The Effect of Neuro feedback Training on Treatment of Insomnia

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A B S T R A C T

The very aim of this study was to examine the possible effect of neurofeedback training on treatment of insomnia. The present study can be considered as an experimental and applied type of research, following a pre-test and post-test design of study. Two groups, namely interventional and control were involved in this study. To do the comparison between the mentioned groups, 20 volunteer-patients were chosen and were randomly assigned to the interventional and control groups. PSQI questionnaire was administered to examine the patients’ sleep quality. The obtained data was analyzed using the SPSS18. The results of the covariance revealed that neurofeedback training has significantly improved the patients’ sleep quality. The Mankova analysis demonstrated that 91.8% of the patients’ differences in the subscales of sleep quality were due to the membership of the groups. Neurofeedback training can be regarded as a safe alternative to other kinds of treatments for insomnia. Efforts for changing the brain waves will be followed with some changes in the brain. After treatment, each of the changes made in electrical activity of brain causes recognition in the whole biological system and makes a comprehensive normal reaction and reflection in the brain, which leads to the improvement of sleep quality.

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INTRODUCTION

Sleeping is the only drug which culminates in alleviation (Suffkel). In order to achieve perfect health, human beings need to enjoy mental as well as physical health. It point is so crucial that the World Health Organization has considered mental health principles as one of its agenda of primary health care for member countries. One of the vital factors, which contribute to human health, is sleeping [1]. Although many people consider sleeping to be the required time for relaxing and retrieval of the lost energy, the scientists have shown that it is a dynamic activity during which many of the vital processes that are essential for health and welfare are still taking place [2]. Sleeping is one of the major factors for retaining circadian rhythm of body. Poor sleep is associated with heart attacks, diabetes, depression, disturbed cognitive processing, fainting, and finally low quality of life [3]. Precise control of sleep is one of the important elements of clinical practices, as sleep disorders are of early symptoms of psychiatric illnesses. Insomnia is the most common and best-known of all sleep disorders [1]. Insomnia can be seen in every age and among every ethnic groups and no culture and country is an exception in this regard. The actual incidence of insomnia differs according to the definition of the severity of it. The symptom of insomnia exists in approximately 33% to 55% of adult population and is one of the most prevalent sleeping disorders in general population [4]. Mostly pharma Cho therapy is used as the treatment of this disease. Nowadays, Barbiturates are not prescribed because of the risks and side effects, so Benzodiazepines are commonly used as sleeping-pills. Nevertheless clinical specialists and pharmacologists all believe the regular use of these drugs alter the construction of sleep through their effects on paradoxical sleep stages, shortening them, decreasing deep sleep stage, leading not to have a healing sleep, reducing sleep efficiency, and eventually they can end up with dependence or addiction. Besides that Benzodiazepines do not affect the causes of sleep disorders; hence the use of these sleep medication should be short-term and be limited to the least effective doses [5]. In addition, pharmacotherapy can’t make fundamental changes in the sleep disorder pathways, thus the reoccurring of the symptoms are very common [6]. Another treatment to be referred to for sleep disorders is Cognitive Behavioral Therapy. The counteractive strategies in this approach are relaxation, cognitive therapy, and teaching the ability of problem-solving that can improve the patients’ status up

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to a reasonable level. However, learning the counteractive skills requires continuous effort while some patients may not have enough motivation for following these therapeutic strategies [7]. Moreover, knowing the pathology of neurologic and psychiatric conditions has been prominently considered to be crucial in recent decades and significant results have been disseminated about brain waves of the engaged individuals [8]. Current information about brain and the relevant equipment help to show brain images non-invasively while performing tasks have led to higher use of brain treatments. In these treatments, every patient is individually trained based on his/her specialty of their brain maps [9]. At present time, scientists consider neurofeedback to be a new avenue for evaluating and changing the brain status. Neurofeedback is a kind of biofeedback, which suggests the mutual association of mind and body. The recognition of this association is the component of healthy life style functionality [10]. Neurofeedback is a comprehensive educational system for the patients, which culminates in alternation, reinforcement, adjustment, and finally improvement in the function of neurocells [9]. Some pieces of research have shown that psychiatric and neurological disorders can be distinguished from distinct EEG patterns and neurofeedback can be used to make a change in these patterns [11]. Actually, neurofeedback is an approach for normalizing the brain performance; those which are deviated from their normal function. This strategy is based on conditioning mechanism [12]. American Psychiatric Association has determined neurofeedback as an effective therapeutic treatment approach for Attention Deficit Hyperactivity Disorder [13]. Neurofeedback has been tested for treatment of epilepsy, insomnia, and cognitive performance. Numerous pieces of research have been carried out on abnormal EEG, QEEG patterns, and their association with medical and mental disorders. In normal conditions, people can not affect their brain waves since they are not aware of it. Neurofeedback enables individuals to notice a visual presentation of the electric activity of their brain, and then this self-awareness lets them improve their brain wave pattern through conditioning [15]. The studies conducted in the last three decades have shown that neurofeedback can improve attention, behavior control, increase cortical activity-movement, and improve intelligence test score which leads to academic achievement. Neurofeedback treatment can significantly reduce the symptoms of conduct disorder and ADHD, substance abuse, social and emotional delinquency, anxiety, depression, learning disability, sleeping disorders, and finally can be a great help in anger management [16].

Results of some studies have shown that the EEG pattern is more irregular during second stage of sleep and sleep spindles appear (which means short waves frequency band 12-14 HZ with high voltage occurs suddenly) and arousal become more difficult [9]. In addition, the first change that clients generally experience and observe after starting the training with neurofeedback is the change and adjustment of their sleep patterns, so it can be hypothesized that neurofeedback can be effective in treating sleep disorders. However, not much research has been conducted in this regard. Hence the present study aims at assessing the efficacy of this therapy in sleep quality improvement and insomnia treatment.

**MATERIALS AND METHOD**

To address the main objective of the present study which was pursuing the possible effect of neurofeedback in treatment of insomnia, a research testing pattern with one interventional and one control group was designed. A pre-test as well as a post-test were conducted for both groups. The sample population of the present study was patients with insomnia admitted to the psychology-psychiatric clinics in Isfahan city. First of all, cases were selected according to diagnostic interview of DSM-V carried out by a psychiatrist. Eventually, 20 individuals, who had the inclusion criteria with no other kinds of disorders and willing to collaborate in the study, were randomly selected. At the beginning, the pre-test was carried out and then they were randomly assigned to two groups, namely interventional and control. Participants in interventional group were trained with neurofeedback which lasted for 8 weeks. Sessions were held three times per week and each session lasted forty-five-minutes, which means every participant attended in total 20 therapeutic sessions. In neurofeedback training, the PROCAMP-2 system which is made in Canada and Biography Infinity software were used. The procedure was in a way that every session, SMR wave (12-15 Hz) as the increasing band was reinforced and waves of 2-7 Hz and 20-30 Hz were suppressed. This procedure was carried out in bipolar way on cz-c4. At the end of 20 therapeutic sessions, post-test was conducted after a two-week gap. Finally, the obtained data were analyzed and the hypotheses were examined. Initially, descriptive statistics were used to describe the results. Before using parametric tests, kolmogrof-Smirnof and Levene's test were run in order to ensure normality and equality of variances, respectively. Besides that, the pre-test bias was controlled by using Co variation analysis. Finally, the hypotheses were analyzed.

**Pittsburgh Sleep Quality Index (PSQI) Questionnaire:**

The PSQI Questionnaire is one of the most common and important ones all over the world. This questionnaire examines the quality of sleep. The application of this questionnaire makes it possible to measures seven domains: subjective sleep quality sleeps latency, sleep duration, sleep efficiency, sleep disorders, use of sleep medication, and daytime dysfunction over the last month. Scoring of the answers is based on a 0 to 3 scale.
The score of 0 represents normal state, 1 represents a mild problem, 2 illustrate a moderate problem, and 3 is demonstrative of a severe problem in sleeping [17]. It takes 5-10 minutes to fill out this questionnaire [18]. The reliability and validity of this questionnaire are 86.5, 89.5, respectively (18). In Heydari’s (date) study, the reliability coefficients of this questionnaire were calculated by Coronbach’s Alpha coefficient. The coefficients were 0.46 and 0.56, respectively; which are reasonable coefficients.

**Results:**

The results of pre-test and post-test and standard deviation scores of sleep quality in interventional and control groups are shown in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Pre-test</th>
<th>Post test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>mean</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>Sleep quality</td>
<td>interventional</td>
<td>10</td>
<td>15.2</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>14.9</td>
<td>2.64</td>
</tr>
</tbody>
</table>

The Average scores are 15/2 and 14/9 in interventional and control group, respectively; which shows the same pattern in each group. A significant decrease can be seen in post-test scores, which means the effectiveness of neurofeedback in treatment of insomnia.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Pre-test</th>
<th>Post test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>mean</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>Pre-test</td>
<td>830.615</td>
<td>1</td>
<td>830.615</td>
</tr>
<tr>
<td>error</td>
<td>216.261</td>
<td>17</td>
<td>12.721</td>
</tr>
</tbody>
</table>

As shown in Table 2., after controlling the effect of sync variable on dependent variable and applying F coefficient, a significant difference in post-test between adjusted quality-of-sleep scores in patients with insomnia(P<0.01) is observed. Therefore, the research hypothesis is accepted so that neurofeedback has contributed in increasing the quality-of-sleep scores in patients with insomnia in post-test. The beneficial effect was 79.3 within interventional group in the post-test stage.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Sum of square</th>
<th>df</th>
<th>Mean square</th>
<th>Significance level</th>
<th>Eta coefficient</th>
<th>Observed power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjective sleep quality</td>
<td>membership</td>
<td>9.359</td>
<td>1</td>
<td>9.359</td>
<td>14.350</td>
<td>0.001</td>
<td>0.566</td>
</tr>
<tr>
<td>Sleep latency</td>
<td>5.665</td>
<td>1</td>
<td>5.665</td>
<td>10.931</td>
<td>0.001</td>
<td>0.498</td>
<td>0.852</td>
</tr>
<tr>
<td>Sleep duration</td>
<td>membership</td>
<td>10.096</td>
<td>1</td>
<td>10.096</td>
<td>10.743</td>
<td>0.001</td>
<td>0.709</td>
</tr>
<tr>
<td>Sleep efficiency</td>
<td>membership</td>
<td>6.717</td>
<td>1</td>
<td>6.717</td>
<td>12.110</td>
<td>0.001</td>
<td>0.524</td>
</tr>
<tr>
<td>Sleep disorders</td>
<td>membership</td>
<td>30.947</td>
<td>1</td>
<td>30.947</td>
<td>30.317</td>
<td>0.001</td>
<td>0.821</td>
</tr>
<tr>
<td>Use of Sleep medication</td>
<td>membership</td>
<td>30.947</td>
<td>1</td>
<td>30.947</td>
<td>30.317</td>
<td>0.001</td>
<td>0.821</td>
</tr>
<tr>
<td>Daytime dysfunction</td>
<td>membership</td>
<td>29.012</td>
<td>1</td>
<td>29.012</td>
<td>65.944</td>
<td>0.001</td>
<td>0.857</td>
</tr>
</tbody>
</table>

It’s illustrated in Table (3) that in post-test stage, there is an improvement at least in one of the sub scales including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disorders, use of sleep medication, and daytime dysfunction. The averages of the mentioned sub scales were reduced in the interventional group in comparison to those of the control one (P<0.01, F= 7.951). This result means 91.8% individual differences in sub scales of subjective quality of sleep, sleep latency, total duration of sleep, sleep disorders, sleep drug consumption, and daytime dysfunction is due to group membership. The observed power of 1 represents the sufficiency of sample size.

**Discussion:**

Insomnia is a common complication in many people, as Ohayun’s review study based on 50 epidemiological researches has shown the incidence rate is 9-15%, while in other studies this effect was reported to be 5-25%. Pharmacotherapy is the dominant treatment for alleviating the insomnia symptoms, yet numerous studies suggest the positive effect of psychological therapy on insomnia symptoms [23,24]. On the other hand, neurofeedback is a modern therapeutic approach which is recently used in different therapeutic areas by
psychologists, psychiatrics, and remedial work therapists. Hence, it can be claimed that neurofeedback therapy is an emerging treatment for insomnia. Neurofeedback is a complementary therapy enabling individuals increase or decrease their brain activity based on conditioning paradigm [25]. Neurofeedback is a complex therapy system, which is a safe and noninvasive and boosts the growth and change of neurocells. In this approach, at first the patient is going to be aware of his/her brain activity, then whenever the patient is able to suppress or reinforce the target activity, he/ she is getting prize. As the final mark, this study identified the effects of neurofeedback as a cure for insomnia.

Conclusion:

The results of Covariance analysis for the first hypothesis addressing the effects of neurofeedback on the treatment of patients with insomnia showed that neurofeedback improves sleep quality scores in patients suffering from insomnia. The degree of this effect was 97/3; however in the review of the literature a similar study was not observed. It is worth to mention that the results of this study were in line with those of Berners et al [26], Cortex et al [27], and Hamer et al’s [28] studies. For instance, the results of Hamer et al’s study illustrates that neurofeedback has a significant effect on the quality of sleep; moreover it has improved the patients’ brain waves. Similarly, Berner et al’s study shows that although neurofeedback training doesn’t play a role in beta spindles activity and behavioral consequences, an increasing trend towards the strength width of sigma wave in NREM stage after the application of neurofeedback in comparison to control group can be observed. Furthermore, a positive significant correlation was observed between beta Spindales activities through sleep stages with short waves and memorial activity of brain. In general, it can be concluded that neurofeedback can be considered as one of the therapeutic alternatives for patients with sleeping disorders, as it corrects the abnormal brain waves. Making alternation in conscious level and during sleep is mostly connected to sub frontal structures of brain. Improvement in balanced function as a behavior is the result of processing enhancement within vestibular system in the brain stem and also improvement of controlling function of cerebellar on vestibular systems and proprioception. All of the mentioned structures are related to sub cortical parts.

Initial and early effect of neurofeedback is dominantly on sub cortical structures, in particular thalamus while reported brain waves in EEG stem from cortical neuro cells activities up to 97% [30]. The findings of the present study with regard to the improvements taking place in the quality of sleep in the absence of significant changes of EEG are in accordance with the above mentioned justifications. Moreover, significant changes in later times through adjustment of thalamus-cortical orbits are expected. It seems that secondary evaluations after a period of time as a follow up phase can make significant changes in EEG. According to this theory, neurofeedback effect on EEG is applicable and doesn’t confine to the areas on which neurofeedback has been applied or used frequencies in the treatment. Thus EEG changes seem to be the consequence of secondary complex organization of EEG.

Findings of Mancova analysis associated with the second hypothesis shows that neurofeedback has decreased in post-test at least in one of the qualitative mental components of sleep, delay in falling sleep, duration of sleep, sleep efficiency, sleep disorders, and daily dysfunction. To clarify the differences, results of Mancova analysis shows that the degree of the impact or differences is 0.0918; which means 91/8 percent of individual differences in sub scales including subjective sleep quality, sleep latency, sleep duration, sleep disorders, use of sleep medications, daytime dysfunction are associated with Group membership. Results shows that neurofeedback improved 56/6% subjective quality of sleep in patients with insomnia, 49/8% sleep latency, 70/9% sleep duration, 52/4% sleep efficiency, 86% sleep disorders, 82/1% use of sleep medication, and 85/7% daytime dysfunction. Nainyian has carried out a study in which he identified the effect of neurofeedback training in decreasing the general anxiety disorder symptoms, the results proved the effectiveness of this treatment in improving the symptoms of GAD.

Several studies have examined the effectiveness of neurofeedback treatment on a wide variety of psychological disorders such as Saeb Taheri [31], Nosrat-Abadi, Borj-Ali and Rostami [32], Gholizade et al [10], Jadidi et al [16], Nurizadeh et al [33], Farokhi et al [34], Vosoughi-Fard et al [35], Fachez et al [36], Mater Pasco et al [11], and Goroziler et al [37]. In conclusion, the results of the abovementioned studies are the same as that of the present study which suggests neurofeedback as a modern, safe, and effective treatment in curing a variety of disorders. Finally, to justify the results it can be said that changes made in consciousness are actually representative of changes in brain and neurofeedback as a therapeutic approach is based on targeting brain waves.

Therefore, association between changes in brain waves and consciousness changes is not a mutual linear association. In other words, alternation in one of these components does not lead to alternations in the other one. Although, mechanism of change in brain isn’t known to us, the improvement can be observed in behavior which is understandable and measurable to us. Thus, there is an association between EEG and sub-thalamocortical which is responsible for brain rhythms and EEG frequencies. Sleep disorders confound and change these rhythms and neurofeedback makes clinical effects last by readjusting and correcting these rhythms.
REFERENCES


