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Comparing the effectiveness of music therapy and alpha-theta neuro-feedback training on anxiety and depression among patients with chronic irritable bowel syndrome

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Original Article

Abstract

BACKGROUND: Non-pharmaceutical interventions are a promising area of research in psychiatry. Traditional treatment of Irritable Bowel Syndrome (IBS) lacked notable efficacy. The aim of this study was to examine the effectiveness of music therapy (MT) and alpha-theta neurofeedback training (NFT) on anxiety and depression symptoms among patients with IBS.

METHODS: Patients with IBS, based on ROME III criteria, and high level of anxiety or depression symptoms were randomly assigned into three groups: (A) music, (B) alpha-theta training, and (C) control. In intervention groups, participants received ten 30-minute sessions of either music or alpha-theta NFT. The Hospital Anxiety and Depression Scale (HADS) was administered for all patients before and after the training period. Thirty-three patients completed the study. Data were analyzed using analysis of covariance (ANCOVA) to compare changes in HADS scores among the three study groups.

RESULTS: There was a significant main effect of HADS scores ($F_{1,18}$ = 17.79, P < 0.001) in the responses of MT group. Significant decreases were observed in HADS scores from pre-intervention to post-intervention tests in MT group comparing to control group. The MT accounted for 49 percent of variance in HADS scores. There was also a significant main effect of HADS scores ($F_{1,20}$ = 17.79, P < 0.010) in the responses of NFT group. HADS scores from pre-intervention to post-intervention tests in alpha-theta NFT group comparing to control group showed significant decreases, too. In addition, MT and alpha-theta NFT did not show any significant difference in somatic symptoms scores between pretest and posttest among patients with IBS.

CONCLUSION: This study showed that MT and alpha-theta NFT significantly alleviated anxiety and depression level among patients with IBS.

KEYWORDS: Anxiety, Depression, Irritable Bowel Syndrome, Music Therapy, Neurofeedback, EEG Feedback, Brainwave Feedback

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Introduction

Irritable bowel syndrome (IBS) as the most common functional gastrointestinal (GI) tract disorder is a cluster of symptoms that is accompanied by recurrent abdominal pain or discomfort and bowel dysfunction.[1] It is estimated that 10% to 20% of the general population are affected.[2]

It has been shown that patients with the

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most intensive symptoms have the worst quality of life, and the morbidity of IBS is equal to severe organic GI diseases. IBS is the second cause of absence from work after the common cold. In a survey of 8 European countries, a randomized cluster sampling of 41984 individuals, patients with IBS, were identified. After psychiatric evaluation, 78 percent of them believed that IBS had some effects on their health state and quality of life. Several studies have evaluated the relationship between IBS and psychiatric disorders.[3] It has been reported that neurosis, anxiety, depression, and dysfunctional cognition are more prevalent in patients with IBS.[4]

Quality of life is often drastically devastated by IBS. Several factors may act to develop IBS, especially brain-gut interactions and psychosocial conditions; moreover, psychiatric disorders have a more important role in IBS than what had been assumed previously.[5] Several studies have mentioned a complex interaction between IBS and stressful life events that affects psychiatric morbidity,[6] but the nature of the relationship is not clear.[7] Anxiety as an emotional condition is associated with stress and nervousness, and influences how the individuals with IBS cope with illness.[8] It has also been supported by the fact that psychiatric disorders specially anxiety and depressive disorders are more prevalent in individuals with IBS than healthy individuals,[9] and even individuals with gastro-esophageal reflux disease (GERD).[10] It is estimated that 40% to 90% of individuals with IBS suffer from psychiatric disorders.[11]

For many sufferers of chronic diseases, an oversensitive or sluggish central nervous system (CNS) may be a cause or contributing factor to symptoms such as pain, anxiety, panic, depression, inattention, tremor, and even seizures.[12] In addition to intestinal problems on the rise, the increase in anxiety and depression is striking.[13]

In the other investigation, it has been stated that emotions are identified as one of the most meaningful effective factors on the IBS.[14] Emotional stress makes people be more vulnerable to suffering from problems such as gastritis, heartburn, colitis, IBS, ulcers, constipation or diarrhea.[15]

Although various alternative interventions as well as drug administration have proven to be effective, some studies have argued that traditional therapeutic programs for IBS lacked meaningful efficacy.[16] Drug administration may be associated with significant improvements in global symptoms and limited by the potential risks of serious adverse effects instead of interfering with adherence to therapeutic regimen in individuals with IBS.[17] Therefore, the significant role of alternative interventions has been emphasized by several studies, especially to reduce anxiety and other psychiatric symptoms.[18] They have strongly suggested that treatment of anxiety in individuals with IBS may require inclusive consideration as a supplement to medical management for promoting coping skills; thus, further studies on the issue are demanded.[19]

Music therapy (MT) has been extensively studied on clinical medicine and is now considered to be a supplement to medical management. Music is used to achieve therapeutic effects.[20] The American Music Therapy Association (AMTA) defines music therapy as "the clinical and

evidence-based use of experimental music to accomplish individualized goals in a therapeutic relationship".[21] MT decreases sympathetic nervous system activity, so it produces the relaxation responses in patients.[22] MT has a positive effect on decreasing anxiety in patients with Alzheimer disease,[16] coronary heart disease (CHD),[23] traumatic brain injury,[24] breast cancer surgery,[25] varicose vein surgery,[26] daily burn care,[27] organ transplantation,[28] and early phase of laboring as well.

Neurofeedback [electroencephalography (EEG) biofeedback] mechanism supplies real-

time information to participants about brain functions. It is based on operant conditioning principle in which the participants learn to lead their brainwaves. During training sessions, patients try to enhance desired brain waves amplitude based on positive feedback.[29]

Neurofeedback training (NFT) is one of the treatments of stress which enables the subject to train himself to control his brain activity during stress and anxiety.[30] NFT trains the subject with functional disability to control his/her brainwaves, also in the case of stress and emotional distress.[28] Mostly, audio is used as content for NFT to increase alpha power in right−prefrontal lobe. NFT is also used to decrease the high−beta using the game as content.[31]

The mechanism of NFT in this way has been clarified by detail. Alpha brainwave is between 7 to 12 Hz which is associated with a relaxed and effortless alertness, and individuals with active alpha brainwave experience a sense of floating, lightness, and tranquility.[32] Theta brainwave ranges from 4 to 8 Hz, which is particularly connected to deep meditation.[33] Alpha and theta brainwaves contribute to relaxation.[30,32] Alpha-theta NFT protocol using auditory feedback has been used successfully in treatment of alcoholism and post-traumatic stress disorder (PTSD).[34]

The National Institutes of Health (NIH) reports that anxiety and depression affect 38 million Americans each year, and this number doubles in relation to those who are predicted to suffer from anxiety or depression during some point in their lives. It is estimated that the cost of treating these two mental health problems is more than $80 billion each year which is more than half of the nation's total mental health cost.[34]

It has been found that the effectiveness of MT and NFT on anxiety and depression of patients suffering from IBS need to be evaluated out of clinical efficacy of these interventions. Therefore, the current study was performed on the basis of the hypothesis that listening to music and performing NFT simultaneously decreases the stress among patients with IBS. In other words, the main goal of this paper was to investigate the effectiveness of MT and alpha-theta NFT on anxiety and depression among patients with chronic IBS.

Materials and Methods

This study was a randomized clinical trial that was registered in Iranian Registry of Clinical Trials and allocated a unique code (IRCT2015050711885N6). Recruitment period was from November 2014 to July 2015. The study was approved by the Research Ethics Committee of Mazandaran University of Medical Sciences, Sari, Iran.

The patients (aged 20 to 40 years) attending gastroenterology clinic of Imam Khomeini Hospital, Sari, were screened by a gastroenterologist for IBS diagnosis based on Rome III criteria.[34] The Persian version of Rome III criteria for IBS diagnosis has been used in Iran.[35] All patients with IBS diagnosis were assessed by Hospital Anxiety and Depression Scale (HADS). HADS is a self-assessment scale that was developed by Zigmond and Snaith.[36] It is commonly used for detecting states of anxiety and depression in the hospital,[37] and outpatient clinic.[36] Scale and subscales are reliable instruments of emotional distress and acceptable psychometric properties in Iran.[35-38] It is a 14-item scale that its items are equally related to anxiety and depression. It takes less than 5 minutes to complete it, and individuals respond to the questions in relation to how they feel. Each item has a 4-point response level (0-3); thus, possible scores for each disorder are up to 21. The analysis of responses reveals the severity of both anxiety and depression. Scores of 0-7 indicate normal levels of anxiety and depression, scores of 8-10 suggest the anxiety and depression, and

score of 11 or higher indicates the presence of the emotional disorders.[36,39]

The patients who referred for further psychiatric evaluation did not receive any medication for treatment of IBS if their HADS scores were higher than 11. They were interviewed by a psychiatrist using the Structured Clinical Interview based on diagnostic and statistical manual of mental disorders (DSM)-IV-TR (SCID) to rule out major psychiatric diagnoses (any psychotic disorder, suicidal ideation or plan, substance use disorder). The patients were excluded if pharmacotherapy was essential for treatment of anxiety and depressive symptoms. Those who were unable to take part fully in all treatment sessions and those who had hearing impairment or patients with nervous system diseases like seizure were also excluded. Informed consent was obtained from all recruited patients after explaining adequate information about the study (Figure 1). The HADS was administered to all participants directly before (first day) and after the training period (20th day). HADS scores were assessed by a trained psychologist who was blind to participants' assignment.

In order to determine the sample size, we used table for determining small sample size from a given population. Thirty four patients with IBS and high score of the HADS were eligible to join the study. They were randomly assigned into three groups: two experimental groups including A (music) and B (NFT), and one control group (Figure 1).

In order to deal with confounding variables, the randomization procedure randomly assigned patients to an experimental group and to a control group. Randomization helped prevent selection bias by the clinicians of this paper.

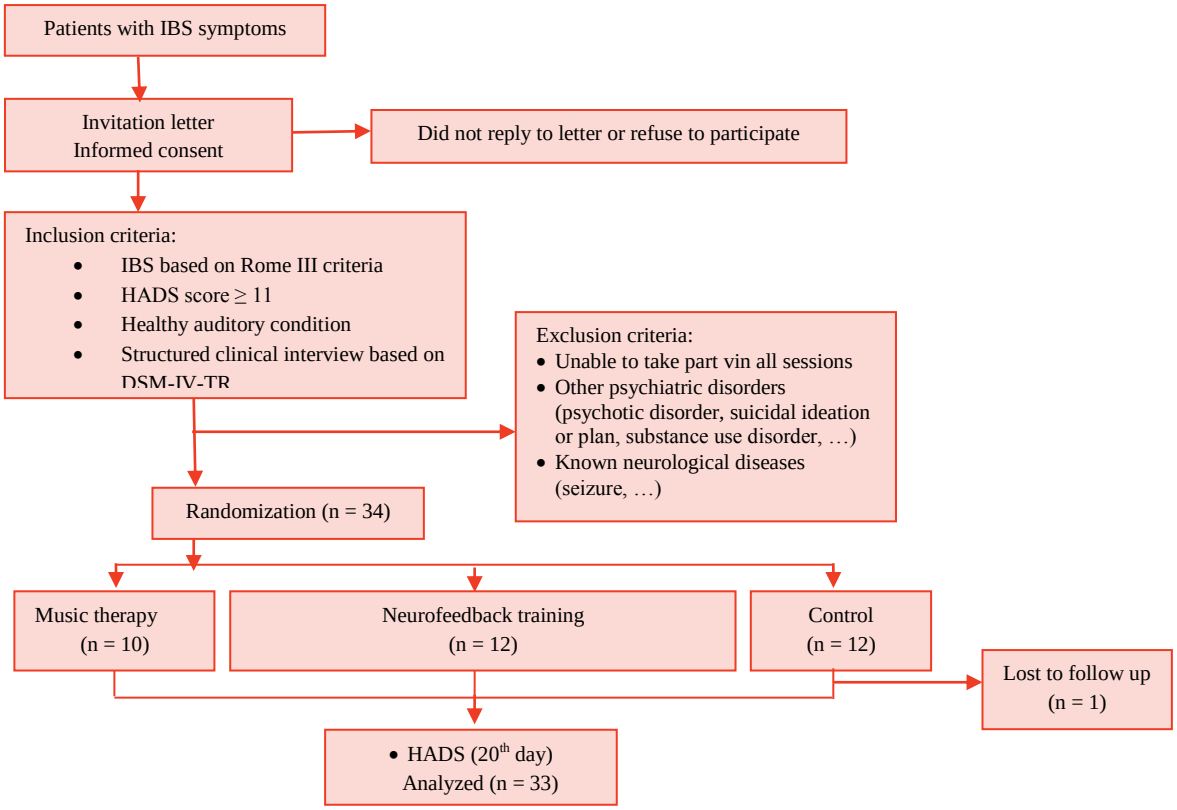

Figure 1. Flow chart of study design

IBS: Irritable bowel syndrome; HADS: Hospital anxiety and depression scale; DSM: Diagnostic and statistical manual of mental disorders

Being unable to take part in all sessions of protocol, and having other psychiatric disorders (psychotic disorder, suicidal ideation or plan, substance use disorder, etc.) and known neurological diseases (seizure, etc.).

Inclusion criteria: Diagnosing IBS based on Rome III criteria, HADS score ≥ 11 in assessment session, healthy auditory condition in order to attend the sessions, and non-clinical psychiatric symptoms based on SCID.

Group A or MT consisted of 10 sessions, 30 minutes for each session, listening to a piece of music named "Spring Awakening" by Don Gibson. The subjects listened to music through a noise reduction headphone connected to the electronic player at the same conditions. Patients were encouraged to concentrate on music. We tried to keep them away from distractions. Treatment session was conducted by a trained psychologist. The patients attended the psychiatric clinic every other day for receiving intervention.

In Group B, the ProComp2 Infiniti™ encoder was used for 10 sessions, 30 minutes for any session of real-time alpha-theta neurofeedback. This neurofeedback protocol was done using mono-polar montage with only auditory feedback. Active electrode was placed at a posterior scalp region (Pz). The participant sat quietly with the eyes closed and did not leave the place during the training.

Training sessions were held in the clinic every other day using the Thought Technology ProComp2 Infiniti (SA7500) by a trained psychologist.

The participants in control group did not receive any intervention. One patient of control group was lost to follow up and so excluded from the study.

The SPSS software (version 20, IBM Corporation, Armonk, NY, USA) was used to analyze the data for analyzing changes in anxiety level. To compare mean scores before and after intervention of each group, analysis of covariance (ANCOVA) was made on the difference in mean scores of HADS among three groups. Kolmogorov–Smirnov test (K-S test) was used to examine normality of distribution for HADS scores. Analysis of variance (ANOVA) and Fisher's exact test were performed to assess statistical significance among groups for age, gender, marital status, and educational level. Statistical significance was considered at $P < 0.050$.

Results

Thirty four patients took part in this study and were assigned randomly to one of the three study groups (10 in MT, 12 in NFT, and 12 in control group). One patient recruited in control group was lost to follow up and so excluded from the study. Thirty-three participants completed the sessions. There were no significant differences among participants considering age, gender, marital status, and educational level (Table 1). The results of this analysis regarding F value and significance level showed this model in analysis of between-subjects and within-subjects effects (Table 2).

In MT and NFT groups, Levene's test results were not significant because their P-values were ($P = 0.110$) and ($P = 0.940$), respectively; and it indicated the equality of error variances for the intervention and control groups; therefore, ANCOVA could be performed.

Table 1. Demographic characteristic of study participants

Characteristics	A* (n = 10)	B* (n = 12)	C* (n = 11)	P
Age (year) (Mean ± SD)	38.90 ± 6.45	39.10 ± 6.35	39.20 ± 5.95	< 0.001
Gender (Women: Men)	(6:4)	(6:6)	(6:5)	0.059
Marital status (Single: Married)	(3:7)	(2:10)	(2:9)	0.001
Educational level (Academic: Diploma)	(2:8)	(5:7)	(2:9)	0.015

* (A): Music therapy; (B): Neurofeedback training; (C): Control
SD: Standard deviation

Table 2. Multivariate testes on the between-subject effects

(I) Group	(J) Group	Mean difference (I-J)	SE	P
Music therapy	Neuro-feedback	-0.067	1.588	0.999
	control	-5.582	1.621	0.007
Neuro-feedback	Music therapy	0.067	1.588	0.999
	control	-5.515	1.548	0.005
Control	Music therapy	5.582	1.621	0.007
	Neuro-feedback	5.515	1.548	0.005

SE: Standard error

There was a significant main effect of HADS scores ($P < 0.001$) in the responses of MT group. Significant decreases were observed in HADS scores from pre-intervention to post-intervention tests in MT group comparing to control group. The MT accounted for 49 percent of variance in HADS scores. There was also a significant main effect of HADS scores ($P < 0.010$) in the responses of NFT group. HADS scores from pre-intervention to post-intervention tests in NFT group comparing to control group showed significant decreases too (Figure 2). In addition, MT and NFT groups did not show any significant difference in somatic symptoms scores between pretest and posttest among patients with IBS.

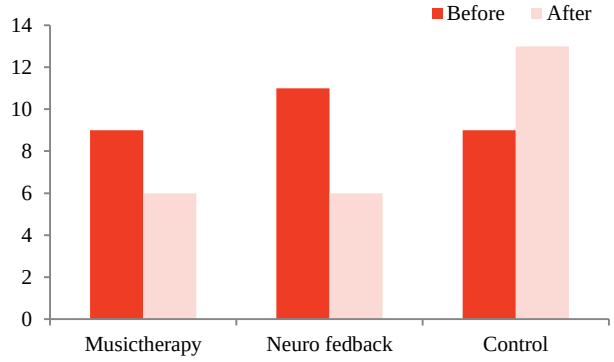

Figure 2. Mean (standard deviation) of the hospital anxiety and depression scale scores among three groups

Discussion

MT and NFT contributed to anxiety. In our study, MT and NFT groups showed significant improvement in diminishing anxiety. This was remarkable among patients with IBS, since our two protocols have not been conducted previously. Brain-gut interactions has been documented in pathophysiology of IBS, so these results can state this hypothesis that psychological factors play a much more important role than previous assumptions.[2]

The first protocol (A) indicated that anxiety level has been improved after the MT sessions. While no study has been performed to investigate the impact of MT on anxiety among patients with IBS, several studies have focused on MT to lessen anxiety level among other patients with traumatic brain injury, dementia, cancer, heart disease, and burn.[16-22,38] Although some studies have shown that stress-related signs as well as subjective anxiety could be diminished by MT, this study could not show a reduction in somatic symptoms of patients with IBS, and it may be related to limited period of interventions. Thus, further research designed with long-term intervention as well as longer follow-up to assess long-term psychiatric outcome is recommended.[1,22,38,40]

Beneficial effects of MT have been recognized previously.[18,22,39,40] Music has positive psychological and physiological effects; it has alleviated anxiety and has improved tolerance among patients with IBS.[41] Most of the investigations with common object have stated that MT can alleviate irritability and nervousness generally.[10,18,19] Other studies have pointed that patients with IBS who were included in group with MT, showed meaningful decrease in taking and requesting sedative and tranquilizer medications.[42] It may be argued that the results of alleviation in emotions after listening therapeutic music are affected by patients suggestibility, but it has

been shown that MT can decrease the rate of emotions more than placebo.[17,42] Learned helplessness effect may happen among participants who are allocated to sham treatment in control group, so this study did not implement sham treatment for control group. Learned helplessness effect happens while participants learn that what they did had nothing to do with outcome, so it may bring about passive behavior as well as low scores.[42] With regard to this point, in our investigation, we assessed and worked up anxiety and depressive mood among patients with IBS and compared the results with a technologic therapeutic procedure named NFT.

We only used headphone to provide MT or so-called "music medicine" for patients with IBS, and this was one of the limitations of the current study. Music medicine is defined as passive listening to pre-recorded music.[41] Listening to music through headphone may increase concentration on music comparing to public broadcasting. We did not use live performance by trained music therapists that might have greater impact on anxiety level.[43] Other studies may include live performance in MT, especially by a music therapist.

The second protocol (B) has also shown that anxiety has been alleviated by NFT. A few studies has supported this idea that alpha-theta module has great impact on anxiety.[42,44,45] It has been argued that the effects of alpha-theta NFT are more than alleviating anxiety; and furthermore, they are associated with creative process and well-being. Alpha-theta NFT may interact with limbic and long-distance circuitry in the brain which is notably accounted for the mood conditions.[31,40,44] It can be concluded that when alpha-theta training leads to diminished frontal beta activity, it can reduce anxiety in patients.[42]

Neuroscience research has revealed that the intestinal tract and the brain are intimately related in terms of hormonal activity and autonomic nervous system connections.[1,2,10,32] This is referred to as the "Gut-Brain Connection". Individuals with IBS frequently present evidence of abnormal high frequency brainwave activity in the frontal lobes where emotional regulation occurs.[32,46] There has been a review revealing positive effects of NFT on IBS symptoms in adult patients with IBS. However, the paper has stated that these results should be interpreted with caution due to the small number of studies examined and the associated methodological problems.[46,47]

While patients with IBS have significantly higher levels of anxiety and depression than healthy population, few studies have addressed alternative medical therapies to alleviate anxiety and depression among patients with IBS.[10] In this way, our present investigation has focused on emotions such as anxiety and depressive mood with applying NFT, and has shown that NFT, equally with MT, can decrease anxiety and depression, and this alleviation was meaningfully more than patients included in waiting list.

Conclusion

It is worth mentioning that non-pharmaceutical interventions give patients more choice over managing chronic disease; therefore, it may improve the quality of their life as well as self-care. With regard to literature, it was shown that IBS is strongly affected by multiple biopsychosocial factors. In this study, we have shown that other novel types of treatment like MT and NFT can alleviate clinical symptoms of patients with IBS. Future studies should address long-term interventions and monitoring physiologic indices of anxiety.

This study showed that MT as well as NFT significantly alleviated anxiety and depression level among patients with IBS.

One of the pitfalls among most of the recent investigations with same object is lack of attention to long-term effects of NFT on IBS;[31-33] therefore, further studies are needed to ascertain

the long-term effects of NFT and the underlying psychosocial mechanisms leading to anxiety reduction and improved quality of life.[41]

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

This study was a randomized clinical trial that was registered in Iranian Registry of Clinical Trials and allocated a unique code (IRCT2015050711885N6). Recruitment period was from November 2014 to July 2015. The study was approved by the Research Ethics Committee of Mazandaran University of Medical Sciences and allocated a unique code (Ir.Mazums.REC.95-A103). Finally, we thank the patients who took part in the study.

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