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Research Paper: Comparison of Mindfulness-Based Cognitive Therapy and Neurofeedback on Quality of Life of Patients With Irritable Bowel Syndrome

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Running Title MBCT and NFB in IBS Patients

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ABSTRACT

Background: Irritable Bowel Syndrome (IBS) is one of the most common gastrointestinal disorders and is usually associated with abdominal pain. This study aimed to compare the effectiveness of mindfulness and neurofeedback on quality of life in patients with irritable bowel syndrome.

Materials & Methods: The present study was a pretest-posttest control group design with a two-month follow-up. The study population included all women with irritable bowel syndrome referred to gastroenterology centers and clinics of Qazvin city in 2019. Patients were selected by convenience sampling and randomly assigned into two experimental and one control groups (n=45). The experimental groups underwent Mindfulness-Based Cognitive Therapy (MBCT) and Neurofeedback (NFB). The Rome-III diagnostic criteria form and the WHOQOL-BREF were administered. Data were analyzed using repeated measure analysis of variance.

Results: There was significant difference between NFB and control group for total quality of life and all its components. The Mean between-group Difference (MD) of total quality of life score in NFB compared to control group was 21.2±2.58 in post-test and 15.4±2.35 in follow-up (P<0.05). MBCT group was significantly different with the control group in component of general health both in post-test (MD= 0.93±0.53) and follow-up (MD=0.73±0.53), (P<0.05).

Conclusion: NFB therapy considerably improved the quality of life of patients with IBS that was remained after two months of follow-up, while MBCT was only effective on improvement of general health in comparison with the control group.

Keywords: Cognitive Behavioral Therapy, Mindfulness, Neurofeedback, Quality of life, Irritable bowel syndrome

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1. Introduction

Irritable Bowel Syndrome (IBS) is the most common gastrointestinal disorder characterized by persistent abdominal discomfort with changes in bowel emptying habits (diarrhea and constipation) [1, 2]. It is a painful and often debilitating disorder for which there is no optimal medical or dietary treatment [3]. IBS also characterized as unusual visceral hypersensitivity is associated with negative emotions and stress [4].

Although there are no specific causes organically, IBS patients suffer from chronic abdominal pain, diarrhea, constipation, or bloating that may affect their quality of life [5]. IBS patients often experience a wide range of problems in addition to gastrointestinal symptoms, such as non-abdominal pain, psychological symptoms, and poor quality of life [6].

In this case, absence from work and reduced quality of social relations are essential complications [7]. Previous studies [8, 9], have pointed to the low level of mental health and quality of life in IBS patients compared to healthy people. The results of other studies also showed that the life quality of IBS patients is low [10-12].

This syndrome causes a significant reduction in all aspects of quality of life [13]. So that, patients avoid certain foods, social situations, work-related situations, leisure, personal relationships, and sex [14]. These patients avoid enjoyable activities for fear of starting symptoms [15, 16].

Mindfulness-Based Cognitive Therapy (MBCT) can be considered as an intervention method that relies on meditation methods such as body examination techniques to increase understanding and awareness regarding the nature of thoughts. This technique is based on teaching people to consciously perceive both voluntary senses, such as eating and moving, and involuntary senses, such as breathing, in order to apply more control on involuntary responses such as stress [17, 18].

Another therapeutic benefit for patients with IBS is neurofeedback that is a type of biofeedback that controls brain waves and provides a feedback signal that teaches self-control of brain function. Neurofeedback usually offers audio and video feedback. Positive or negative feedbacks are generated for favorable or unfavorable brain activities, respectively [19].

given the different functions of cognitive status, especially the extent and severity of physical symptoms and quality of life, there exists a controversy which type of treatment may be the most appropriate option for IBS. Due to the higher prevalence of IBS among women than men with predominance of diarrhea and the higher number of female patients referred to clinics, women with Diarrhea predominant Irritable Bowel Syndrome (IBS-D) were selected as the statistical population for the study [16]. Therefore, the present study aims to compare the effectiveness of mindfulness and neurofeedback on quality of life in patients with irritable bowel syndrome to investigate and compare the effect of mindfulness-based cognitive therapy and neurofeedback on the quality of life of IBS patients.

2. Materials and Methods

The present study was a pretest-posttest control group design with a two-month follow-up that was conducted on female patients with IBS-D based on the diagnostic criteria of Rome-3 by gastroenterologist referred to gastroenterology centers and clinics in Qazvin in 2019. Inclusion criteria were age range between 20 to 40 years old, a minimum diploma level of education, no history of severe mental disorders based on the DSM–5 classification recognized during psychiatrist's interview, absence of physical illnesses other than the disease under the study, and willingness to participate in the study. Patients were excluded if they had gastrointestinal bleeding, blood in the stool, fever, weight loss, anemia, nocturnal diarrhea, heartburn that awakes the patient, the presence of a palpable mass on examination, diagnosed with severe mental illness or admission due to mental illness during the last two years, history of trauma or abdominal surgery, including gastrointestinal resection and pregnancy or intention to become pregnant during the study, receive mindfulness-based cognitive therapy or neurofeedback intervention at least one year before the study, inability to participate in intervention sessions continuously defined as absence of more than two sessions, and consumption of Tricyclic antidepressants higher than 25 mg per day. A preliminary explanation of the purpose of the study was provided for all study participants and they were assured that all information collected will be kept confidential. Then an informed consent was obtained from the participants.

The minimum sample size of 15 subjects was considered per group. Therefore, the study sample consisted of 45 women with irritable bowel syndrome from the statistical population who were voluntarily selected and randomly assigned into the control group (n=15), the neurofeedback group (n=15), and the second mindfulness-based cognitive therapy group (n=15). The par-

ticipants were assigned into study groups using random number table.

The first experimental group underwent eight weekly sessions of 90 minutes of mindfulness-based cognitive therapy intervention [20]. The second experimental group underwent 30 sessions of 45 minutes of neurofeedback three times a week. These sessions were done through gradual learning of increasing amplitude of the beta wave and reducing the theta wave in the electroencephalogram [19]. The control group did not receive any intervention. Before any intervention, a pre-test was performed on the three groups participating in the study. One week after the end of the intervention and two months after the post-test, follow-up was performed for all three groups.

Research tools

Structured clinical interview: Structured clinical interview was used by a psychiatrist based on DSM–5 to evaluate the inclusion and exclusion criteria of the study. This interview is a semi-structured clinical interview used to diagnose mental disorders.

WHOQOL-BREF was designed by the World Health Organization to assess quality of life and consisted of 26 questions in 4 components [21]. Components of WHOQOL-BREF included physical health (7 items), mental health (7 items), Social relationships (3 items), and environmental health (9 items). The two initial questions do not fall into any of these components and assess the state of health and quality of public life (general health items 1 and 2). Each item scored on a 5-point Likert type scale from strongly agree=1 to strongly disagree=5 except for 3 items that were scored in reverse. The overall quality of life, scores range from 26 to 130 for physical health components (7 to 35), mental health (6 to 30), social relations (3 to 15), environmental health (8 to 40), and regarding general health, it fluctuates from 2 to 10. In this questionnaire, a higher score indicates better more quality of life, and a lower score means lower quality of life [21, 22]. The Persian version of the questionnaire was validated by Nejat et al. in a study to evaluate the psychometrics of this questionnaire confirmed the content and appearance of this questionnaire through direct translation and reverse translation and using the opinion of experts. Also, in order to measure the reliability of the questionnaire in the dimension of internal adjustment, using intra-branch correlation values and Cronbach's alpha for all components of the quality of life questionnaire above 0.70 and only the social relations component obtained Cronbach's alpha coefficient of 0.55 [23]. In the present study, the value of Cronbach's alpha coefficient for the total score of quality of life and components of physical health, mental health, social relations, environmental health, and general health were 0.92, 0.75, 85, 80, 88, and 0.86, respectively.

Intervention procedure

Mindfulness-based cognitive therapy was created upon the theory of mindfulness by adapting the stress reduction model based on the mindfulness model and the principles of cognitive therapy [20, 23]. In this therapy, mindfulness is an intervention that can be used in combination with cognitive behavior therapy. It includes various meditations, introductory training on depression, body checking exercises, and several cognitive therapy exercises that show the connection between the body's moods, thoughts, feelings, and senses [17, 24]. Mindfulness-based cognitive therapy sessions were presented to the first experimental group in 8 sessions of 90 minutes once a week (for eight weeks).

Neurofeedback intervention aims to steadily increase the amplitude of beta waves and decrease theta waves in the electroencephalogram [19]. Neurofeedback implementation was conducted using device 8-Channel BIOLINE Neuro Biofeedback with bipolar electrodes, in 30 sessions of 45 minutes (three times a week). In the beginning, the C3 beta band (15-18 Hz) was used as an incremental band, and Theta and beta bands were used as decreasing bands, and in the second half of the treatment, the low beta band (12-15 Hz) was used as the incremental band instead of the beta band. Low beta amplification (12-15Hz) is often used in the right hemisphere, and amplification of the C3 beta frequency range C3 (15-18 Hz) is often used in the sensorimotor band; C3, C4, CZ. The body movements and muscle signals (EEG artifacts) may cause artificial brain waves, so Theta (4 to 8 Hz) and long Beta frequency bands (20 to 30 Hz) were used as stopbands. Using these bands ensured that muscle signals are not going to be calculated. The participant was given a score when she was able to keep the high beta (15-18 Hz) or low beta (12-15 Hz) above the threshold and keep the decreasing theta (4-7 Hz) and the increasing beta (20-30 Hz) below the threshold for 0.5 seconds. The score was recorded on the computer screen, and the feedback was given to the participant to know the score on the selected game screen both visually and aurally. This process continued until the end of each session. The 10-20 system of electrode placement was used for the connection of the electrodes on the head. Thus, in the first half of the treatment, the central electrode was placed to C3 and the two electrodes to the

ears. In the second half, the central electrode was put in C4 and the two electrodes to the ears.

Statistical analysis

Data were described using frequency, mean and Standard Deviation (SD). The normality assumption of continuous variable was assessed using Shapiro-Wilk test. The effect of interventions on quality of life was examined using repeated measures ANOVA, considering the treatment and control groups as the between participants variable and time (pretest, posttest, and follow-up) as within participants variable. Post hoc Tukey test was used for pairwise comparison. All analyses were performed in SPSS version 22. A P-value less than 0.05 was considered as significant.

3. Results

The present study consisted of three groups of 15 people. The mean age of the study participants was 30.8±4.01. Regarding to the level of education, the majority (47%) had bachelor degree, were married (67%), and have a disease duration between 1 to 5 years (51%). There was no significant difference among groups in terms of baseline characteristics (Table 1). Table 2 shows the mean and standard deviation of quality of life components. There was no significant difference in the baseline values of all component among three groups.

According to the result of Mauchly's test, the assumption of sphericity was not met. So, the result of Greenhouse–Geisser with epsilon correction was reported. There were statistically significant group by time interaction for physical health ($F_{2,84}$=18.49, P=0.001, η_p^2=0.47), mental health ($F_{2,84}$=21.132, P=0.001, η_p^2=0.50), community relations ($F_{2,84}$=40.300, P=0.001, η_p^2=0.66), environmental health ($F_{2,84}$=48.917, P=0.001, η_p^2=0.70), and general health ($F_{2,84}$=11.152, P=0.001, η_p^2=0.35). The results of the post-hoc pairwise comparisons showed that there was significant difference between NFB compared to the control group for all study variables. The MBCT-control group showed significant difference in the component of general health. But there was no significant difference between MBCT and NFB in terms of quality of life and its components.

The result of mean between-group difference are shown in Table 3. The Mean-Difference (MD) indicated that NFB group had significantly higher quality of life score for both post-test (MD=21.2±2.58) and follow-up (MD=15.4±2.35) compared to the control group. Similarly, the components of quality of life in NFB group had higher score indicating better improvement compared to the control group. The mean-difference of general health showed significantly higher score in MBCT compared to the control group in posttest (MD= 0.93±0.53) and follow-up (MD=0.73±0.53).

4. Discussion

This study revealed that NFB therapy considerably improved the quality of life of patients with IBS that was remained after two months of follow-up, while MBCT was only effective on improvement of general health

Table 1. Baseline characteristics of experimental and control groups

Characteristics		Mean±SD/No. (%)		
		Cognitive Therapy	Neurofeedback	Control Group
Age (years)		30.93±4.51	31.33±4.01	30.07±3.81
Education level	Diploma	5(33.3)	4(26.7)	4(26.7)
	Bachelor	7(46.7)	7(46.7)	7(46.7)
	Master	2(13.3)	3(20.0)	4(26.7)
Marriage status	Single	5(33.3)	4(26.7)	6(40.0)
	Married	10(66.7)	11(73.3)	9(60.0)
Disease duration	>1year	4(26.7)	6(40.0)	7(46.7)
	1-5 years	9(60.0)	8(53.3)	6(40.0)
	6-10 years	2(13.3)	1(6.7)	2(13.3)

Table 2. Components of quality of life in three phases of the study

Variable	Group	Mean±SD		
		Pre-test	Post-test	Follow-Up at 2 Month
Total quality of life score	Cognitive therapy	57.400±10.4	95.600±6.833	89.667±7.659
	Neurofeedback	57.733±9.743	90.867±8.609	85.533±6.534
	Control	62.333±6.102	69.667±5.434	70.133±4.749
Physical health	Cognitive therapy	17.400±3.312	27.467±3.292	25.133±3.603
	Neurofeedback	16.933±2.186	26.0±3.402	24.067±3.615
	Control	17.933±2.789	18.933±3.240	19.0±2.928
Mental health	Cognitive therapy	12.533±4.121	22.800±1.971	21.933±1.486
	Neurofeedback	13.133±2.696	21.733±2.219	21.200±1.971
	Control	14.200±3.028	18.067±3.127	18.733±2.685
Community relations	Cognitive therapy	6.267±1.387	11.600±1.724	10.800±1.567
	Neurofeedback	5.867±1.959	11.267±1.100	10.133±0.834
	Control	7.133±2.726	8.333±1.915	7.600±1.404
Environmental health	Cognitive therapy	16.933±3.283	24.533±2.900	23.533±3.204
	Neurofeedback	17.667±4.716	23.600±5.152	22.600±4.763
	Control	18.0±2.171	18.800±1.859	19.333±1.952
General health	Cognitive therapy	4.267±1.791	9.200±1.104	8.267±1.486
	Neurofeedback	4.133±1.246	8.267±1.486	7.533±1.246
	Control	5.067±1.668	5.533±1.959	5.467±1.598

Table 3. Between-group comparison of NFB-control and MBCT-control on quality of life and its components

Variable	Phase	Mean Difference NFB-Control	SD	P	Mean Difference MBCT-Control	SD	P
Total quality of life	Pre-test	-4.600	3.270	0.347	-4.933	3.270	0.994
	Post-test	21.200	2.585	0.001	4.733	2.585	0.172
	Follow-up	15.400	2.347	0.001	4.133	2.347	0.195
Physical health	Pre-test	-1	1.023	0.595	0.467	1.023	0.892
	Post-test	7.067	1.209	0.001	1.467	1.209	0.452
	Follow-up	5.067	1.240	0.001	1.067	1.240	0.668
Mental health	Pre-test	-1.067	1.219	0.659	0-.600	1.219	0.875
	Post-test	3.667	0.909	0.001	1.067	0.909	0.475
	Follow-up	2.467	0.769	0.007	0.733	0.769	0.610
Community relations	Pre-test	-1.267	0.623	0.117	0.400	0.623	0.798
	Post-test	2.933	0.590	0.001	0.333	0.590	0.840
	Follow-up	2.533	0.477	0.001	0.667	0.477	0.352
Environmental health	Pre-test	-0.333	1.295	0.964	-	1.295	0.839
	Post-test	4.800	1.306	0.002	0.933	1.306	0.756
	Follow-up	3.267	1.278	0.037	0.933	1.278	0.747
General health	Pre-test	-0.933	0.579	0.252	0.133	0.579	0.359
	Post-test	2.733	0.532	0.001	0.933	0.532	0.001
	Follow-up	2.067	0.530	0.001	0.733	0.530	0.001

in comparison with the control group. This finding is in agree with previous studies by Parhizgar et al. [25] and Chamani Galandari et al. [26]. The findings of Henrich et al. [27] showed that mindfulness based cognitive therapy reduced the symptoms of irritable bowel syndrome. The purpose of mindfulness therapy in people with stressful thought and events is to reduce emotional reactions and strengthen cognitive evaluation [17]. Using this technique, people learn to create a broader awareness of negative thoughts about their current state instead of negative thoughts about the disease and the poor quality of life with the disease and this kind of awareness will eventually lead to early detection of emotional patterns associated with thinking, feeling and bodily sensations [28]. The impact of mindfulness is through four mechanisms including: Attention adjustment, Awareness of the body, regulation of emotion and change in the individual`s view of self as constant [29]. Mindfulness skills that are thought to individual`s Include: Awareness of breathing, bodily sensations, sounds and all activities of the individual [20]. Mindfulness can also help people to be free from intrusive thoughts, habits and unhealthy patterns of behavior and plays an important role in regulating behavior [30]. In this study, MBCT was not effective on quality of life component other than general health. The reason might be due to the duration of the study, which could not affect other structures of quality of life.

Naliboff et al., showed that mindfulness-based therapy effectively improves inflammatory biomarkers in people with inflammatory bowel disease [31]. González et al., showed that general changes in mindfulness are associated with better treatment outcomes in IBS patients [32]. Recent studies have also reported the positive effects of mindfulness-based cognitive therapy and neurofeedback on a wide range of variables in patients with IBS [26, 33, 34]. Pashing and Khosh Lahjeh, pointed to the strengthening of indicators of quality of healthy life and psychological capital for the prevention and treatment of symptoms of irritable bowel syndrome [35].

NFB therapy is a way to learn actively and consciously control the different states of the brain waves, and by providing a special sound or image in exchange for receiving feedback from the brain, the brain waves can be directed to the desired frequency [19]. NFP helps the brain learn how to regulate itself and correct functional deficits. Its effectiveness is based on the learning and conditioning process and regulates brain waves, adapts neural networks, increases beta waves, and reduces slow waves such as theta and delta in the frontal lobe. As a result , it increases the activity of the frontal lobe and reduces the anxiety caused by the disease and consequently increases the quality of life on patients with irritable bowel syndrome [36]. Neurofeedback tries to teach self-regulation by recording electrical responses and providing feedback to the subject and correcting functional defects that lead to more desirable behaviours and improve quality of life [19]. The results of this study showed that neurofeedback intervention is effective in increasing the quality of life of IBS patients that was remained stable over time. This findings is in agree with previous studies by Goldenberg et al. [33], Blaskovits et al. [36], Vezenkov et al. [37]. Blaskovits showed the effectiveness of neurofeedback in reducing anxiety and stress and improving quality of life in adults with chronic disease [36].

In another case study by Vezenkov et al., a patient with severe IBS that was treated with neurofeedback significantly improved intestinal function and quality of life [37]. Oraki et al. concluded that neurofeedback could reduce depression and anxiety in women with abdominal pain [38]. Parhizgar et al.'s study showed the effect of behavioral therapy integrated with mindfulness on reducing pain in patients with irritable bowel syndrome [25]. Elahi Nejad et al., also showed the effect of neurofeedback on improving patients' general and special life quality [39].

MBCT and NFB both are self-regulating therapy. The difference between them is that self-regulation in MBCT is based upon the techniques of concentration and bodily sensations that are thought to participants during training sessions but self-regulation in neurofeedback is based on using computer technology. Neurofeedback helps the brain learn how to regulate itself and correct functional deficits [40].

5. Conclusion

This study revealed that NFB therapy significantly improved the quality of life of patients with IBS, while MBCT was only effective on improvement of general health in comparison with the control group. According to the results of the present study, it is recommended that clinical therapists and health psychologists consider there therapies along with drug treatment in the form of workshops and group intervention sessions. This study suffered from some limitation including lake of control over the socio-economic status of participants, small sample size and lack of representativeness of the study sample.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Islamic Azad University of Rasht (Code: IR.IAU.RASHT.REC.1399.086).

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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