THE EFFECT OF SHORT-SESSION NEUROFEEDBACK THERAPY ON BRAIN WAVE ACTIVITY IN CHILDREN WITH ADHD

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ABSTRACT

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by symptoms of inattention, and distractibility, with or without hyperactivity. According to the CDC, it was the most common mental health disorder among children aged 3-17 years, with a prevalence of 9.8% from 2016 to 2019. Over time, various therapeutic methods have been developed to treat ADHD patients, one of which is neurofeedback therapy. Neurofeedback (NFB) therapy, also known as Neurotherapy, is a type of biofeedback therapy that utilizes feedback from brain activity to optimize brain function in children with ADHD potentially. This study aims to determine the effects of short-session neurofeedback therapy on brainwaves in children with ADHD using the quasi-experimental method. Samples were obtained from medical records of SMR and Theta brainwave activity from the first and fifth sessions of neurofeedback therapy through simple random sampling. A sample size of 30 was calculated and analyzed using a paired sample T-test. The researcher decided to measure changes after 5 sessions because childhood is a very active period, and children have numerous activities, limiting their availability for therapy. It was found that after undergoing neurofeedback therapy for 5 sessions, there was a significant improvement in the patient's SMR wave activity compared to before therapy (p=0.004). However, there was no substantial change in the patient's Theta wave activity before and after the 5 neurofeedback therapy sessions (p = 0.178). The considerable increase in SMR waves indicates an improvement in the patient's ability to concentrate on specific tasks without being easily distracted.

Keywords: ADHD, Child, Neurofeedback, Sensorimotor Rhythm Sensor, Brainwaves.

ABSTRAK

Attention Deficit Hyperactivity Disorder (ADHD) adalah gangguan perkembangan saraf yang ditandai dengan gejala kurang perhatian, dan mudah terganggu, dengan atau tanpa hiperaktif. Menurut CDC, ADHD adalah gangguan kesehatan mental yang paling umum di antara anak-anak berusia 3-17 tahun, dengan prevalensi 9,8% dari tahun 2016 hingga 2019. Seiring berjalannya waktu, berbagai metode terapi telah dikembangkan untuk menangani pasien ADHD, salah satunya adalah terapi neurofeedback. Terapi Neurofeedback (NFB) atau yang juga dikenal dengan Neuroterapi, merupakan salah satu jenis terapi biofeedback yang memanfaatkan umpan balik dari aktivitas otak untuk mengoptimalkan fungsi otak pada anak yang berpotensi mengalami ADHD. Penelitian ini bertujuan untuk mengetahui efek dari terapi neurofeedback sesi pendek terhadap gelombang otak pada anak-anak dengan ADHD menggunakan metode kuasi-eksperimen. Sampel diperoleh dari catatan medis aktivitas gelombang otak SMR dan Theta dari sesi pertama dan kelima terapi neurofeedback melalui pengambilan sampel acak sederhana. Jumlah sampel sebanyak 30 dihitung dan dianalisis menggunakan uji T sampel berpasangan. Peneliti memutuskan untuk mengukur perubahan setelah 5 sesi karena masa kanak-kanak adalah masa yang sangat aktif, dan anak-anak memiliki banyak kegiatan, sehingga membatasi ketersediaan mereka untuk terapi. Ditemukan bahwa setelah menjalani terapi neurofeedback selama 5 sesi, terdapat peningkatan yang signifikan pada aktivitas gelombang SMR pasien dibandingkan dengan sebelum terapi (p=0,004). Namun, tidak ada perubahan substansial pada aktivitas gelombang Theta pasien sebelum dan sesudah 5 sesi terapi neurofeedback (p = 0,178). Peningkatan yang cukup besar pada gelombang SMR menunjukkan peningkatan kemampuan pasien untuk berkonsentrasi pada tugas-tugas tertentu tanpa mudah terdistraksi.

Kata Kunci: ADHD, Anak, Neurofeedback, Sensor Irama Sensorimotor, Gelombang Otak.

A. Pendahuluan

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by symptoms of inattention and distractibility, with or without hyperactivity. This developmental disorder can be problematic for children if not addressed promptly. According to the CDC, the prevalence of ADHD in 2016-2019 was the most common mental developmental disorder in children, with a prevalence of 9.8% in children aged 3-17 years. In addition, an increase in ADHD cases in a national population survey in the United States showed an increase in

prevalence from 6.1% to 10.2% between 1997 and 2016. On the one hand, while some children have an undeniable diagnosis and clearly require treatment, some experts are concerned about the risk of overdiagnosis and overtreatment, particularly with stimulants and other psychotropic medications. As with most psychotropic medications, treatment considerations treatment must be carefully weighed against the potential for adverse outcomes.

Neurofeedback training (NFB), also called neurotherapy, is a type of technology-based biofeedback therapy that uses feedback from brain activity to strengthen healthy brain function through conditioning brain activity. Unlike therapies that only use psychotropic drugs, this therapy helps train the brain to function more optimally in an effort to overcome ADHD. Because neurofeedback therapy can be said to teach the brain, it generally requires several sessions to achieve the desired results.[6] On the other hand, childhood is a busy time filled with various activities, making it difficult for children to undergo neurofeedback therapy regularly and consistently. Therefore, this study titled "The Effect of Short-session Neurofeedback Therapy on Brain Wave Activity in Children with ADHD" aims to determine how effective short-session neurofeedback therapy is in addressing ADHD issues in children.

B. Metode Penelitian

This study uses a quantitative approach aimed at researching the population, in this case patients with ADHD. The type of research applied is a single-group quasiexperiment. The population used in this study are patients with ADHD disorders at the Talenta Centre Clinic in Bekasi who have undergone at least 5 sessions of neurofeedback therapy. A total of 30 samples obtained were first processed using a normality test, then data with a normal distribution was calculated using a paired T test and data with a non-normal distribution was processed using a Wilcoxon signed-rank test.

The research was conducted by collecting neurofeedback therapy data from patients who met the inclusion criteria with permission from the Talenta Centre Bekasi Clinic. The data obtained was then sorted and processed using SPSS version 26. The data was collected and processed to see the effect of neurofeedback therapy on brain waves in ADHD

patients, namely SMR brain wave activity and theta waves. There is one way to measure a patient's brain wave activity, which is by measuring brain wave activity while undergoing neurofeedback therapy.

C.Hasil Penelitian dan Pembahasan

This study used secondary data obtained from the medical records of patients who had undergone therapy at the Talenta Centre Clinic in Bekasi. Medical records that met the inclusion criteria as research samples were randomly selected again until 30 samples were obtained for analysis. Each SMR and theta wave data was divided into two groups, namely pretest (measurement of brain wave activity in session 1 of neurofeedback therapy) and post-test (measurement of brain wave activity in session 5 of neurofeedback therapy).

Table 1 Results of SMR Waveform Measurements in Session 1

		Statistik
SMR	N	30
	Mean	51.08
	Median	58.53
	Standar Deviasi	22.37
	Distribusi	.051

Calculation results using SPSS 26 on data before treatment (pre-test) obtained number of sample that valid amounting to 30 data points, with a mean value of 51.08, median = 58.53, and standard deviation = 22.37.

Table 2 Results of SMR Waveform Measurements in Session 5

		Statistik
SMR	N	30
	Mean	63.86
	Median	64.55
	Standar Deviasi	23.68
	Distribusi	.399

The results of calculations using SPSS 26 on the post-test data obtained a valid sample size of 30 data points, with a mean value of 63.86, a median value of 64.55, and a standard deviation of 23.68. Based on Tables 1 and 2 above, it can be seen that the significance value of the Shapiro-Wilk test for the pretest results on SMR wave measurements is 0.051. This

indicates that the SMR wave pretest data is normally distributed, because the significance value of the pretest data is greater than the significance level of 0.05. The significance value of the Shapiro Wilk test for the SMR wave post-test results is 0.399. This indicates that the post-test data is normally distributed because the significance value of the post-test data is greater than the significance level of 0.05.

Table 3 Summary of The Paired-Sample t-Test of The SMR Wave

Class	Average	T-score	T table	P value
Pretest	51.083	3,140	2,045	0.004
Post-test	63.868			

From Table 3 above, it can be seen that the pretest class had an average of 51.083, while the posttest class had an average increase of 63.868, representing an increase of 12.785. Furthermore, based on the T-test, the calculated T-value was 3.140. The T-table value at df 29 was 2.045. Based on the above analysis, the calculated T-value > T-table (3.140 > 2.045) and the significance value was less than 0.05 ($p = 0.004 < 0.05$). From this data, it can be said that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Therefore, it can be concluded that there is a significant increase in SMR waves between patients before neurofeedback therapy (pretest) and after 5 sessions of neurofeedback therapy (post-test).

Table 4 Result of Theta Wave Measurements in Session 1

		Statistik
Theta	N	30
	Mean	122.35
	Median	138.12
	Standar Deviasi	35.24
	Distribusi	.000

The results of calculations using SPSS 26 on the pretest data obtained a valid sample size of 30 data points, with a mean value of 122.35, a median value of 138.12, and a standard deviation of 35.24.

Table 5 Result of Theta Wave Measurements in Session 5

		Statistik
Theta	N	30
	Mean	132.12
	Median	144.96
	Standar Deviasi	27.13
	Distribusi	.000

The results of calculations using SPSS 26 on the post-test data obtained a valid sample size of 30 data points, with a mean value of 132.12, a median value of 144.96, and a standard = 27.13. Based on Tables 5 and 6 above, it can be seen that the significance value of the Shapiro-Wilk test for the pretest results on Theta wave measurements is 0.00. This indicates that the SMR wave pretest data is not normally distributed because the significance value of the pretest data is greater than the significance level of 0.05. The significance value of the Shapiro Wilk test for the post-test results of the Theta wave is also 0.00. This indicates that the post-test data is not normally distributed because the significance value of the post-test data is greater than the significance level of 0.05.

Table 6 Summary of Theta Wave Hypothesis Test

Wilcoxon signed-rank test	
	ThetaPost – Theta
Z Score	-1.347
Asymp. Sig (2-tailed)	.178

Table 6 The Wilcoxon test results for Theta wave neurofeedback show that the Z count is - 1.347 and sig of 0.178. A sig value greater than 0.05 (p = 0.178 > 0.05) means that the Ho hypothesis is accepted and Ha is rejected. This means that there was no significant difference in theta waves before and after 5 sessions of neurofeedback therapy in patients.

Discussion

Increased theta wave activity and reduced beta/SMR wave activity, particularly in the frontal lobe of the brain, have been associated with ADHD. Theta waves are brain waves that occur in a relaxed state or when a person is not fully focused on a specific task.[9] EEG (Electroencephalogram) research

shows a relationship between increased theta waves and ADHD symptoms, especially in children. Low beta waves or SMR are associated with more focused brain activity and are involved in complex cognitive tasks. A decrease in beta wave activity has been observed in some parts of the brain in individuals with ADHD, which indicates an inability to focus attention efficiently. Low Beta Waves, also known as Sensorimotor Rhythm or SMR, are waves that appear in the sensorimotor cortex in the 12-15 Hz frequency range.

These waves play an important role in a person's ability to concentrate. In patients with ADHD, various studies show that ADHD patients have less SMR wave activity. Therefore, increasing SMR wave activity is usually one of the targets of neurofeedback therapy. The significant increase in SMR wave activity after undergoing neurofeedback therapy in this study indicates an improvement in patients' ability to concentrate on an activity, making them less easily distracted.

Theta waves are low-frequency electrical waves generated by the brain. These waves are the second slowest brain waves, with a frequency range of 4-8 Hz. Theta waves are present during sleep and wakefulness. Theta waves generally occur during light sleep, dreaming, or deep relaxation. According to existing theories, increased theta wave activity can be found when there is a decrease in a person's ability to concentrate, including in patients with ADHD. Therefore, suppressing theta waves is generally one of the targets of neurofeedback therapy for patients with ADHD.[18] However, in this study, the data showed that theta waves in patients were not significantly affected after undergoing neurofeedback for 5 sessions.

The results of this study indicate that the brain performance of patients improved with neurofeedback therapy. These results are in line with previous studies that say neurofeedback training therapy is like a learning process for the patient's brain, and that learning process undergoes a series of consolidation and reconsolidation processes over time and with training.

E. Kesimpulan

Based on the results of the analysis examining SMR and theta brain wave activity in sessions 1 and 5, it was concluded that there was a

significant difference in the patient's SMR wave activity before and after undergoing short-term neurofeedback therapy for 5 sessions. However, there was no significant difference in theta wave activity.

CONFLICT OF INTEREST

This study was approved by the ethics committee with number 193/V/2024/KEP of the University of National Development Jakarta, and the researchers have no conflicts of interest during the writing of this scientific article.

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