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Determining the Effect of Transcranial Direct Current Stimulation on Depression and Anxiety in Methadone Consumers: A Randomized Controlled

Mahdi Naeim, MSc, Ali Rezaeisharif, PhD,† and Samira Ghobadi Bagvand, MSc‡*

Abstract

Background:
Preliminary evidence suggests transcranial direct current stimulation (tDCS) has antidepressant and antianxiety efficacy. Because its effects have not been tested on methadone consumers, we investigated its efficacy.

Objectives:
This research is aimed at determining the effect of tDCS on depression and anxiety in methadone consumers.

Methods:
The present study was conducted in a pretest-posttest design. In this research, 40 people were studied as a group. These people took a test before and after the 8 days of tDCS. After the primary test, people received device simulation for 8 consecutive days at a specific time. Kolmogorov-Smirnov and Wilcoxon tests were used for analyzing the data.

Results:
The results show that with the score of 1.69 for the first variable, the patients' anxiety level is much lower at the time of the electric stimulation. Also, regarding the score of 1.62 in the second hypothesis, it can be stated that the depression level was much lower at the time of performing the simulation.

Conclusions:
It seems that tDCS can improve the severity of depression and anxiety symptoms. It can be used as an effective treatment.

Key Words: tDCS, depression, anxiety, methadone

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BACKGROUND

Although the use of weak electrical currents to stimulate the brain has been described for centuries in the history of medicine, it has been reintroduced with higher intensity currents since 2000 as "transcranial direct current stimulation" (tDCS). It involves passing a weak, depolarizing current through the brain. This shifts the resting membrane potential, with anodal stimulation depolarizing the soma of pyramidal cells, whereas cathodal stimulation results in hyperpolarization. The effects of tDCS on neuronal excitability have now been demonstrated in numerous neuroimaging and physiological studies, providing a sound neurobiological basis for its use for neuromodulation in patient populations.[1,2] Per capita prevalence of depression among the addicts is about 50% to 60% and the prevalence of minor depressive disorder is about 10%. Also, the per capita prevalence of addiction among the total patients with psychological disorders is about 29% and among the depressed patients referring to psychiatric clinics, it is about 56%.[1] It is stated that 40% of the people who have drug abuse (opiate or nonopiate) have had a period in their lives in which they had the diagnostic criteria of major depressive disorder.[3] Quality of life is considered as a valid scale for evaluating the outcome of the therapeutic and service methods provided for a damaged person.[4] Quality of life includes the persons' physical health, psychological state, social relationships, religious and personal beliefs, and it is evaluated based on the persons' mental experiences.[2] Researchers have shown that abuse of opiate drugs, calmatives, and alcohol is related to low quality of life. The results of the researches about the effect of methadone maintenance treatment on the addicts' psychological health are contradictory. For example, some research has shown that compared with the general population, the addicts under treatment by methadone have had a high level of psychological

From the *Social Determinants of Health Research Center, Ardabil University of Medical Sciences; †Department of Counseling, University of Mohaghegh Ardabili, Ardabil; ‡Department of Psychology, Tehran Branch, Islamic Azad University, Tehran, Iran.

The authors declare no conflict of interest.

Correspondence to: Mahdi Naeim, MSc, Social Determinants of Health Research Center, Ardabil University of Medical Sciences, Ardabil 56136, Iran (e-mail: mnaeim64@gmail.com).

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problems, and they have experienced most of the mood and emotional disorders such as depression and anxiety.[5] In treatment with methadone, special centers deliver this drug to patients in the form of edible syrup and in a controlled way. From the experts' view, the replacement of methadone can decrease the prevalence of injection addiction and dangerous diseases such as AIDS, and on the other hand, communication of the addicts with drug distributors is prevented and the probability of crime commitment is decreased.[6] In the late 1990s, a method called tDSC was introduced which invaded the nerve tissue by induction of electric current. In this method, the anode electrode is connected to the considered point and, as a reference cathode electrode is connected to a point distant from the anode electrode. Electric current is directed from the anode electrode which is a simulator to the cathode electrode which is inhibitory. tDCS is one of the newest methods of brain stimulation which has attracted attention for 2 reasons: being noninvasive and economically cheap. Also, this method with magnetic stimulation is considered as one of the harmless and nonseizure causing methods. In the tDSC method, even a weak electric current enters the nerve tissue through the skin and cranium and changes the irritability of this tissue. The commonly used protocols of tDCS are related to 2 electrodes connected on the skin one of which works as an anode and the other works as the cathode. An electric current of 1 to 2 mA is applied for 20 minutes between these 2 electrodes each of which usually has a cross-section of 35 cm^2. The direction of the current is from the cathode to the anode and depending on the direction and intensity of the current, irritability of the cerebral cortex is increased or decreased.[7] According to what was stated, the main question of this research is whether determining the effect of tDCS on depression and anxiety in methadone consumers?

OBJECTIVES

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METHODS

This research is a pretest and posttest. The statistical population of this study includes methadone users in Ardabil city. For this purpose, 50 people were selected by the available sampling method. After declaring their consent for cooperation, people filled the questionnaires. These people took a test before and after the stimulation period (in 8 d and at a specific time every day). The research population includes 50 persons referring to addiction treatment centers of the city of Ardabil who are intended to quit their addiction and are consuming methadone by informing the center staff.

Procedure

After getting a written consent letter and insuring the persons about the privacy of their information, questionnaires (which are available in the appendix) were filled. The Beck depression inventory whose reliability and validity had been measured in domestic studies was used. In the study performed by Dobson and Mohammad Khani, Cronbach α coefficient was reported as 96% for this test. The Beck test includes 21 questions and 4 choices for each question. If the respondent chooses the first choice of all the questions, the resulted score will be 0, and if the person chooses the fourth choice of all the questions, the score will be 63. In this test, if the person gets a score of < 16, the result suggests no depression, for the scores of 17 to 25 the result if mild depression, for the scores of 26 to 33 the results if moderate depression, and for the scores of > 34 the result if severe depression. For evaluating the anxiety, the Berger test was used whose reliability and validity were determined.

Also, all the subjects have an age range of 20 to 45 years old, and for controlling the gender, the research population has been selected from among the men. To prevent the effect of temperature and climatic conditions on further tiredness, all the tests are done in the evening. All the subjects are asked not to have any physical exercise for 24 hours before the test, and to have enough rest and sleep. The conditions of execution of the test were the same for all the subjects. All the subjects are healthy persons. For analyzing

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TABLE 1. Descriptive Statistics on Depression and Anxiety in Experimental and Control Groups, in Pretest and Posttest

		Examination Group		Control Group	
Variable	**Statistical Index**	**Pretest**	**Posttest**	**Pretest**	**Posttest**
Depression	Average	27.70	10.05	28.51	28.72
	The standard deviation	9.81	5.14	11.01	11.38
Anxiety	Average	45.91	28.09	46.19	46.37
	The standard deviation	8.15	7.02	7.73	8.12

One of the defaults of covariance analysis before the covariance analysis test to assume the homogeneity assumption is the pretest and posttest regression slope. The results of regression slope homogeneity analysis showed that the relationship between (pretest) and (posttest) variables at the level of regression slope homogeneity study in the 2 groups was not significant. The Levene test was then performed to check the homogeneity of the variance, the results of which are shown in Table 2.

the data, descriptive and inferential statistics were used. To determine the normality of data distribution, in the part of descriptive statistics, mean and standard deviation were used and in the part of inferential statistics, the Kolmogorov-Smirnov test was used, and the significance level of α was considered as 5%. To compare the levels of the severity of depression, the Wilcoxon test was used. All the statistical studies were done by using SPSS20 and Excel (2016) software.

RESULTS

In the present study, the information obtained was evaluated using statistical analysis of covariance analysis. Descriptive findings of the experimental and control groups in the pretest and posttest stages about depression and anxiety are shown in Table 1.

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According to Table 2, the results showed that the variables of depression (0.054) and anxiety (0.076) were not significant. So the defaults of analysis of covariance are established.

According to Table 3, the variable of depression (50.17, 0.001) and the variable of anxiety (46.815, 0.001) after the test are significant at the level of (0.001). Therefore, it can be said that there is a difference between the scores of the experimental and control groups in the posttest for the adjustment of the pretest effect, which is the highest coefficient of effect related to depression (0.82). In other words, tDCS appears to have had a greater effect on the depression of methadone consumers than on their anxiety.

TABLE 2. Levene Test Results to Check the Assumption of Homogeneity of Variances

Variable	**Level**	***F***	***df*1**	***df*2**	**Significance**
Depression	Posttest	0.054	1	6	0.045
Anxiety	Posttest	0.076	1	9	0.91

The results showed that the variables of depression (0.054) and anxiety (0.076) were not significant. So the defaults of analysis of covariance is established.

TABLE 3. The Results of 1-way Analysis of Covariance in Depression and Anxiety, the Difference Between the Experimental Group

Variable	The Experiment Ss	Error Ss	The Experiment Ms	Error Ms	*F*	*P*	η
Depression	851.60	365.12	851.60	21.82	50.17	0.001	0.82
Anxiety	2736.183	1647.30	2736.183	75.491	46.815	0.001	0.481

The variable of depression (50.17, 0.001) and the variable of anxiety (46.815, 0.001) after the test are significant at the level of (0.001). Therefore, it can be said that there is a difference between the scores of the experimental and control groups in the posttest with respect to the adjustment of the pretest effect, which is the highest coefficient of effect related to depression (0.82). In other words, transcranial direct current stimulation appears to have had a greater effect on the depression of methadone consumers than on their anxiety.

DISCUSSION AND CONCLUSION

The results show that regarding the score of 1.69 for the first hypothesis, the level of patients' anxiety at the time-consuming methadone is much lower than when they do not use methadone. As a result, both the hypotheses are approved with a confidence of 95%. The results of this research are similar to the results of the researches performed by Knotkova and colleagues.[8–15] Paying attention to depression and anxiety and the effect of tDCS on these variables in the addicts has great importance. Therefore, the role of these stimulations in the performance of the nervous system in different age groups, their effect on depression and anxiety, and especially on promotion of life quality is very significant. Although depression and anxiety usually simultaneously exist in people with drug addiction, the role of electric tDCS has been paid less attention in this, and sometimes, contradictory results have been reported by the researchers. However, for treating depression and anxiety, magnetic stimulations have been used more than electric stimulations, while electric stimulations are much cheaper and simpler and have lower risks.[8] Nevertheless, research on the effect of electric tDCS on depression and anxiety in methadone consumers. has not paid much attention. Regarding the fact that drug consumption is one of the most important health problems in society, performing such projects will be useful. Most of these people are single and unemployed and they have about 5 to 10 years of drug consumption background. Such patients have mostly started their addiction with psychedelic pills and at the later stages, they prefer crystal drug to other drugs. The important point is that among the population of this research, most of them are educated persons with associate and bachelor degrees who are about 30 to 35 years old. However, after referring to addiction treatment centers, these people began to consume methadone under the control of the center staff. According to the results, their depression and anxiety level is much lower than the people who have not decided to quit their addiction yet.

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