usually in the form of a game, video, image, or computer audio, is provided to the person. The alpha-delta protocol is used to teach neurofeedback. To implement this protocol, the active electrode is placed on the pz point (10-20 system is used to use these brain points) [19].The other two electrodes, the reference electrode and the ground electrode, are connected to right eardrum and left eardrum, respectively. At the beginning of each session, a baseline was taken for two minutes and the reinforcement thresholds were determined based on it.

Results

In this section, descriptive information of women's anxiety in pre-test, post-test and follow-up in experimental and control groups is first presented in Table 1.

Table 1. Mean and standard deviation of anxiety separately based on type and test group

		Test	Mean	SD
	Neurofeedback therapy	Pre-test	38.33	4.206
		Post-test	23.91	3.5
		Follow up	2.08	3.47
Control group	Control group	Pre-test	35.83	5.18
		Post-test	32.25	4.9
		Follow up	38.08	5.16

Based on information in Table (1), although the pre-test scores in the control and experimental groups are almost the same, the post-test scores of the experimental group have decreased compared to the control group and changes in the subjects' scores in the follow-up stage compared to the post-test are not significant.

Table 2. Results of Kolmogorov-Smirnov test to check the normality of data

	Anxiety
Kolmogorov-Smirnov	1.458
Sig	0.082

Based on the results, the significance level of Kolmogorov-Smirnov test for anxiety was calculated at 82%. Thus, H1 on non-normality of data of the anxiety questionnaire was rejected and hypothesis H0 on the normality of data of this questionnaire was confirmed by Kolmogorov Smirnov. To examine the hypothesis that states neurofeedback therapy has a significant effect on reducing the symptoms of anxiety in women, analysis of covariance was used, the results of which are shown in Table 3.

Table 3. Summary of analysis of covariance for intragroup factor (neurofeedback therapy) and intergroup factor (experimental and control groups)

Source of variations	Sum of squares	df	Mean of squares	F ratio	Sig	Eta-squared
Group	234.083	1	234.083	11.527	0.001	0.208
Test	675.00	1	675.00	33.24	0.001	0.430
Group× Test	574.083	1	574.083	28.27	0.001	0.391
Error	893.5	44	20.307			

Based on Table 3, the level of significance observed for the test, group, as well as the interactive effects of the test and group is significant at the level of 0.05. Therefore, it can be concluded with 95% confidence that the changes in anxiety in pre-test and post-test in the experimental and control groups are not the same. As comparison of the changes in Table 3 shows, the level of anxiety of the subjects who received neurofeedback therapy was significantly reduced compared to the control group. In other words, neurofeedback therapy significantly reduces women's anxiety. The Eta value (effect size) also indicates that approximately 39.1% of changes in women's anxiety is influenced by the group (experimental and control).

To test Hypothesis 2 that states neurofeedback therapy reduces the symptoms of anxiety in women, analysis of covariance was used and the results are shown in Table 4.

Table 4. Intragroup factor (neurofeedback therapy) and intergroup factor (experimental and control groups)

Source of variations	Sum of squares	df	Mean of squares	F ratio	Sig	Eta-squared
Group	2080.333	1	2080.333	110.416	0.001	0.715
Test	12.000	1	12.000	0.637	0.429	0.014
Group× Test	40.333	1	40.333	2.141	0.151	0.046
Error	829.000	44	18.841			

Based on Table 5, the significance level observed for test and the interactive effects of the test and groups is not significant at the level of 0.05. Comparison of the changes in Table 1 also shows that the level of anxiety of subjects who received neurofeedback therapy did not decrease compared to the control group. Therefore, it can be concluded with 95% confidence that the level of women's anxiety in the follow-up test has not changed, indicating the persistence of neurofeedback therapy effect.

Conclusion and Discussion

The present study was conducted to evaluate the effectiveness of neurofeedback training in reducing anxiety symptoms in women with anxiety disorders. The results revealed that neurofeedback training reduced anxiety symptoms in women. These results are in line with those of studies conducted by Hammond [18], Khossorour [20], Mooro [21], Gerrett and Silver [22], Ghayour Kazemi et al. [12]. Since cognitive and emotional aspects are involved in anxious people, various studies have shown that the mentioned aspects have biological and physiological bases in the frontal part and brainwaves. Thus, the present study uses neurofeedback therapy with an emphasis on biological bases to reduce the symptoms of anxiety [23]. In addition, the results of the research conducted by Jahanian Najafabadi et al. [11] show that neurofeedback training could significantly reduce the anxiety of research participants. In explaining this result, it can be stated that the human brain can heal itself, meaning that it can re-learn the mechanisms of self-regulation in normal functioning [24]. Oraki et al. [25] showed that neurofeedback could reduce depression, anxiety, stress and abdominal pain of patients, but it had no effect on their stress level. Also, the results of a study conducted by Yousefi et al. [26] showed that neurofeedback therapy could reduce anxiety in people of different age groups by conditioning brainwaves and increase their relaxation time by repeating sessions. Since a defect in brainwaves occurs in anxiety disorders and reinforcing alpha brainwaves causes more relaxation in people, the results of research show that 80 to 90% of neurofeedback therapy has treated anxiety [27]. Regarding the protocols that are effective in reducing anxiety, it is seen that people experience relaxation after about 5 minutes of training. Anxious people can increase their relaxation with training and repetition after being acquainted with their physiological and nervous changes. Another result of the study suggests that neurofeedback training has a persistent effect on reducing the symptoms of anxiety in women. This result is consistent with the results of the studies conducted by Elahinejad [28], Oraki [25], Smith [29], Margaret [30] and Rosenfield [24]. In explaining this result, it can be stated that in anxiety states, the brain responds to anxiety by over-alertness. Anxiety is an aspect of reduced brain self-regulation. Anxiety states are quite evident in the EEG, and when the brain is involved in self-regulation, it is found that its effects are more lasting and it is possible by reinforcing the brainwaves and when the brain is reinforced in the self-regulation direction, the mechanism of physiological arousal accelerates and the brain is not vulnerable to anxiety [31]. Also, the results of a study conducted by Peters et al. [32] indicated that the mean of asymmetry of their activity significantly decreased after neurofeedback therapy sessions and its rate and persistence was more in women. The present study suffered some limitations. The subjects of this study included only women with anxiety disorders, so we should treat with caution in generalization the results to men. Also, since a convenient sampling method was used in this study, we should treat with caution in generalizing the results obtained from the sample to whole population. Also, due to application of technology in neurofeedback method and its novelty, the patient motivation and hope for new treatment could affect the results, which was not controlled in the present

study. Based on the results of the present study, it is recommended for psychiatric clinics to use neurofeedback more in the treatment of anxiety.

Reference

1. Steven C Hayes, Kirk D Strosahl0 A practical guide to acceptance and commitment therapy. Translated to Persian by: Khamseh A .Tehran: Arjemand pub;2004. P:131

2. Pourshahsavari F, The Effect of Group Counseling (Problem Solving) on Reduce of Anxiety Among Alzahra University Students [M.A. Thesis in Persian]. Tehran, Iran: Alzahra University: 1999 (in Persian).

3. Sadeeghi A, Anxeity , definition and cause of treatment , Isfahan : Education and Training publication:2001[book in Persian].

4. John M Demos, Getting started with neurofeedback , Translated to Persian by Azarangi D , Rahmanian M. Tehran: Danjeh pub; 2015, p: 19 (in Persian).

5. Schwartz M, Andrasik F, Biofeedback,2003, A Practitioner's quide. New York: quilford

6. Moazami. D. An Introduction to Neuropsychology. Tehran. Samt Pub; p: 341 (in Persian).

7. Hammond D C, Neurofeedback treatment of depression with roshi , Journal of neurofeedback , 2000, 4(2):45-56.

8. Mohammadi S Y, Malmir T, Golzar M, The Impact of neurofeedback on anxiety and assertiveness in people with panic disorder, 2016, journal of neuropsychology vol 2, no 2, (series 5) summer 2016.

9. Simkin D R, Thatcher R W, Luber J, Quantitative eeg and neurofeedback in children and adolescents anxiety disorders, depressive disorders , comorbid addiction and attention – deficit/hyperactivity disorder, and brain injury.2014 , child adolesc psychiatry clin n am, 2014, 23(3): 427- 64.

10. Nainian M , Babapour J , Garoosi Farshi T, Shaeeri M, Rostami R. Comparing the influence of drug therapy and neurofeedback training on reduction of anxiety symptoms and life quality of generalized anxiety disorder (GAD) Patients. CPAP, 2013: 2(7):1-14 (in Persian).

11. Jahanian N A, Salehi M, Rahmani M, Imani H, The effect of neurofeedback training on reduce of anxiety . 2014, J Res Behave Sci 2014:11(6):657-664 (in Persian).

12. Ghayour Kazemi F, Sepehri Shamloo Z, Mashhhadi A , Ghanaee Chamanabad A, A Comarative study efeectiveness of metacognitive therapy with neurofeedback training on anxiety symptoms , emotion regulation and brain wave activity in female students with social anxiety disorder, 2018,J Neuropsychology, vol, 4,NO. 1,(Series 12) 2018 (in Persian).

13. Ashoori J, The Effect Of Neurofeedback Training On Anxiety and Deppression in Students with Attention Deficit/ Hyperactivity Disorders. 2016, Journal of Education and Community Health , No 9 Volume 2, Issue 4 (in Persian).

14. Fiers A G , teral T G, Clinical Psychology , 2006,Translated to Persian by firozbakht M. Tehran : Roshad Pub ;2011, P37.

15. Costa M A, Gadea M, Hidalog V, Perez V, Sanjuan J , An Effecttive Neurofeedback Training with Cortisol Correlates in a clinical case of anxiety . 2017. Universitas psychologic , 15(5).

16. Mickel B. F, Ganet. B.W, Rendales K, Speterzerk, Users Guide Forth. Scid 5 cv Interview Structured Clinical for DSM-5 Disorders Clinician Version. 2016.

17. Ashtiani A F, Psychological tests personality and mental health,2009, Tehran: beasat pub; p 319.

18. Hammond D C, Neurofeedback treatment for anxiety and affective disorders. 2005, journal of child and adolescent psychiatry, 2,P:131-137.

19. Nosratabadi M, QEEG assement guided in diagnosis and neurofeedback in treatment of ADHD , An experimental research [MA Thesis in Persian]. Tehran : Allame Tabatabaei University: 2008 .

20. Khossorour S,. The Effect of Neurofeedback in Decreasing Anxiety and Symptoms Severity of Patients with Irritable Boweld Syndrome. Journal of Urumia University of Medical Science, 2017, Vol. 28 (10).

21. Mooro NC. A Review of Eeg Biofeedback Treatment of Anxiety Disorder, 2000, Clinical Electoroencepthaogram, 31(1): 1-6.

22. Gerrett B, Silver MP/ The Use of Emg and Alpha biofeedback to Relieve Test Anxiety in College Students, 1970, LN Wickramasekeral, .

23. Yongy, Yan H, Hong Z, Jing Y L, Effectiveness of Mindfullness Based Stress Reduction and Mindfulness Removal Accompained by Biofeedback on the Anxiety of the Students. Journal of knowledge on Research in Applied Psychology; 2015, 12(3): 4-11.

24. Rosenfeldjp/ EEG biofeedback of Frontal a Symmetry in Affective Disorder., Biofeedback , 1997, 1,8-25.

25. Oraki M, Dortaj A, Mahdizadeh A, Evaluating the Effectiveness of Neurofeedback Treatment on Depression, Anxiety, Stress and Abdominal Pain in Patients with Chronic Psychosomatic Abdominal Pains, 2016 Journal of Neuropsychology, vol, 2, 3 (series) (In Persian).

26. Yousefi F, Shariati K, Hemmati Sabet, A Comparative Study of Neurofeedback and Mindfulness-Based Stress Reduction on Social Anxiety Disorder, 2017, Journal of Psychology and Psyciatry Shenakht, Vol. 4/ No. 1/ P: 51-65. (In Persian).

27. Jalilean R. Helth Magazine, Retrieved from the Internet 2010.

28. Elahinejads/Makavand Hosseini Sh/Sabahi P/ Effect of Neurofeedback Therapy Versus Group Reality Therapy on Anxiety and Depression Symptoms among Women with Breast Cancer. / Journal of Diseases Breast, 11 (4):39.

29. Smith PN/Marvin WS/ Neurofeedback with Juvenile Offenders: A Pilot Study in the Use of Qeeg Based and Analog Based Remedial Neurofeedback Training, 2006, Journal of Neurotherapy 2006; 9 (3): 87-89.

30. Margaret EA/ Neurofeedback for Cerebrapalsy Journal of Neurotherapy, 2004: 8 (2): 93-4.

31. Qlyzadhz, Baba Kh, Rostami, R/ Bayrami M. Poursharifi. H. Effects of Light Feedback on Cognitive Performance, Cognitive Neuro Sciency PhD Thesis, 2010, Tabriz. 25.

32. Peters F, Oehlen M. Ronner J, Vanos J, Lousberg R/ Neurofeedback as Treatment for Major Depressive Disorder- A Pilot Study. 2014. from www.plosone.org.