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Neurofeedback Training as Adjuvant Therapy for Improving Depressive Symptoms Based on Patient Health Questionnaire – 9 (Phq-9) Scores in Post schizophrenia Depression: A Case Report

Ristina Ardiyani[1]*, Santi Yuliani[2]
[1]RS Lestari Raharja, Indonesia, [2]RS Jiwa Soerojo, Indonesia
Email: ristinaardiyani27@gmail.com*

KEYWORDS

Neurofeedback, post-schizophrenic depression, depressive symptoms, alpha wave, Patient Health Questionnaire – 9 (PHQ-9).

ABSTRACT

Post-schizophrenic depression, a depressive episode that occurs in patients with schizophrenia, often presents with more prominent depressive symptoms than schizophrenic symptoms. Despite pharmacotherapy, additional therapies are essential to improve symptoms and overall functioning. This study explores the use of neurofeedback as an adjuvant therapy in a 50-year-old female patient with a history of paranoid schizophrenia. The patient presented with symptoms of sadness, withdrawal, auditory and visual hallucinations, and a PHQ-9 score of 22. Along with pharmacotherapy (escitalopram, risperidone, and trihexyphenidyl), the patient underwent five sessions of neurofeedback with an alpha/theta/beta2 protocol aimed at enhancing alpha waves, which are often deficient in depressed individuals. Results showed that the patient's alpha wave amplitude increased from 9.2% in the first session to 9.9% in the fifth session, and the PHQ-9 score decreased, indicating improvement in depressive symptoms. These findings suggest that neurofeedback is an effective non-invasive therapy for post-schizophrenic depression, enhancing treatment outcomes when used alongside pharmacological interventions, ultimately improving the patient's quality of life and mental health.

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Corresponding Author: Ristina Ardiyani
Email: ristinaardiyani27@gmail.com

INTRODUCTION

Neurofeedback is a non-invasive, non-pharmacological therapy based on self-regulation, in which signals of the brain's electrical activity (brain waves) are recorded and displayed to the individual in the form of visuals, sounds, or animations. Individuals are given positive feedback when the brain produces the desired wave pattern (Al-Qaysi et al., 2021; Xu et al., 2023). Through this process, individuals learn to modulate the activity of brain waves in the direction of more adaptive and optimal patterns, which are related to improved psychological function, relaxation, emotion regulation, focus, and cognitive function. The use of neurofeedback in the field of psychiatry aims to improve

the function of brain wave regulation through feedback from the brain's electrical activity recorded in an electroencephalogram (EEG). In psychiatry, neurofeedback is used as an adjunct therapy for various mental health disorders related to brain wave activity dysfunction, such as attention deficit hyperactivity disorder (ADHD), autistic spectrum disorder (ASD), anxiety disorder and panic disorder, depression, insomnia, internet game disorder, alcohol use disorder, post-traumatic stress disorder (PTSD) and complex PTSD (C-PTSD), schizophrenia, and dementia (Malik et al., 2025; Markiewicz et al., 2021).

Neurofeedback training (NFT) is a form of training based on the principle of biofeedback, where individuals are given real-time feedback on their brain wave activity with the aim of improving self-regulation of brain function. Through the use of electroencephalography (EEG), neurofeedback training allows individuals to consciously observe and modulate brain wave activity, thereby correcting dysfunctional neurophysiological patterns. A number of studies have shown that neurofeedback training can provide clinical benefits and symptom improvement in a variety of psychiatric disorders (Malik et al., 2025; Hafeez et al., 2021).

The effectiveness of neurofeedback is based on the principles of neuroplasticity, self-regulation, operant conditioning, and balance restoration in brain tissue. This is related to the brain's ability to adapt, form new neural connections, and change its structure in response to experience and training. When the brain produces the desired brain wave pattern, the patient is given a positive stimulus—either in the form of images, videos, or sounds—but if the desired wave pattern is not achieved, the stimulus stops. Thus, with repeated training, it is expected that individuals will be able to maintain a more adaptive and healthy pattern of brain activity independently, even after the training session is stopped. In general, neurofeedback programs in psychiatry depend on a psychiatric diagnosis. In depression, the number of neurofeedback training sessions can range from twenty to forty sessions, with the duration of each session ranging from twenty to thirty minutes, at a frequency of two to five times per week, which can then be reduced according to clinical evaluation as well as symptom improvement response in the patient. Based on the principle of brain neuroplasticity, it is shown that more intensive and consistent training tends to result in faster and more stable changes. The effectiveness of neurofeedback tends to increase gradually, so a long-term approach with high consistency is highly recommended. Some studies have reported significant clinical benefits and symptom improvement after ten to twenty sessions. In addition to frequency, the selection of neurofeedback training protocols is crucial. The protocol is determined based on the goal of brain waves such as delta, theta, alpha, sensory motor rhythm (SMR), beta, and high beta (gamma), as well as electrode placement locations. Protocol adjustments are made individually, based on clinical evaluation (Malik et al., 2025; Hafeez et al., 2021; Grosselin et al., 2021).

Depression is a mood disorder characterized by feelings of sadness, emptiness, hopelessness, loss of interest or pleasure in daily activities, and various physical and cognitive symptoms that interfere with social functioning, work, or daily life. According to the DSM-5, a person can be diagnosed with depression if they experience five or more symptoms such as depressive mood almost every day, loss of interest or pleasure in almost all activities, changes in weight or appetite, sleep disturbances, fatigue or loss of energy, feelings of worthlessness or excessive guilt, difficulty thinking or making decisions, and finally the presence of thoughts of death or suicide that persist for two weeks. Depression can affect all aspects of a person's life—physically, emotionally, socially, and professionally. In addition, it can result in changes in thinking and behavior. The sufferer may feel hopeless, worthless, easily tired, have difficulty concentrating, withdraw, and even have suicidal thoughts. Long-term effects, if not treated, can increase the risk of other mental disorders such as anxiety, panic disorders, physical health disorders, and increased risk of suicide. Depression is one of the most common mental disorders and is a global health problem (Elvira & Hadisukantanto, 2022; American Psychiatric Association, 2022).

The Patient Health Questionnaire – 9 (PHQ-9) is one of the screening tools that can be used to detect and measure the severity of depression symptoms, especially in adults. It aims to quickly screen depression symptoms, help diagnose depression early, assess severity, and can be used to monitor responses to treatment or adjuvant therapy. In PHQ-9, there are nine questions with a total score interpretation including: 0–4 categorized as no depression, 5–9 mild depression, 10–14 moderate depression, 15–19 moderately severe depression, and 20–27 severe depression (American Psychiatric Association, 2022).

According to the World Health Organization (WHO), more than 280 million people worldwide suffer from depression, with the highest prevalence occurring in women of productive age, between 15 and 50 years old. Data based on the Indonesian Ministry of Health in 2023 states that 9.8 million Indonesians are depressed. Depression not only impacts individuals emotionally but also has a profound impact on families, work environments, and society at large. Depression can become a chronic condition and can lead to suicide, which is the second leading cause of death. The etiology of depression is multifactorial, involving complex interactions between biological, psychological, and social factors. Imbalances of neurotransmitters such as serotonin, dopamine, and norepinephrine are often associated with the pathophysiology of depression, along with abnormalities in brain structure or function and genetics. Additionally, traumatic experiences, prolonged stress, grief, and environmental and genetic factors also play important roles in the development of this disorder (Elvira & Hadisukantanto, 2022; Sadock et al., 2024).

According to the DSM-5, post-schizophrenic depression is a depressive episode that appears in patients with schizophrenia, where depressive symptoms are more prominent than symptoms of schizophrenia. After the psychotic episode of schizophrenia subsides, it is followed by a major depressive episode. This condition has a significant impact on the patient's quality of life. Depression that arises after schizophrenia can lead to social dysfunction, decreased adherence to medication, psychotic relapse, decreased cognitive function, impaired emotional regulation, and an increased risk of suicide. Therefore, it is important to recognize and treat post-schizophrenic depression early and appropriately (Elvira & Hadisukantanto, 2022; American Psychiatric Association, 2022; Sadock et al., 2024).

Biologically, post-schizophrenic depression is related to dysfunction of neurotransmitters such as dopamine, serotonin, and norepinephrine, and abnormalities in brain structure or function, which have similarities with the causes of depression in general. However, from the psychological perspective, post-schizophrenic depression can be caused by the patient experiencing despair due to awareness of the chronic disease they suffer from, social stigma, and difficulties in achieving independence or previous social roles. Socially, environmental factors such as social isolation, unemployment, and lack of family support can also worsen the condition (Elvira & Hadisukantanto, 2022).

Research shows that about 25–50% of schizophrenic patients experience depressive episodes in the remission stage or after the main psychotic symptoms are under control. This signals the importance of a comprehensive therapeutic approach involving pharmacological therapies, psychotherapy, and adjuvant therapies such as neurofeedback training to modulate brain wave activity, specifically alpha waves related to depression (Malik et al., 2025; Elvira & Hadisukantanto, 2022).

In depression, including post-schizophrenic depression, alpha wave deficiency occurs in the frontal area. Alpha waves are brain waves with a frequency of 8–12 Hz and are the dominant brain waves in relaxation, emotion regulation, mood, and cognitive function. Alpha wave deficiency in the frontal area is related to increased anxiety, tension, mood disorders, sleep disturbances, and impaired cognitive function. Due to abnormalities in the frontal area, the selection of electrode placement on F3 and F4 can be used. By increasing or balancing alpha wave activity in the frontal area, this therapy can help patients gain emotional balance, improved mood, calmness, and enhanced executive function (Hafeez et al., 2021; Liu et al., 2024).

Based on the description above, neurofeedback training is a non-invasive therapeutic adjuvant that can be considered to treat post-schizophrenic depression, especially in improving emotional regulation, motivation, mood, relaxation, sleep disorders, and cognitive function. With proper protocols and good clinical monitoring, neurofeedback training can improve patients' quality of life, improve symptoms, and speed up recovery from depression so that the prognosis will be better. Although these therapeutic adjuvants cannot yet

replace pharmacotherapy, they are nonetheless worthy of consideration as part of a multimodal approach in long-term psychiatric care (Malik et al., 2025; Patil et al., 2023).

Studies have highlighted the potential of neurofeedback as an adjunctive therapy for psychiatric disorders, including depression. For instance, a study by Hengameh et al. (2020) demonstrated that neurofeedback improved cognitive performance and emotional regulation in patients with major depressive disorder by modulating alpha and theta waves. Another study by Wu et al. (2018) found that neurofeedback significantly reduced depression symptoms in patients with generalized anxiety disorder by enhancing alpha wave activity. These studies have provided a foundation for understanding the neurophysiological mechanisms of neurofeedback in mental health treatment, but they have largely focused on generalized depression rather than post-schizophrenic depression, a condition characterized by unique challenges.

The objective of this research is to evaluate the effectiveness of neurofeedback as an adjunctive therapy for post-schizophrenic depression, focusing on the modulation of brain wave activity, particularly alpha waves. The findings of this study contribute to the growing body of literature supporting neurofeedback as a non-invasive, effective treatment for improving emotional regulation, motivation, and cognitive function in post-schizophrenic depression. By integrating neurofeedback with pharmacological treatments, this research aims to improve patient outcomes and provide a comprehensive therapeutic approach for individuals suffering from this complex condition.

RESEARCH METHOD

Case Study

A woman, aged 50 years, came to a psychiatric outpatient polyclinic. Autoanamnesis obtained revealed that in the last two weeks she seemed sad, reluctant to speak, often silent, restless, walking back and forth, withdrawing, and crying. Alloanamnesis revealed that the patient hears whispers that scare her, causing fear; she feels that someone is talking, sees strange shadows, loses interest in activities she previously engaged in frequently, is reluctant to talk, has difficulty sleeping, becomes easily upset and offended, feels like a burden to her family, harbors a desire to end her life, has no appetite, difficulty focusing, and forgetfulness. The triggering factor is a feeling of loneliness and remembering her mother who passed away. These complaints affect the patient's control of emotional impulses, interpersonal relationships, and social functioning.

The patient has a history of paranoid schizophrenia since 2018 and receives routine treatment with clobazam 10 mg/24 hours per oral, clozapine 25 mg/12 hours per oral, trihexyphenidyl 2 mg/24 hours per oral, olanzapine 10 mg/24 hours per oral, and risperidone 2 mg/24 hours per oral.

The patient is the third of six children and has a poor relationship with some family members. Her relationship with her parents was good, but after both parents passed away, she felt sad and lonely. The patient lives alone, with poor family support; financial support is obtained from her eldest brother. She is unmarried, not working, and her highest education level is high school (*SMA*). There is no history of previous medical disorders, forensic history, substance use, or alcohol use.

Mental Status Check:

The mental status check was obtained as follows:

Table 1. Mental Status Check

Appearance	**It seems that women are age-appropriate, take enough self-care, and do not see scars on the body.**
Attitudes and Behaviors	Non-cooperative.
Caution with Checkers	Easy to pull, hard to list.
Soul Connection	Get.
Consistency	Labil.
Mood	Sad.
Afek	Limited.
Thought Form	Unrealistic.
Contents of Thoughts	Idea Of Reference.
Perception	Audiotoric and Visual Hallucinations.
Self-Reflection	Bad.

Patient Health Questionnaire – 9 (PHQ – 9):

Patient Health Questionnaire – 9 (PHQ - 9) is obtained as follows:

Table 2. Patient Health Questionnaire Results – 9 (PHQ – 9)

No.	**Question**	**Never (0)**	**Multiple Days (1)**	**More Than Half The Day (2)**	**Almost Every Day (3)**
1	Lack of interest or enthusiasm for doing anything				3
2	Feeling depressed, sad, or hopeless				3
3	Difficulty sleeping or sleeping excessively			2	
4	Feeling tired or lacking energy			2	
5	Decreased or increased appetite				3
6	Feeling a failure or disappointment in yourself or your family			2	
7	Difficulty concentrating or focusing				3
8	Moving or speaking slowly or feeling restless so that they move more often				3

9	Feeling better off dying or wanting to hurt yourself	1
	Total	**22**

Based on the results of the examination above, a diagnosis of post-schizophrenic depression was obtained. Patients were hospitalized for fourteen days with escitalopram 10 mg per 24 hours of oral care, risperidone 2 mg per 24 hours of oral care, trihexyphenidyl 2mg per 24 hours of oral and adjuvant therapy neurofeedback *training* for five sessions with *the enhance* alpha/*suppressed* theta/*suppressed* protocol beta2. The alpha wave results in the first session were 9.2% of the goal, the second session 9.0% of the goal, the third session 9.5% of the goal, the fourth session 9.5% of the goal and the fifth session 9.9% of the goal.
The results of the alpha wave after neurofeedback are as follows:

Channel	Round	Points	Time min.		Delta 0.5-4.0 Hz	Theta 4.0-8.0 Hz	Alpha 8.0-12.0 Hz	SMR 12.0-15.0 Hz	Beta 15.0-22.0 Hz	Beta2 22.0-50.0 Hz	Total
F3	☑ 1	499	10.00	*Goal [µV]*	11.47	8.72	5.28	3.67	4.13	6.42	
				Amplitudevv [µV]	36.37 (45.6%)	13.43 (16.8%)	7.42 (9.3%)	5.25 (6.6%)	8.15 (10.2%)	9.18 (11.5%)	79.79
F3	☑ 2	528	10.00	*Goal [µV]*	11.47	8.72	5.28	3.67	4.13	6.42	
				Amplitudevv [µV]	38.58 (43.9%)	14.89 (16.9%)	8.09 (9.2%)	5.89 (6.7%)	9.11 (10.4%)	11.41 (13.0%)	87.97

Figure 1. Results of the First Post-Neurofeedback Alpha Wave

Channel	Round	Points	Time min.		Delta 0.5-4.0 Hz	Theta 4.0-8.0 Hz	Alpha 8.0-12.0 Hz	SMR 12.0-15.0 Hz	Beta 15.0-22.0 Hz	Beta2 22.0-50.0 Hz	Total
F3	☑ 1	467	10.00	*Goal [µV]*	11.47	8.72	5.28	3.67	4.13	6.42	
				Amplitudevv [µV]	36.66 (44.6%)	14.39 (17.5%)	7.33 (8.9%)	5.18 (6.3%)	8.52 (10.4%)	10.06 (12.2%)	82.13
F3	☑ 2	451	10.00	*Goal [µV]*	11.47	8.72	5.28	3.67	4.13	6.42	
				Amplitudevv [µV]	35.03 (43.1%)	14.21 (17.5%)	7.31 (9.0%)	5.22 (6.4%)	8.62 (10.6%)	10.93 (13.4%)	81.32

Figure 2. Second Post-Neurofeedback Alpha Wave Results

Channel	Round	Points	Time min.		Delta 0.5-4.0 Hz	Theta 4.0-8.0 Hz	Alpha 8.0-12.0 Hz	SMR 12.0-15.0 Hz	Beta 15.0-22.0 Hz	Beta2 22.0-50.0 Hz	Total
F3	☑ 1	538	10.00	*Goal [µV]*	11.47	8.72	5.28	3.67	4.13	6.42	
				Amplitudevv [µV]	40.46 (43.3%)	16.15 (17.3%)	8.65 (9.3%)	6.18 (6.6%)	9.85 (10.5%)	12.13 (13.0%)	93.41
F3	☑ 2	549	10.00	*Goal [µV]*	11.47	8.72	5.28	3.67	4.13	6.42	
				Amplitudevv [µV]	35.77 (41.6%)	16.04 (18.7%)	8.17 (9.5%)	5.89 (6.8%)	9.24 (10.8%)	10.84 (12.6%)	85.94

Figure 3. Third Post-Neurofeedback Alpha Wave Results

Channel	Round	Points	Time min.		Delta 0.5-4.0 Hz	Theta 4.0-8.0 Hz	Alpha 8.0-12.0 Hz	SMR 12.0-15.0 Hz	Beta 15.0-22.0 Hz	Beta2 22.0-50.0 Hz	Total
F3	☑ 1	521	10.00	*Goal [µV]*	11.47	7.72	5.78	3.67	4.13	6.42	
				Amplitudevv [µV]	41.92 (42.6%)	16.26 (16.5%)	9.41 (9.6%)	6.81 (6.9%)	10.48 (10.7%)	13.45 (13.7%)	98.33
F3	☑ 2	521	10.00	*Goal [µV]*	11.47	7.72	5.78	3.67	4.13	6.42	
				Amplitudevv [µV]	32.68 (39.8%)	15.69 (19.1%)	8.17 (9.9%)	6.03 (7.3%)	9.28 (11.3%)	10.36 (12.6%)	82.21

Figure 4. Results of the Fourth Post-Neurofeedback Alpha Wave

Channel	Round	Points	Time min.		Delta 0.5-4.0 Hz	Theta 4.0-8.0 Hz	Alpha 8.0-12.0 Hz	SMR 12.0-15.0 Hz	Beta 15.0-22.0 Hz	Beta2 22.0-50.0 Hz	Total
F3	☑ 1	521	10.00	*Goal [µV]*	11.47	7.72	5.78	3.67	4.13	6.42	
				Amplitudevv [µV]	41.92 (42.6%)	16.26 (16.5%)	9.41 (9.6%)	6.81 (6.9%)	10.48 (10.7%)	13.45 (13.7%)	98.33
F3	☑ 2	521	10.00	*Goal [µV]*	11.47	7.72	5.78	3.67	4.13	6.42	
				Amplitudevv [µV]	32.68 (39.8%)	15.69 (19.1%)	8.17 (9.9%)	6.03 (7.3%)	9.28 (11.3%)	10.36 (12.6%)	82.21

Figure 5. Results of the Fifth Post-Neurofeedback Alpha Wave

RESULT AND DISCUSSION

Post-schizophrenic depression is a depressive episode that appears in patients with schizophrenia where the symptoms of depression are more prominent than the symptoms of schizophrenia, after the psychotic episode of schizophrenia subsides, followed by a major depressive episode. This condition is one of the complications that often occurs but is often overlooked and has a major impact on the patient's prognosis and has a significant impact on the patient's quality of life. Post-schizophrenic depression is characterized by the appearance of depressive symptoms almost every day such as feelings of sadness, loss of interest or pleasure in almost all activities, changes in weight or appetite, sleep disturbances, fatigue or loss of energy, feelings of worthlessness or excessive guilt, difficulty thinking or making decisions and thoughts of death or suicide that last for two weeks. Depression can affect all aspects of a person's life physically, emotionally, socially and professionally as well as an increased risk of suicide (Elvira & Hadisukantano, 2022; American Psychiatric Association, 2022; Sadock et al., 2024).

Management in post-schizophrenic depression must be carried out comprehensively, multidisciplinary and individualized according to the patient's profile, including pharmacological, non-pharmacological and adjuvant management of non-invasive therapies such as neurofeedback training. Depression is related to dysregulation of brain wave activity, especially in the frontal area. There is a deficiency of alpha waves, dominance of beta wave 2 and dominance of theta waves (Liu et al., 2024; Patil et al., 2023).

Alpha waves are the dominant brain waves in conditions of relaxation, emotion regulation, mood and cognitive function. Alpha wave deficiency in the frontal area is related to increased anxiety, tension, mood disorders, sleep

disorders and impaired cognitive function. Beta wave 2 is a wave related to alertness, decision-making processes and responses to stress. Dominance in the beta2 wave results in the appearance of anxiety, muscle tension, insomnia or restlessness. While theta waves can be detected during drowsiness, the dominance of theta waves is related to decreased concentration and focus, brain fog and psychomotor retardation (Hafeez et al., 2021; Liu et al., 2024; Patil et al., 2023).

The dysregulation of wave activity in post-schizophrenic depression can be managed by neurofeedback training with the protocol of enhance alpha / suppressed theta / suppressed beta2 with the main goal of enhance alpha to achieve a state of relaxation, increase motivation, emotion regulation, mood and improve executive function. Due to abnormalities in the frontal area, the selection of electrode placement on the left frontal (F3) and right frontal (F4) was selected. The selection in electrode placement is related to the presence of alpha wave asymmetry that is visible in depressions (Hafeez et al., 2021; Xie et al., 2023).

Alpha wave asymmetry is the imbalance of alpha wave amplitude between the left hemisphere and the right hemisphere in the frontal area. In depression, left frontal alpha asymmetry is obtained, meaning that F3 is more dominant in alpha waves which indicates that the left frontal is less active. Thus neurofeedback training with electrode placement in F3 and F4 can be used as an additional non-invasive therapy method to correct alpha wave asymmetry in patients with depression, by enhancing left frontal activity (enhance alpha) and normalizing emotional balance (Hafeez et al., 2021; Patil et al., 2023; Xie et al., 2023).

The following is the placement and function of electrodes in the frontal areas of F3 and F4:

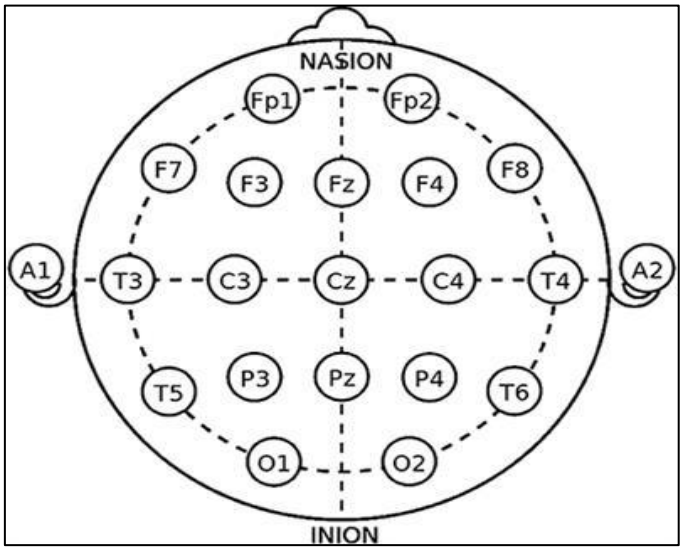

Figure 6. Electrode Placement

Table 3. Frontal Area Electrode Laying Function

Sites	Functions	Considerations
Frontal Lobes	Fp1, Fp2, Fpz, Fz, F3, F4, F7, F8	LH: Working memory, concentration, executive planning, positive emotions.
		RH: Episodic memory, social awareness.
		Frontal poles: Attention judgment.
		LH: Depression
		RH: Anxiety, fear, executive planning, poor executive functioning.

Based on the results of neurofeedback training in post-schizophrenic depressive patients with a frequency of five sessions, a duration of twenty minutes per session with *the alpha* enhance/*suppressed* theta/*suppressed* beta2 protocol with the placement of electrodes in the F3 and F4 areas, an increase in alpha wave amplitude results was obtained in the third to fifth neurofeedback sessions. There was a decrease in the alpha wave amplitude in the second session compared to the first session and the alpha wave amplitude was stagnant in the third and fourth sessions.
The following are the results of the neurofeedback training obtained:

Table 4. Results *of Neurofeedback Training*

SESSION	ALPHA WAVE
first	9,2 %
second	9 %
third	9,5 %
fourth	9,5 %
Fifth	9,9 %

Based on these results, it can be concluded that there is an increase in alpha wave amplitude after neurofeedback is performed. In the first session, 9.2% of the goal was obtained and in the fifth session, 9.9% of the goal was obtained. The percentage in this case is the result of the achievement of the training target as seen from the goal amplitude that has been determined. This condition refers to what percentage during the training session the patient's alpha amplitude results in achieving the training target value. The increase in the percentage results shows the occurrence of the brain adaptation process so that alpha wave activity succeeds in achieving the target training value, neuroplasticity occurs through the mechanism of repetition and reward system (positive feedback) so that the brain forms a new synapse pathway that modulates brain waves in the desired direction. This certainly affects the improvement of depression symptoms in post-schizophrenia patients which can be seen from the improvement with a decrease in the value of the patient health questionnaire – 9 (PHQ-9) (Patil et al., 2023; Misaki et al., 2025; Morimoto & Nakazato, 2021).

Alpha waves (8–12 Hz) generally increase when individuals are in a state of relaxation, not too tense, and not too sleepy. However, in some cases, alpha waves can decrease or stagnate during training sessions. This can be caused by

several factors such as excessive anxiety, uncomfortable sitting positions, environmental disturbances such as noise, room temperature that is too hot, too bright screen, can also be related to fatigue, drowsiness and lack of understanding of the patient in stimulating relaxation conditions (Grosselin et al., 2021; Demos, 2019).

Decreased or stagnant alpha waves during neurofeedback training sessions can be caused by a combination of internal factors. However, this does not mean that therapy fails, but it does show that brain training is an adaptive process that requires repetition. Based on the principle of brain neuroplasticity, it is shown that more intensive and consistent training tends to result in faster and more stable changes. The effectiveness of neurofeedback tends to increase gradually (Malik et al., 2025; Demos, 2019).

However, there was an improvement in psychiatric clinical status and an improvement in depression symptoms in post-schizophrenia patients after neurofeedback training due to the improvement of alpha wave asymmetry which was shown by the improvement in the value of the patient health questionnaire-9 (PHQ-9) to 10. The improvement in depression symptoms can be seen from the positive expression that begins to appear where the patient seems less sad, smiles, more communicative, feels calmer, can sleep, appetite improves, is more focused, the patient begins to be able to take care of himself, do activities, socialize, be more stable in emotions, be cooperative with therapy, do not have the desire to end life and hallucinations (American Psychiatric Association, 2022; Negeri et al., 2021).

Improvement or decrease in the value of patient health questionnaire – 9 (PHQ-9) after neurofeedback training in post-schizophrenic depression can be related to the effect of neurofeedback training which can improve alpha wave asymmetry so as to increase positive affect, modulate brain wave activity, especially by increasing alpha waves in the frontal area, which is related to relaxation conditions and emotional balance, lowering excess theta waves so that they can achieve a more focused state and lowering beta2 waves so that it can reduce anxiety. In addition to being related to brain wave modulation, neurofeedback training can normalize activity in the dorsolateral prefrontal cortex (DLPFC), ventromedial prefrontal cortex (VMPFC) and Anterior Cingulate Cortex (ACC) which play a role in cognitive function and emotion regulation. In addition, it can increase homeostasis of the release of the neurotransmitters dopamine and serotonin related to increased mood and motivation, stimulate neuroplasticity through synapse changes, this is further related to the consistency of neurofeedback training, the more consistent, the more consistent there can be structural and functional changes in brain tissue, improve long-term emotional resilience which has an impact on reducing the recurrence of depression. In addition, there is an increase in the sense of self-control, especially towards symptoms. The overall can further reduce the value of the patient health questionnaire – 9 (PHQ-9) which is accompanied by an

improvement in depression symptoms (Patil et al., 2023; Misaki et al., 2025; Peeters et al., 2020).

The following are the results *of the patient health questionnaire* – 9 (PHQ-9) before neurofeedback *training* is as follows:

Table 5. Results *of Patient Health Questionnaire* – 9 (PHQ-9) before neurofeedback *training*

No.	Question	Never (0)	Multiple Days (1)	More Than Half The Day (2)	Almost Every Day (3)
1	Lack of interest or enthusiasm for doing anything				3
2	Feeling depressed, sad, or hopeless				3
3	Difficulty sleeping or sleeping excessively			2	
4	Feeling tired or lacking energy			2	
5	Decreased or increased appetite				3
6	Feeling a failure or disappointment in yourself or your family			2	
7	Difficulty concentrating or focusing				3
8	Moving or speaking slowly or feeling restless so that they move more often				3
9	Feeling better off dying or wanting to hurt yourself		1		
Total			**22**		

The following are the results *of the patient health questionnaire* – 9 (PHQ-9) after neurofeedback *training* is as follows:

Table 6. Results *of Patient Health Questionnaire* – 9 (PHQ-9) before neurofeedback *training*

No.	Question	Never (0)	Multiple Days (1)	More Than Half The Day (2)	Almost Every Day (3)
1	Lack of interest or enthusiasm for doing anything			2	
2	Feeling depressed, sad, or hopeless		1		
3	Difficulty sleeping or sleeping excessively	0			
4	Feeling tired or lacking energy	1			
5	Decreased or increased appetite		2		
6	Feeling a failure or disappointment in yourself or your family	1			
7	Difficulty concentrating or focusing			2	
8	Moving or speaking slowly or feeling restless so that they move more often		1		

9	Feeling better off dying or wanting to hurt yourself	0
	Total	**10**

CONCLUSION

Neurofeedback training is a non-invasive complementary therapy in the field of psychiatry based on self-regulation, which has been proven significant in improving depressive symptoms, as seen from the improvement of the *Patient Health Questionnaire – 9* (PHQ-9) scores in post-schizophrenic depressive patients. In post-schizophrenic depression, neurofeedback training with the enhance alpha / suppress beta 2 / suppress theta protocol has shown effectiveness in increasing alpha waves in the frontal area, which plays an important role in the process of relaxation, mood regulation, positive emotion regulation, and motivation recovery. It lowers beta 2 waves, which are associated with anxiety and excessive agitation, and suppresses theta waves, which are often associated with attention disorders, psychomotor retardation, and brain fog.

Through a series of consistent training sessions, neurofeedback not only acts as a therapeutic adjuvant in depressive disorders but can potentially improve executive function and enhance the patient's overall quality of life by stabilizing neurophysiological function and modulating brain wave activity to achieve appropriate conditions. With the support of a multidisciplinary approach, this intervention can be part of comprehensive management in patients with post-schizophrenic depression, especially in cases that show limited response to pharmacotherapy. Neurofeedback can be considered as part of a multimodal approach in long-term psychiatric care.

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