IJBS

10.30491/IJBS.2023.403907.1978

International Journal of Behavioral Sciences

Original Paper

Comparing the Effectiveness of Transcranial Direct Current Stimulation and Cognitive Behavioral Therapy Treatments on Sexual Desire Disorder in Women

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Submitted: 17 September 2023
Accepted: 14 October 2023

Int J Behav Sci. 2023; 17(3): 141-147

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Abstract

Introduction: The purpose of this study was to compare the effectiveness of transcranial direct current stimulation treatments and Cognitive Behavioral Therapy (CBT) on sexual desire disorder in women.
Method: The methodology of this study was semi-experimental with a pre-test and post-test design. The statistical population of the present study consisted of all women who suffered from the problem of decreased sexual desire and for this purpose went to medical centers during the year 2021 in Tabriz and were diagnosed with the hypoactive sexual desire disorder. In this research, the sampling method was available. The sample included 30 women (each group including 10 women) who had the problem of decreased sexual desire and were randomly selected in three groups including test group one transcranial Direct-Current Stimulation (tDCS), test group two (CBT) and the control group. In order to collect data, the Hurlbert index of sexual desire was used. Hurlbert obtained the reliability of the sexual desire questionnaire as 0.86 in the test-retest method. The internal consistency coefficients of Halbert's sexuality questionnaire using two methods of Cronbach's alpha was 0.89. To test the research hypotheses, one-way covariance analysis was used, using the SPSS software version 26.
Results: The mean of the tDCS and CBT groups showed that both treatment methods were effective in reducing sexual desire disorder ($P < 0.001$). To generalize the results of this study, more research is needed in the future.
Conclusion: The results showed that both tDCS and CBT methods are effective in reducing hyposexuality in women with sexual desire disorder. In fact, these two methods can be used in the treatment of the abovementioned disorders.

Keywords: Sexual Desire Disorder, CBT-based Treatment, tDCS-Based Treatment

Introduction

Sexuality is one of the most personal and private parts of people's lives [1]. Each person is a sexual being with preferences and fantasies that sometimes may surprise them, but these are usually a part of normal sexual functioning. However, these tendencies are considered abnormal when fantasies or desires affect humans in a harmful way [1]. The harmful effects of such desires cause sexual problems and disorders and lead scientists to systematically study human sexual behaviors. Issues such as sexual problems, sexual impotence, etc., may be hidden and not expressed due to fear and anxiety, shame and embarrassment or feelings of inadequacy and guilt. It is worth mentioning that women do not express the symptoms of these problems correctly due to decency and modesty. Actually, sexual problems appear latently with other symptoms and complications such as physical discomfort, depression and dissatisfaction with married life [2]. Other reasons that have caused women to shy away from sex and its content are the thoughts that every woman has about sex, which can be

different among women and take certain forms that may be right or wrong. Among these are thoughts of unwanted pregnancy or lack of fertility, relationship only because of sex and lack of satisfaction with sex, which is very important among women. If satisfaction is not achieved, women face negative feelings and worries [3, 4]. The existence of such problems in the sexual sphere of women has caused sexual desire disorders in them. Basson is perhaps the most famous person in the world who has studied sexual reluctance in women. The studies she has carried in the field of women's sexual reluctance have led to the transformation and even change of Diagnostic and Statistical Manual of Psychiatric Disorders (DSM) criteria in its fifth edition [2].

In the mind of a human being, sexual relationship consists of two components: the first is a romantic relationship and the second is carnal. The studies conducted in this field show that the initiation of sexual intercourse in women is mostly due to the emotional level improvement in a romantic process than erotic issues and sexual stimulation [3, 4]. Therefore, in women, the initiation of sexual intercourse is more with feelings. In addition, mental arousal in women is more important than their physical arousal, and no correlation has been found between physical arousal and mental arousal in women. In fact, physical arousal is not a predictor of sexual behavior in women, but the opposite has been proven to be right in men [5]. In this study, it has been proven that there are two ways to create stimulation and sexual desire in women, one is physical stimulation and the other is mental stimulation. It has been estimated that the symptoms of physical arousal show faster than those of the mind. Physical arousal, through the stimulation of the autonomic nervous system and the stimulation of the thalamus and then the amygdala, causes a hyperemic response in the female genital area, and this factor causes genital physical symptoms such as warmth, high pulse, wetness and lubrication, erection of the clitoris and hyperemia of the labia majora and labia minora. This is while in the second process, which leads to mental arousal in women, a longer path is taken through the nervous system. The activation of sexual neurons in the thalamus is achieved through environmental and mental stimulation, as well as strengthening or even weakening this, based on the person's thoughts, imaginations and feelings or her previous experience in relation to sexual behaviors. Therefore, the place of information storage and processing can be considered in the cerebral cortex and memory in the hippocampus [3, 4].

On the other hand, DSM distinguishes two types of sexual desire disorders. Hypoactive sexual desire disorder, which refers to the weakness or lack of sexual desires and thoughts; and also sexual aversion disorder, which is a more severe disorder in which a person actively avoids almost any sexual contact with another person. Hypoactive sexual desire disorder is one of the widespread sexual dysfunctions. These disorders include sexual desire disorder, orgasm and sexual arousal disorders, vaginismus and sexual phobia. The prevalence of sexual dysfunction (58.3%) in women is one of the most common sexual disorders that causes many family and marital problems. In fact, any disorder that leads to inconsistency and lack of satisfaction in sexual intercourse and leads to dissatisfaction in sexual behavior is called sexual disorder [6]. The cause of these sexual disorders can be seen as psychological disturbances, moral slips, marital life failures, incompatibilities, sexual arousal disorders, female orgasmic disorders, sexual pain disorders and sexual disorders caused by addiction and general medical diseases [7]. The treatment of sexual desire disorders can include medication and psychological counseling, and in recent years, new cognitive neuroscience treatments. These methods are used to treat acquired sexual desire disorder in women. However, there is no exclusive treatment for this disorder. Some patients need treatment through emotional attention and solving communication issues, and to treat other patients, we need to focus on their sexual relationship. These people can improve the way and time of their sexual activity through special training and exercises [8]. Clinical experiences have shown that one of the important factors of sexual disorders is negative cognitive processes. Cognitive Behavioral Therapy (CBT) is one of the most effective counseling methods for sexual desire disorders in recent decades. In this method of treatment, cognitive processes are as important as environmental influences or behavior. This treatment is a type of behavioral therapy created in traditional psychotherapy situations and reflects the increasing interest of therapists in improving cognition as an effective factor on emotions and behaviors. The goal of CBT is to correct misinterpretations, reinforce a sense of control over life, increase positive and constructive self-talk, and strengthen coping skills [9]. According to the basic assumptions of cognitive-behavioral models, patients' thinking and perception shape their emotions and behaviors. Cognitive-behavioral models have shown interesting results in correcting health-related beliefs and behaviors as well as eliminating risk factors [10].

Today, CBT is one of the most famous and common methods of treating women's sexual disorders and dysfunctions [11]. This treatment is a set of psychotherapy interventions, which aims to reduce the psychological problems, and is known as one of the effective treatments among various psychological treatments. On the other hand, incongruent cognitions play their role in how information is interpreted in sexual situations and ultimately in the sexual response cycle of a person. Therefore, one's beliefs, attitudes, knowledge of sexual issues, as well as attention and concentration skills can be cognitive components. Therefore, CBT by correcting misplaced interpretations, directing negative self-talk, correcting illogical thought patterns and ineffective cognitions, with the aim of launching efficient and adaptive coping responses and controlling negative emotions along with other methods for the treatment of sexual disorders, is suggested [12].

Another treatment method is the technique of transcranial Direct-Current stimulation or tDCS, which increases the ability of the brain to process incoming information. Although the effectiveness of this treatment does not make

it self-sufficient or superior to other treatment methods [13], it is one of the methods that causes relative ease of use regarding immunity and biological-neurological effects [14]. In fact, it is a non-invasive tool, and it has the ability to stimulate nerve points of the brain that are either accessible or inaccessible, which is regulated by increasing or decreasing cortical excitability. Several studies show the ability of this technique to induce neural flexibility and regulate cognition and behavior in adults [15].

Therefore, tDCS changes the excitability of neurons and moves the membrane potential of surface neurons in the direction of depolarization or hyperpolarization and eventually causes more or less firing of brain cells from the skull by using direct electric current in order to change the excitability of the cortex in the desired areas. Brain functions are increased or decreased, while the focus of tDCS is somewhat limited, but its functional effects appear directly in the limited area below the electrodes [16]. Therefore, it can be concluded that electrical stimulation is a non-invasive brain technique that has the ability to exert transient change through weak electrical current on the skull, which includes changes in tDCS physical parameters, stimulation location, electrode size, stimulation duration and current polarity (anode or cathode), each of which can cause different effects, as well as create excitability in cortical areas [17]. Considering the negative effects of sexual disorders in interpersonal relationships and causing emotional problems, conducting research related to sexual disorders seems necessary. According to the mentioned materials, the aim of the present study was to compare the effectiveness of tDCS treatments and CBT for sexual desire disorders in women.

Method

In this research, there were two experimental groups and one control group. Before presenting the tDCS and CBT interventions, all the subjects underwent a pre-test and their status was measured in terms of the level of sexual desire measured by Halbert index of sexual desire. After this stage, the participants of experimental group one (treated with tDCS) underwent tDCS intervention for 10 sessions, and experimental group two (treated with CBT), received cognitive behavioral therapy for eight sessions. At this stage, the control group did not receive any treatment. Of course, after performing therapeutic interventions and completing the research process, the control group received tDCS treatment for 10 sessions. After the interventions, the Halbert test was taken again as a post-test.

The current study was a semi-experimental research of pre-test and post-test type with a control group. The statistical population included all the women who suffered from the problem of decreased sexual desire and for this purpose went to medical centers including urology, neurology, obstetrics and gynecology and psychology centers in Tabriz during the year 2021 and were diagnosed with the hypoactive sexual desire disorder.

According to the suggestion of Gall and Burke (2003), in semi-experimental studies, the number of 10 people in each group is a suitable number [18]. Therefore, in this research, the researcher has considered 10 people for each group, and in total, 30 people have been considered as the research sample for three experimental and control groups. In a similar semi-experimental research, samples of 10 to 15 people have been used for each group. Also, in this research, the available sampling method has been used. Considering that the sampling method in this study was available, but the replacement of people in the groups was completely random. In this research, after the initial evaluations and consideration of the entry and exit criteria, the researcher placed people randomly in three experimental and control groups. The criteria for entering the research were: having a sexual desire disorder, age between 25 and 50 years and having high school education or above. In this study, the data obtained by performing Hurlbert's pre-test and post-test were analyzed through one-way analysis of variance.

Ethical considerations were in accordance with the recommendations of the ethics committee in biological research of Tabriz Islamic Azad University, Medical Sciences Unit and were as follows: In this research, it was explained to the subjects that they are completely free to participate in the research and in every part of the research process, if they don't want to, they can withdraw from the cooperation. The subjects were not required to pay any money and the researcher has committed to be available to the subjects. In this study, the subjects were assured that in case of possible damages, the research team would compensate for them, and finally, the subjects were requested to sign the consent form to participate in the research. In this research, it was explained to the subjects that they were completely free to participate in the research and in any stage of the research, they could withdraw from the cooperation. In this study, the subjects were assured that in case of possible damages, the research team would compensate for them, and finally, the subjects were requested to sign the consent form to participate in the research.

The exclusion criteria included history of epilepsy, history of brain surgery or head trauma, use of anticonvulsant or antipsychotic drugs, cognitive disorder or major psychiatric disorder, having metal objects in the body, and diabetes. These cases were identified by the psychologist in the initial clinical interview.

The tools used in this study are as follows:

Halbert Index of Sexual Desire: This test which consists of 25 items was created by Halbertand (1992). This test aims to evaluate the subject's sexual desire and the scoring method for each item is defined from 0 to 4. The minimum score is 0 and the maximum score is 100. According to the Likert scale, people in this test are in one of the following classes: very weak (0-20), weak (21-40), medium (41-60), strong (61-80) and very strong (81 to 100) [26]. The test-retest reliability of the test obtained by Halbert was 0.86 and this credit was obtained by Shafiei on 40 married female students in 2004. The Cronbach's alpha was 0.92. In terms of validity, this test has construct validity of 0.92.

CBT Treatment Method: It consists of holding eight weekly training sessions for each person as follows:

Table 1. Cognitive Behavioral Therapy Training Sessions

First session	Getting to know the therapist and clients, explaining the research objectives and essential concepts, performing the Halbert test.
Second session	Identifying dysfunctional beliefs and explaining negative beliefs about sexual performance, teaching cognitive behavior patterns, and introducing cognitive distortions about sexual performance and its undesirable quality, task (revision of cognitive distortions)
Third session	Teaching cognitive errors (thinking nothing or everything, exaggerated generalization, mental filter, neglecting the positive, zooming in, hasty conclusions, labeling, personalization...).
Fourth session	Relaxation training and its anti-anxiety effect, homework review and reviewing previous week's training.
Fifth session	Examining assignments, teaching methods to deal with cognitive distortions, and practicing identifying cognitive distortions using thought recording sheets.
Sixth session	Teaching the four sexual cycles (desire, stimulation, orgasm and withdrawal) and a detailed explanation about sexual desire disorder.
Seventh session	Examining assignments, teaching coping methods for behaviors and thoughts that lead to sexual dysfunction. Tasks: cognitive reconstruction, completion of thought recording sheets, practicing coping and preventing inappropriate behaviors and thoughts.
Eighth session	Examining the process of correcting errors, evaluating homework and performing the Halbert test.

The use of this educational package has been emphasized in Howton's cognitive behavioral therapy book [28] and related articles by Babakhani et al. [25] and Nizam Nia et al. [28].

tDCS Treatment Method: One of the techniques that provides the external stimulation of the human brain in a safe and non-invasive way without the need for neurosurgery is transcranial Direct Current Stimulation or tDCS. Due to the changes in the polarity of the neuron membrane caused by the application of direct electric current (0.5 to 2 mA) on the scalp, the neuronal excitability of the membrane is also changed [19]. This technique works based on brain mapping and technical investigations of cognitive neuroscience in different parts of the brain, increasing activity through the placement of the anode and decreasing brain activity due to the placement of the cathode. Regarding sexual desire disorders, several studies show the importance of the dorsolateral prefrontal cortex or DLPFC. Of course, this region is also important in other executive and cognitive functions such as concentration, craving and desire for food [20]. Since most activities require an increase in brain function, anodic stimulation is the most common type of tDCS. The stimulating electrode is called the active electrode, while the passive electrode is called the reference. In most research, the reference electrode is placed above the right or left eye, however, in most studies, no attention has been paid to the inhibitory or strengthening effects of the reference electrode on the point where it is located. Some recent studies, especially the study conducted by Nitsche et al. (2007), show that it is better to have a small stimulating electrode and a large reference electrode. In this way, it is possible to have a current with a higher density under the therapeutic electrode and a lower density under the reference electrode. This arrangement allows the reference electrode to be placed on any point of the scalp without affecting the brain function. Most studies use a stimulation of about 1 mA in a 7 cm x 7 cm electrode. In this method, the client sits on a chair and the researcher, after preparing the pads and moistening them and connecting the anode and cathode electrodes, places them in the F3 and F4 areas in the prefrontal part of the head and tightens them with a bandage in the same area. After placing the electrodes on the head, the tDCS device starts working with a maximum of 2 mA of electricity for 20 minutes. After the end of the stimulation time, the device turns off by itself. This process was repeated three times a week for ten sessions for each subject.

Results

Demographically, the sample were from the middle class of the society. In terms of education, they were at the diploma level and above. In terms of age, they were in the range of 25 to 50. In this study, three groups of tDCS, CBT and control, each of which included 10 women, were examined. Demographic findings show that the age of the participants was between 37/16 + - 5/15. In terms of marriage history, they were between 10/86 + - 5/63 years old. In terms of education, 3.13% were below diploma, 40% were diploma and post-diploma, and 46.7% were bachelor and above. Economically, 76.7% were in average status and 23.3% were in good status.

One-way analysis of covariance was used to investigate the effectiveness of transcranial direct current stimulation treatment on sexual desire disorder in women. For this purpose, first, the assumptions of this method, which include the normality of covariate and dependent variables, the homogeneity of the variance of the dependent variable, the linearity of the relationship between the dependent variable and the covariate, and the homogeneity of regression slopes between the covariate and the dependent variable in the experimental and control groups were examined and confirmed. The results of the one-way covariance analysis to test this issue are shown in Tables 2 and 3.

Table 2. The results of one-way covariance analysis for the first subject test

Source	Sum of Squares	df	Mean Square	F	P	Eta Squared
Corrected model	4533.79	2	2266.89	54.04	0.0001	0.86
Intercept	85.27	1	85.27	2.03	0.172	0.10
Pre	2533.79	1	2533.79	60.41	0.0001	0.78
Group	2357.47	1	2357.47	56.20	0.0001	0.76
Error	713.00	17	41.94			
Total	50562	20				
Corrected total	5246.80	19				

Table 3. Modified Means of Sexual Desire Variable in the First Subject

Variable	Group	Mean	Std. Error
Sexual desire	tDCS	58.49	2.05
	Control	36.70	2.05

According to the results of Table 2, it can be seen that at the significance level of 0.001, there is a significant difference between the tDCS and control groups in the level of sexual desire of women (F = 56.20, p = 0.001 and η2= 0.76). Also, according to the results of Table 3, the modified mean of the "sexual desire" variable in the tDCS group (58.49) is greater than the modified mean of this variable in the control group (36.70). As a result, tDCS has increased the sexual desire of women. Therefore, this method is effective on sexual desire disorder in women.

One-way analysis of covariance was also used to investigate the effect of cognitive behavioral therapy on sexual desire disorder in women, and the assumptions of this method were examined and confirmed. The results of one-way covariance analysis to test this issue are shown in Tables 4 and 5.

According to the results of Table 4, it can be seen that at the significance level of 0.001, there is a significant difference between the CBT and control groups in the level of sexual desire of women (F = 290.05, P = 0.01 and η^2= 0.94). Also, according to the results of Table 5, the modified mean of the "sexual desire" variable in the CBT group (59.43) is greater than the modified mean of this variable in the control group (31.76). As a result, the method of cognitive behavioral therapy has significantly increased the sexual desire of women. Therefore, the method of cognitive behavioral therapy is effective on sexual desire disorder in women.

It is possible to explain the therapeutic effects of CBT and tDCS in the way that the cognitive and behavioral changes created in the CBT method, including the change of beliefs and false communication patterns, have improved and reduced the sexual desire disorder. In the tDCS method, the f3 and f4 areas are considered to be among the areas that play a role in reducing anxiety. Maybe the reduction of anxiety has led to improvement in sexual desire disorder. Of course, it should be noted that it is still too early to generalize this finding. It needs to be confirmed by further research.

Table 4. Results of One-way Covariance Analysis for the Second Subject Test

Source	Sum of Squares	df	Mean Square	F	P	Eta Squared
Corrected model	2207.42	2	1103.71	145.03	0.0001	0.94
Intercept	37.78	1	37.78	4.96	0.040	0.22
Pre	927.42	1	927.42	121.86	0.0001	0.87
Group	2207.40	1	2207.40	290.05	0.0001	0.94
Error	129.37	17	7.61			
Total	43924	20				
Corrected total	2336.80	19				

Table 5. Modified Means of Sexual Desire Variable in the Second Subject

Variable	Group	Mean	Std. Error
Sexual desire	CBT	59.43	1.020
	Control	31.76	1.020

Discussion

The aim of the present research was to compare the effectiveness of transcranial direct current stimulation treatments and CBT for sexual desire disorders in women. Two issues have been raised in this study. The first topic states that tDCS-based treatment is effective on women's sexual desire disorder. According to the findings based on one-way analysis of covariance, this hypothesis is significant at the P=0.001 level. In other words, the mean difference between tDCS and control groups is significant. Therefore, tDCS therapeutic intervention has increased the average level in this group.

The second topic of the research states that CBT-based treatment is effective on women's sexual desire disorder. The findings of the research show that this difference is also significant at the level of P=0.001. In other words, the subjects of the CBT group compared to the control group faced an increase in average after the intervention of the CBT therapeutic method, and this increase means improvement in the hyposexuality.

A study conducted by Pezzoli et al., investigated the effects of tDCS on attentional bias in pedophilic disorder. Previous research has shown that men who are sexually attracted to children have an automatic attentional bias toward children. For this reason, it is assumed that increased prefrontal activity can reduce possible pedophilic attention bias. In this study, tDCS electrodes were placed on the DLPFC region. The results of this research did not confirm the significance of the difference between the means of the two groups [21]. In another study, which is considered as a case report, the effectiveness of tDCS in severe chemsex addiction was investigated. This study reveals that Chemsex is a growing health problem. This is seen among men who are homosexual. It is believed that this behavior has severe physical and psychological consequences. This research is the first report of an intervention, which was conducted in a patient addicted to chemsex. Disappearance of chemsex behavior occurred after five daily sessions of right prefrontal cortex stimulation. After eight months of follow-up, the symptoms did not return [22].

In another research, the effect of tDCS on provoked vestibulodynia was studied. Provoked vestibulodynia is the most common problem of Vulvodynia. Despite its high prevalence and its harmful sexual, marital and psychological consequences, therapeutic interventions for it are limited. The follow-up results have shown that tDCS is effective on Provoked Vestibulodynia Disorder (PVD). These positive effects were stable three months later. These cases show the effect of the tDCS method on sexual disorders [23].

In another study conducted by Hajivosoogh et al., the effect of CBT on the improvement of hyposexuality has been discussed. In this semi-experimental study with a sample of 30 women, the statistical analysis of the independent T-test showed that CBT training was effective in improving women's sexual desire [24]. Another study also confirmed that CBT training is significantly effective on sexual relationships and sexual self-efficacy. These findings are in line with the findings of the present study [25].

Conclusion

The present study showed that the tDCS treatment method is effective on hypoactive sexual desire disorder. The findings after ten 20-minute sessions indicated that the average scores of the pre-test had significantly increased. Also, after ten sessions, CBT training showed its positive effects in increasing the sexual desire of women with hypoactive sexual desire disorder. In other words, CBT and tDCS can play an effective role in improving sexual desire disorder.

The main limitation in this study was access to the desired samples. This is due to the fact that discussing sexual issues in our society is still one of the challenging issues and people are not willing to talk about their sexual problems and make them public. Maybe families have been suffering from these problems for a long time, but they don't seek treatment. This thought made it difficult for the researcher to access the research sample. It is hoped that in the coming future, with the development of sex therapy centers, this problem will be considered similar to other human problems, and families will calmly seek such treatments if needed.

Conflict of Interests

The authors declare that they have no conflicts of interest regarding this article.

Ethical Approval

This research has been approved by the code of ethics IR.IAU.TABRIZ.REC.1400.157 from Tabriz Azad University of Medical Sciences.

Acknowledgment

The authors would like to express their gratitude to the participants who participated in this research.

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