The Impact of Respiratory Biofeedback Use on Symptom Severity in Panic Disorder

Abstract

Aim: This study aimed to enhance conscious awareness of respiratory control in panic disorder patients to prevent panic attacks. **Materials and Method:** Thirty participants (aged 18–65) diagnosed with panic disorder were recruited from NP Istanbul Brain Hospital and NP Istanbul Medical Center. They were divided into two groups: one received only psychoeducation on breathing techniques, while the other received psychoeducation combined with visual biofeedback (Galvanic Skin Resistance, heart rate, respiratory depth, and skin temperature). Breathing training was conducted over four weeks, and outcomes were assessed using the Panic Agoraphobia Scale, State and Trait Anxiety Scale, and biofeedback metrics. **Result:** Both groups showed significant improvements in Panic Agoraphobia Scale scores and reductions in State and Trait Anxiety scores. The biofeedback group demonstrated more pronounced improvements in respiratory control, with significantly lower breathing rates in the final assessment. **Conclusion:** Respiratory biofeedback combined with psychoeducation effectively improves respiratory control and reduces anxiety symptoms in panic disorder patients.

Keywords: *Panic Disorder, Biofeedback, Respiratory Control, Psychoeducation.*

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Introduction

The age of onset for anxiety disorders varies by specific disorder. Separation anxiety disorder and specific phobias typically begin in childhood, with an average onset age of 7 years, followed by social anxiety disorder at 13 years, agoraphobia without panic attacks at 20 years, and panic disorder at 24 years. Anxiety disorders generally follow a chronic course, with symptoms fluctuating in severity between periods of relapse and remission in generalized anxiety disorder and panic disorder, while social anxiety disorder tends to exhibit a more persistent chronic course. Epidemiological studies have observed a significant decrease in the prevalence of anxiety disorders after the age of 50. Generalized anxiety disorder remains the only anxiety disorder commonly diagnosed in individuals aged 50 and older. [1].

Prospective studies suggest that anxiety disorders are chronic, meaning patients may suffer from their illness for years or decades. However, this does not mean that the anxiety disorder persists permanently for the rest of the patient's life. Anxiety disorders begin in childhood, adolescence, or early adulthood until they peak in middle age, then tend to decline again with aging [2].

Anxiety disorders are the most prevalent psychiatric disorders and are associated with a high disease burden. Specific (isolated) phobias, with a known prevalence of 10.3%, are the most common anxiety disorders, although individuals with isolated phobias rarely seek treatment [3]. Panic disorder, with or without agoraphobia, is the second most common, with a prevalence of 6.0%, followed by social anxiety disorder (social phobia) at 2.7%, and generalized anxiety disorder at 2.2%. Despite the significant impairment associated with each anxiety disorder and the availability of effective treatments, only a small proportion (15% to 36%) of patients with anxiety disorders are recognized in primary care settings[4].

Panic disorder is characterized by recurrent and unexpected panic attacks, which manifest through symptoms such as palpitations, sensations of suffocation, chest pain, and a fear of dying. This disorder is associated with substantial social, occupational, and physical disability, as well as significant economic costs. Additionally, there is evidence suggesting an increased risk of suicide among individuals with panic disorder[14]. Consequently, identifying effective strategies and methods to mitigate the effects of this condition and facilitate its treatment is of paramount importance.

The initial onset of panic disorder typically occurs in the twenties, with the risk in women being twice that in men. In panic disorder, anticipatory anxiety and agoraphobia persist between panic attacks, allowing for an operational diagnosis based on clinical symptoms. A study conducted in Italy observed that panic disorder significantly affects the quality of life of patients. Additionally, the study reported a

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lifetime prevalence of panic disorder of 3.6% overall, with a prevalence of 4.4% in women and 2.5% in men[5].

Recently, there has been an increasing number of applications to various clinics and hospitals due to panic disorder, which causes panic attacks characterized by symptoms such as unexpected palpitations, shortness of breath, dizziness, and paresthesia. Studies have confirmed that 6.7% of primary care patients meet the diagnostic criteria for panic disorder. Additionally, it was reported that 28% of patients with panic disorder have sought treatment in emergency departments[6].

The lifetime prevalence of panic disorder in Taiwan is 0.4%. According to data from the National Comorbidity Survey (NCS), the lifetime prevalence of panic disorder in the United States is 3.5%, while the lifetime prevalence of panic attacks is 7.3%. In a survey conducted by Kaiya in Japan, which included 4,000 participants, the prevalence of individuals meeting the criteria for panic attacks was 6.6%, and the prevalence of those meeting the criteria for panic disorder was 5.0% [7].

Family studies have documented an increased risk of panic disorder among relatives of affected individuals, with estimates ranging from 5% to 16%. The risk of developing panic disorder increases 17-fold when first-degree relatives of patients with panic disorder are considered. These findings suggest that panic disorder has significant heritability. It has a higher prevalence compared to other psychiatric disorders and exhibits unique genetic influences on "panic symptoms" distinct from other anxiety symptoms[8]. Additionally, there is a higher prevalence of panic disorder among women compared to men. Neurobiological factors, including serotonergic neurotransmission, beta-adrenergic sensitivity, and differences in dopamine pathways, may partially explain the gender disparity in panic disorder prevalence[2].

Certain conditions suggest a neurobiological etiology of panic disorder. Anatomical findings include changes in brain volume affecting regions such as the amygdala, temporal lobe, and creatine, as well as decreased phosphocreatine metabolites in the medial temporal lobe[9]. Low benzodiazepine receptor affinity has been observed near the hippocampus and amygdala in patients. Additionally, some studies have reported differences in gamma-aminobutyric acid (GABA) concentrations, which provide partial insight into the neurobiological underpinnings of panic disorder[10]. Panic attacks may increase anxiety sensitivity, and imaging studies suggest that the insular cortex, which is associated with anxiety sensitivity and bodily awareness, plays a role in this process[11].

From a psychosocial perspective, the key concept for understanding the etiology of panic disorder is anxiety sensitivity. Anxiety sensitivity is believed to develop through negative life events, observations, and parental modeling of distressed reactions to bodily sensations.

Psychophysiological theories propose that respiratory distress contributes to the development of panic disorder. Research has shown that symptomatic and respiratory recovery from voluntary hyperventilation is delayed in individuals with panic disorder. It remains unclear whether recovery from voluntary hyperventilation normalizes with treatment[12].

In a study conducted by Tunnell et al., thirty-seven patients with panic disorder were treated with hypoventilation, and the results were compared with a control group. The study reported that this treatment was highly effective in reducing panic disorder pathology. These findings support the role of respiratory dysregulation as a feature of panic disorder and demonstrate the utility of voluntary hyperventilation recovery as a treatment outcome measure for respiratory-based panic disorder [12].

The immediate sense of control over symptoms can often prevent anxiety and panic. Thus, voluntary hyperventilation is employed as a training tool to expose patients to the vicious circle model and to reproduce feared somatic symptoms, providing immediate relief from long-standing feelings of helplessness[15].

Slow diaphragmatic breathing is a treatment method used in behavioral therapy for panic disorder. Yamada et al. observed that some patients with panic disorder struggled with diaphragmatic breathing and initially experienced decreased vital capacity, although this could be restored with respiratory training. Their comparative study, involving healthy controls, investigated the relationship between diaphragmatic breathing ability and vital capacity percentage in patients with panic disorder. The results demonstrated that vital capacity was significantly reduced in patients with impaired diaphragmatic breathing compared to those with normal diaphragmatic breathing. However, vital capacity was restored to levels equivalent to those of healthy controls following respiratory training. This study provides preliminary evidence of decreased vital capacity associated with abnormal respiratory movements in panic disorder patients and underscores the importance of respiratory training [16].

Additionally, patients are trained to reinterpret the physical symptoms of hyperventilation as normal physiological reactions rather than life-threatening events. The immediate sense of control over symptoms often helps in preventing anxiety and panic. Despite its potential benefits, the response to hyperventilation as a diagnostic tool has not been systematically utilized to evaluate treatment outcomes, and measurements such as partial arterial blood CO2 and respiratory rate are rarely recorded during treatment [16].

The objective of this study was to evaluate the efficacy of respiratory biofeedback in the management of panic disorder. Patients diagnosed with panic disorder were divided into two groups: one receiving psychoeducation and the other receiving respiratory biofeedback. We hypothesized that respiratory biofeedback would have a more significant impact on respiratory parameters and on the severity of panic disorder and anxiety symptoms compared to psychoeducation alone.

Materials and Methods

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Participants

The exclusion criteria for this study included: individuals younger than 18 or older than 65 years of age, those with a history of using psychoactive substances other than tobacco, pregnant individuals, those diagnosed with dementia, individuals with mental retardation, and those who have experienced trauma or diseases affecting their state of consciousness.

Procedure

The study sample comprised 30 participants, aged 18 to 65, diagnosed with panic disorder at the outpatient clinics of NP Istanbul

Brain Hospital and NP Istanbul Medical Center. Among these participants, 15 received psychoeducation solely on breathing techniques, while the remaining 15 were provided with verbal psychoeducation in addition to visual biofeedback, which included images of Galvanic Skin Resistance (GSR), heart rate and depth (BVP), and temperature. Over a period of 4 weeks, correct breathing techniques were taught and monitored through respiratory biofeedback. A comparative analysis was conducted between the two groups. Throughout the study, medication regimens for both groups remained unchanged, and participants who were not on medication at the start of the study continued to be observed without pharmacological intervention. Non-Interventional Research Ethics Committee permission was received from Uskudar University with approval date 25.04.2019 and number 61351342-/2019-278.

Scales

The measurement tools employed during the study included the Panic Agoraphobia Scale and the State and Trait Anxiety Scales.

Panic Agoraphobia Scale: The Panic Agoraphobia Scale, was originally developed by Borwin Bandelow (Bandelow, 1995) and later was adapted into Turkish (Tural, 2000)(15), comprises a total of 14 items distributed across five subscales. This instrument can be completed by either the observer or the participant. The subscales include: panic attack characteristics (4 items), agoraphobia/avoidance behavior (3 items), anticipatory anxiety (2 items), disability (2 items), and health anxiety (2 items). The scale utilizes a five-point Likert format to assess the severity of symptoms.

State and Trait Anxiety Scale: The State and Trait Anxiety Inventory was developed by Spielberger, Gorsuch, and Lushene in 1970(16). The Turkish adaptation was conducted by Öner and Le Compte in 1983[17]. The State Anxiety Scale includes questions designed to assess how individuals feel at a particular moment or under specific conditions, consisting of 20 items in total. The Trait Anxiety Scale, also comprising 20 items, aims to determine how individuals generally feel, independent of specific circumstances. Both scales utilize a Likert-type format. The total scores for both inventories range from 20 to 80, with higher scores indicating higher levels of anxiety.

Participants in this study were initially administered the Panic Agoraphobia Scale and the State and Trait Anxiety Scale. These assessments were repeated in the 5th week to measure changes in anxiety and panic symptoms.

Applying Respiratory Biofeedback: The biofeedback technique, also known as applied psychophysiological feedback, utilizes principles such as interoceptive exposure to assist patients in experiencing and comprehending the connection between their thoughts and bodily sensations. This technique typically involves the display of audio, visual, or tactile representations of a patient's autonomic arousal through various modalities, including heart rate and respiratory rate.

Biofeedback offers several benefits, as it provides personalized information about a patient's physiological arousal during panic attacks without the need to artificially induce symptoms. This method may facilitate a quicker understanding of the connection between thoughts and bodily sensations, which is a key component of cognitive behavioral therapy (CBT). Despite its effectiveness, the widespread use of biofeedback has been limited due to the necessity for specialized equipment to quantitatively monitor heart and respiratory rates during an attack[18].

Psychoeducation

Psychoeducation is defined as an intervention aimed at transferring systematic, structured, and didactic information about a disease and its treatment, integrating emotional and motivational aspects to enable patients to cope with the disease and improve treatment compliance and effectiveness. Patients commonly have questions such as “What type of disorder do I have?”, “What are my symptoms?”, “How can I cope with my symptoms?”, “How can my disorder be treated or controlled?”, “What are the treatment options and which one is best?”, and “What are the side effects of treatments?” [19]. Psychoeducation provides systematic, structured, and didactic information about the illness and its treatment to the patient and/or their family and caregivers, while integrating emotional aspects to help patients manage their illness [20].

In our study, 15 of the 30 panic disorder patients received psychoeducation exclusively on breathing techniques, while the remaining 15 received verbal psychoeducation in conjunction with visual biofeedback. The biofeedback included images of Galvanic Skin Resistance (GSR), heart rate and depth (BVP), and temperature. Correct breathing techniques were taught over a 4-week period by monitoring respiratory biofeedback, and a comparison of the two groups was performed.

During the psychoeducation sessions, the importance of healthy breathing was emphasized. It was explained that chest breathing can lead to increased anxiety and stress, resulting in symptoms such as palpitations, sweating, tremors, and flushing. Furthermore, improper breathing can cause fatigue, absent-mindedness, and carelessness due to inadequate oxygen supply to the brain. Therefore, diaphragmatic breathing, also known as low breathing, was recommended as the correct method.

The addition of visual images to the verbal psychoeducation was hypothesized to provide an advantage to the patients by enhancing their confidence and determination in taking control of their breathing. Patients were able to monitor their breathing patterns during visual respiration exercises, allowing them to observe improvements and ensure proper breathing techniques were being utilized until the next session.

Data analysis

The data obtained from the study were analyzed using the SPSS 20.0 software package. Clinical data were evaluated with the parametric independent two-sample t-test for parameters exhibiting a normal distribution and with the non-parametric Mann-Whitney U test for those exhibiting a non-normal distribution. Additionally, a two-way ANOVA test was employed to observe the interaction between group and measurement values. A P value of less than 0.05 was considered statistically significant.

RESULTS

Comparison of participants in the Treatment and control groups in terms of sociodemographic characteristics

When the distribution of some sociodemographic characteristics of the participants in the Treatment group and control group is examined, as seen in Table 1, 26.7% of the participants in the Treatment group and 43.8% of the participants in the control group are male. While 66.7% of the participants in the Treatment group are married, 37.5% of the participants in the control group are married. Additionally, 40.0% of the participants in the Treatment group and 56.3% of the participants in the control group did not have children. When analysis was made for these variables, it was seen that there was no statistically significant difference between the groups (p>0.05).

Comparison of Participants' First and Last Test Scores of the Panic Attack Scale

When the total score of the Panic Attack Scale of the participants in the Treatment group was examined, it was seen that they received an average of 22 points in the first-test and 8.80 points in the last-test, and the difference was statistically significant (p = 0.001). When the total Panic Attack Scale score of the participants in the control group was examined, it was seen that they received an average of 23 points in the first-test and 14.40 points in the last-test, and the difference was statistically significant (p = 0.008).

When the Panic Attack subdomain score of the participants in the Treatment group was examined, it was seen that they received an average of 4.33 points in the first-test and 1.40 points in the last-test and the difference was statistically significant (p = 0.001). When the Panic Attack subdomain score of the participants in the control group was examined, it was seen that they received an average of 6.13 points in the first-test and 3.13 points in the last-test, and the difference was statistically significant (p = 0.002).

When the Agoraphobia subdomain score of the participants in the Treatment group was examined, it was seen that they received an average of 5.40 points in the first-test and 3.27 points in the last-test and the difference was statistically significant (p = 0.006). When the Agoraphobia subdomain score of the participants in the control group was examined, it was seen that there was no statistically significant difference between the mean scores obtained from the first-test and last-test (p = 0.104).

When the Health Concern subdomain score of the participants in the Treatment group was examined, it was seen that they received an average score of 3.20 in the first-test and 1.00 in the last-test, and the difference was statistically significant (p = 0.012). When the Health Concern subdomain score of the participants in the control group was examined, it was seen that they received an average of 2.87 points in the first-test and 1.60 points in the last-test, and the difference was statistically significant (p = 0.005).

According to Table 2, it can be said that the scores obtained from the Panic Attack Scale and its subdomains were lower in the last evaluation than in the first evaluation for both groups. For this reason, the statistical analysis was continued with two-way ANOVA analysis and the difference between the groups' decrease in scale scores was observed. Looking at the two-way ANOVA test results, it was observed that the decrease in mean scores was not significantly different between the two groups: Panic Attack Scale (p=0.326), panic attack subdomain (p=0.949), agoraphobia subdomain (p=0.953), anticipatory anxiety subdomain (p=0.089), disability subdomain (p=0.287) and health concern subdomain (p=0.230).

Analysis of STAI 1 and STAI 2 Scale scores

Looking at the average scores of the participants in the Treatment group on the STAI-1 scale in Table 3, it was seen that they received an average of 43.07 points in the first-test and 28.13 points in the last-test, and the difference was statistically significant (p = 0.001). Considering the average scores of the participants in the control group on the STAI-1 scale, it was seen that they received an average of 45.07 points from the first-test and 35.27 points from the last-test, and the difference was statistically significant (p = 0.005).

Considering the average scores of the participants in the Treatment group on the STAI-2 scale, it was seen that they received an average of 54.27 points in the first-test and 43.80 points in the last-test, and the difference was statistically significant (p = 0.001). Considering the average scores of the participants in the control group on the STAI-2 scale, it was seen that they received an average of 52.13 points in the first-test and 48.67 points in the last-test, and the difference was statistically significant (p = 0.043).

Looking at Table 3, it can be said that both the Treatment group and the control group received lower scores on the STAI 1 and STAI 2 scales in the final evaluation compared to the first evaluation. Therefore, statistical analysis was continued with a two-way ANOVA test. As a result, it was found that the decrease in the mean scores obtained from the STAI 1 (p = 0.277) and STAI 2 (p = 0.057) scales was not significantly different between the groups.

Analysis of breathing rates

In Table 4, the average number of breaths of the participants in the Treatment group in the first evaluation is 21.40, and the average number of breaths in the last evaluation is 13.00. The difference is statistically significant (p<0.001). The average number of breaths of the participants in the control group in the first evaluation was 17.60, and the average number of breaths in the last evaluation was 13.73. The difference is statistically significant (p=0.001).

Looking at Table 4, it can be said that the breath counts of both the Treatment group and the control group in the last evaluation were lower than the breath counts in the first evaluation. Therefore, statistical analysis was continued with two-way ANOVA test. As a result, it was found that the decrease in the number of breaths of the participants in the Treatment group at the last evaluation was greater than in the control group (group*measurement p=0.014).

Comparison of first-test and last-test respiration and amplitude values of participants in the treatment group

As seen in Table 4, the average respiratory value of the individuals in the Treatment group was 14.57 in the first evaluation, while the average was 12.00 in the last evaluation. The difference is statistically significant (p=0.030). While the amplitude value of the individuals in the Treatment group at the first evaluation was 3.76, the amplitude value at the last evaluation was 3.35. The difference is not statistically significant (p=0.266).

DISCUSSION

Significant improvements were observed in the post-test scores of participants in both groups on the Panic Agoraphobia Scale.

Tables

Table 1: Comparison of Treatment and Control Groups in Terms of Sociodemographic Characteristics

Variables		Treatment n (%)	Control n (%)	X^2	p
Gender	Male	4 (26.7)	7 (43.8)	0.987	0.320
	Female	11 (73.3)	9 (56.3)		
Marital Status	Married	10 (66.7)	6 (37.5)	2.637	0.104
	Single	5 (33.3)	10 (62.5)		
Number of children	0	6(40.0)	9 (56.3)	1.102	0.777
	1	4 (26.7)	4 (25.0)		
	2	3 (20.0)	2 (12.5)		
	3	2 (13.3)	1 (6.3)		

Table 2: Comparison of Panic Attack Scale Scores Measured in First test and Last test

Scales	Tests	Treatment Ave.±Sd.	*t*	*p*	Control Ave.±Sd.	*t*	*p*
Panic Attack Scale Total Score	First test	22.00±9.89	4.496	**0.001**	23.00±8.79	3.120	**0.008**
	Last test	8.80±1.24			14.40±9.11		
Panic attack subdimension	First test	4.33±2.38	4.036	**0.001**	6.13±3.11	3.873	**0.002**
	Last test	1.40±2.44			3.13±2.64		
Agoraphobia subdimension	First test	5.40±2.61	3.264	**0.006**	6.60±2.72	1.737	**0.104**
	Last test	3.27±2.52			4.93±2.98		
Anticipatory anxiety subscale	First test	5.13±1.64	4.741	**0.001**	4.33±1.91	2.624	**0.020**
	Last test	2.00±0.36			2.80±2.21		
Disability subdimension	First test	3.93±3.43	2.852	**0.013**	3.20±2.83	1.775	**0.098**
	Last test	1.13±0.13			1.93±2.01		
Concern about health subscale	First test	3.20±2.45	2.905	**0.012**	2.87±1.88	3.300	**0.005**
	Last test	1.00±1.30			1.60±1.54		

Table 3: Comparison of STAI 1 and STAI 2 scores Measured in First test and Last test

Scales	Tests	Treatment Ave.±Sd.	*t*	*p*	Control Ave.±Sd.	*t*	*p*
STAI-1	First test	43.07±11.56	4.391	**0.001**	45.07±10.11	3.373	**0.005**
	Last test	28.13±10.75			35.27±9.36		
STAI-2	First test	54.27±11.65	4.034	**0.001**	52.13±9.75	2.221	**0.043**
	Last test	43.80±10.29			48.67±9.17		

Table 4: Comparison of the Average Breath Counts Measured in the First test and Last test

Group	Tests	Ave.±Sd.	*t*	*p*
Treatment	First test	21.40±4.70	6.941	**0.001**
	Last test	13.00±2.75		
Control	First test	17.60±5.44	4.326	**0.001**
	Last test	13.73±3.17		

This included significant improvements in the sub-domains of panic attack, agoraphobia, anticipatory anxiety, and health anxiety. However, in the disability sub-domain, a statistically significant decrease was observed only in the treatment group, not in the control group.

The first controlled study of breathing training in panic disorder was conducted by Bonn et al. in 1984. Agoraphobic patients with panic disorder who responded to a standard hyperventilation test with panic symptoms were alternately assigned to one of two treatment groups: either two breathing training sessions

followed by seven weeks of normal living or nine weeks of normal living alone. During therapy, there was little difference between the groups in weekly panic attack frequency, agoraphobia, and somatic symptom ratings. However, post-treatment results showed that breathing training was superior in terms of improvement in resting respiratory rate, somatic symptom score, and the elimination of panic attacks at six-month follow-up [21].

In our study, the Panic Agoraphobia Scale was used, and significant improvements were observed in the final evaluation. The results are consistent with Bonn et al.'s findings, suggesting that breathing training is effective in the treatment of panic disorder.

Additionally, other studies have shown that biofeedback therapy is effective in reducing the frequency and severity of panic attacks, symptom complaints, and other psychological features associated with panic disorder, and also improves the results of scales reporting anxiety such as the STAI scale [22,23].

According to the results of this study, the respiratory value of the treatment group in the last evaluation was found to be lower with a statistically significant difference compared to the respiratory value in the first evaluation. When looking at the amplitude value of the experimental group, no statistically significant difference was found between the values in the first evaluation and the last evaluation. In addition, the participants' breathing rates were measured at the first and last evaluation. However, it was observed that there was no significant difference between the number of breaths of the treatment group and the control group in both the first and last evaluation.

In addition, the difference between the number of breaths in the first and last evaluation was also evaluated. The improvement in breathing rates of both the experimental group and the control group was noteworthy. As a result of the analysis performed to find out which group's improvement was more different, it was determined that the group*measurement value was statistically significant, that is, the improvement in the breathing rates of the treatment group was more evident.

The breathing pattern of the control group at the first evaluation was chest breathing in 10 people (66.7%) and diaphragmatic breathing in 5 people (33.3%). In the final evaluation, it was observed that the breathing pattern of all participants in the control group was diaphragmatic breathing (100%). The difference was statistically significant ($p<0.001$). The breathing patterns of the participants in the experimental group at the first evaluation were observed to be chest breathing in 7 people (46.7%) and diaphragmatic breathing in 8 people (53.3%). In the final evaluation, the breathing method of all participants in the experimental group (100%) was diaphragmatic breathing. The difference was statistically significant ($p=0.004$).

Psychophysiological theories hypothesize that respiratory distress is a contributing mechanism to panic disorder. Additionally, symptomatic and respiratory recovery from voluntary hyperventilation has been shown to be delayed in panic disorder, and it is unclear whether recovery from voluntary hyperventilation normalizes with treatment [24].

In a study conducted by Tunnell et al., thirty-seven panic disorder patients were treated with hypoventilation and the results were compared with the control group. They stated that this treatment was very effective in reducing panic disorder pathology. Results provided support for respiratory dysregulation as a feature of panic disorder and demonstrated the utility of voluntary hyperventilation recovery as a treatment outcome measure for the respiratory-based panic disorder treatment [12].

Slow diaphragmatic breathing is a treatment method employed in behavioral therapy for panic disorder. Yamada et al. observed that some patients with panic disorder were unable to perform diaphragmatic breathing effectively, resulting in an initial decrease in their vital capacity, which could be restored through respiratory training. In a 2017 comparative study, Yamada et al. investigated the relationship between diaphragmatic breathing ability and vital capacity percentage in patients with panic disorder and healthy controls. The study found that vital capacity was significantly reduced in patients with impaired diaphragmatic breathing compared to those with normal diaphragmatic breathing. However, vital capacity was restored to levels comparable to those of healthy controls following respiratory training. The study highlighted preliminary findings on the decreased vital capacity associated with abnormal respiratory patterns in patients with panic disorder and underscored the importance of respiratory training in managing panic disorder [13].

Meuret and colleagues (2001) reported the methodology and results of their ongoing breathing training controlled study on 4 participants. Four-week biofeedback therapy aimed to increase voluntary self-monitored end-tidal pCO2 and reduce respiratory rate and instability through breathing exercises in participants' environments. They stated that the frequency and severity of panic attacks, trait anxiety, anxiety sensitivity and depression were greatly improved. Physiological data obtained by 24-hour ambulatory monitoring before and after treatment, home training, and laboratory evaluation during follow-up indicated that patients started with low pCO2 levels at rest and increased these levels during and after treatment [22].

Individuals diagnosed with panic disorder often report shortness of breath or other respiratory complaints, supporting both the hyperventilation and false suffocation alarm theories of panic. Training individuals to modify their breathing patterns is a common intervention; however, objective measurement of breathing in patient assessment and monitoring treatment outcomes is infrequently performed. To our knowledge, no studies on respiratory biofeedback have been conducted in our country. Future research should explore the combined effects of these techniques and the influence of pretreatment moderators on treatment response. The improvements observed in individuals with panic disorder treated with respiratory biofeedback in larger sample groups can be evaluated in future studies. From this perspective, our study serves as a guide for future research. New intervention studies can be designed based on the results obtained from this study.

Future Directions

Given the scarcity of studies on respiratory biofeedback in our country, future research should investigate the combined effects of psychoeducation and biofeedback and examine the impact of pretreatment moderators on treatment response. Larger sample sizes and additional intervention studies could further validate the benefits of respiratory biofeedback in treating panic disorder. The present study serves as a preliminary guide for such future investigations, offering a foundation for new intervention strategies.

Conclusion

The study indicates that both psychoeducation and respiratory biofeedback significantly improve panic disorder symptoms, with biofeedback showing a greater impact on respiratory parameters and overall symptom improvement. These findings support the inclusion of respiratory biofeedback in the treatment of panic disorder and highlight the need for further research to explore its full potential and efficacy.

Patient informed consent

Patient informed consent was obtained.

Ethics committee approval

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Conflict of Interest

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Author contribution subject and rate:

Hatice Yıldız Burkovik (50%) Designed the research, data collection and analyses and wrote the whole manuscript.

Buse Göçmen Er (30%) Contributed with comments on research design and slides interpretation.

Barış Metin (20%) Contributed with comments on manuscript organization and write-up.

REFERENCES

1. Kessler RC., Avenevoli, S., Costello, E.J. Prevalence, persistence, and sociodemographic correlates of DSM-IV disorders in the National Comorbidity Survey Replication Adolescent Supplement. Arch Gen Psychiatry, 2012;69(4):372–380. doi:10.1001/archgenpsychiatry.2011.160
2. Bandelow MS, Michaelis S. Epidemiology of anxiety disorders in the 21st century. Diaoluges Clin Neurosci, 2015;17(3):327-335. DOI: 10.31887/ DCNS.2015.17.3/bbandelow
3. Chisholm D, Sweeny K, Sheehan P. Scaling-up treatment of depression and anxiety: a global return on investment analysis. Lancet Psychiatry, 2016;3(5):415–424. DOI:https://doi.org/10.1016/S2215-0366(16)30024-4
4. Kroenke KS. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. Annals of internal medicine, 2007;146(5), 317-325.
5. Carta MG, Moro MF, Aguglia E. The attributable burden of panic disorder in the impairment of quality of life in a national survey in Italy. Int J Soc Psychiatry, 2015;61:693–699. DOI: 10.1177/0020764015573848
6. Hayashi KM. Electroencephalogram abnormalities in panic disorder patients: a study of symptom characteristics and pathology. BioPsychoSocial medicine, 2010;4(1),9.
7. Kaiya H, Umekage T. Factors associated with the development of panic attack and panic disorder: Survey in Japanese population. Psychiatry Clin Neurosci, 2005;59:177-182. https://doi.org/10.1111/j.1440-1819.2005.01354.x
8. Smoller JW, Gardner-Schuster E. The genetic basis of panic and phobic anxiety disorders. Am J Med Genet Part C, 2010;148:118–126. https://doi.org/10.1002/ajmg.c.30174
9. Uchida R, Del-Ben CM. Decreased left temporal lobe volume of panic patients measured by magnetic resonance imaging. Braz J Med Biol Res, 2003;36:925–929. https://doi.org/10.1590/S0100-879X2003000700014
10. Sibille E. Genetic inactivation of the serotonin1A receptor in mice results in downregulation of major GABAA receptor α subunits, reduction of GABAA receptor binding, and benzodiazepine-resistant anxiety. https://doi.org/10.1523 JNeurosci, 2000;20:2758–2765.
11. Critchley HD, Wiens S, Rotshtein P. Neural systems supporting interoceptive awareness. Nat Neurosci, 2004;189–195. doi10.1038/nn1176
12. Tunnell NR. Habituation or normalization through treatment? Experiential and respiratory recovery from voluntary hyperventilation in treated versus untreated patients with panic disorder. Behavior Therapy, 2020;52(1):124-125. doi: 10.1016/j.beth.2020.03.003
13. Yamada T. Recovery of percent vital capacity by breathing training in patients with panic disorder and impaired diaphragmatic breathing. Behavior Modification, 2017;41(5):665-682. https://doi.org/10.1177/0145445517711436
14. de Jonge P, Roest AM, Lim CCW. Cross-national epidemiology of panic disorder and panic attacks in the world mental health surveys. Depress Anxiety, 2016;33(12):1155–77. DOI 10.1017/9781316336168.007
15. Tural UF. Validity and reliability of the Turkish version of the Panic and Agoraphobia Scale. Turk Psikiyatri Derg, 2000;11(1):29-39.
16. Spielberger C. Manual ForState-TraitAnxiety Inventory, Paloalto, California: Consulting Psychologists, 1970.
17. Öner L, Le compte A. Durumluk-Sürekli Kaygı Envanteri El Kitabı, Boğaziçi, Istanbul, 1998.
18. Richards BK. Brief Internet-Based Treatment For Panic Disorder. Behav. Cogn. Psychother, 2001; 29(1):113–117. DOI: 10.1017/S1352465801001138
19. Yoonessi, A., Ekhtiari, H. Text messages as a tool for assessing public concern about drug problems.IntJDrugPolicy,2013.24(6):624–627. https://doi.org/10.1016/j.drugpo.2013.06.002
20. Bossema, E.R., de Haar C.A.J., Westerhuis, W. (2011). Psychoeducation for patients with a psychotic disorder: effects on knowledge and coping. Prim Care Companion CNS Disord, 13(4):213–223 :doi:10.4088/PCC.10m01116
21. Bonn JA. Enhanced behavioral response in agoraphobic patients pretreated with breathing retraining. Lancet, 1984;2:665-669. DOI: https://doi.org/10.1016/S0140-6736(84)91226-1
22. Meuret AE. Respiratory biofeedback-assisted therapy in panic disorder. Behavior Modification, 2001;25(4):584-605. https://doi.org/10.1177/0145445501254006
23. Goodwin EA. A cognitive-behavioral, biofeedback-assisted relaxation treatment for panic disorder with agoraphobia. Clinical Case Studies,2006;5(2):112-125. https://doi.org/10.1177/1534650103261212
24. Tunnell NC. Habituation or Normalization? Experiential and Respiratory Recovery From Voluntary Hyperventilation in Treated Versus Untreated Patients With Panic Disorder. Behavior Therapy, 2021;52(1):124-135. https://doi.org/10.1016/j.beth.2020.03.003