Research Paper: Comparing the Effect of Transcranial Direct Current Stimulation With Cognitive-Behavioral Intervention on Craving and Resilience of Volunteers for Quitting Addiction

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ABSTRACT

Background: Many studies have emphasized the craving experience as a reason for the persistence of addiction. This study aimed to compare the effect of Transcranial Direct Current Stimulation (TDCS) with Cognitive-behavioral Therapy (CBT) on reducing craving and increasing the resilience of addicts under treatment.

Methods: The study population comprised all addicts referring to addiction clinics in. To implement the research, 45 participants were selected purposely from these clinics based on the inclusion and exclusion criteria and randomly assigned to three groups (15 participants in each group). The experimental group number 1 received electrical stimulation of the brain over the skull twice a week for the 10 sequential sessions. Experimental group number 2 received 10 sessions of CBT. Research tools were drug craving and resilience questionnaires.

Results: The results of covariance multi-factor analysis of variance showed that TDCS and CBT have decreased craving and increased resilience.

Conclusion: Both interventions can be utilized to enhance resilience and decrease craving in volunteers for quitting addiction referring to addiction clinics.

Introduction

Unfortunately, addiction and drug use as a social dilemma is on the rise, particularly among younger generations [1]. The main feature of drug use disorders is a set of cognitive, behavioral, and physiological symptoms that urge the person to continue drug abuse, despite its problems [2]. Also, the change in brain circuits is the main consequence of drug abuse, which may remain after detoxification, especially in people with severe disorders. The behavioral effects of these brain changes may

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express in frequent lapses and intense urge to drug use when addicts are exposed to drug-related stimuli. Long-term therapies may improve these effects [3].

In the most recent conceptualizations of drug abuse, craving is seen as a key element causing a persistent and increased use of drugs and dependence on it [4, 5]. In the process of treatment and after achieving abstinence, a strong desire is seen to re-experience the effects of the drug [6, 7]. Many studies have emphasized the craving experience as the main reason for the persistence of addiction [8]. Craving can be defined as a conscious experience and intense and persistent desire to consume drugs [9, 10]. However, some researchers consider the unconscious motivational dimensions of obtaining and consumption behaviors as dimensions of craving [11]. Others define craving as an "urge to substance use" [12]. Craving plays an important role in the post-treatment relapse phenomenon and drug consumption and dependence. This desire may be seen a few hours after the beginning of the treatment or even days and months after its end. The frequency and intensity of craving slowly diminish but rarely disappear [13]. Diagnosis and treatment of clinical manifestations of craving are commonly considered as one of the main factors of treatment outcomes.

Recent studies suggest that resilience is one of the factors that has a protective effect on craving [14]. Resilience is defined as the ability or the consequence of successful adaptation to threatening conditions. Resilience is not merely a passive resistance to harms or threatening conditions but also involves active participation and proactivity regarding the environment. This attitude is one of the factors preventing the occurrence of psychological problems among people and protects them against the psychological effects of life challenges like addiction [15]. Resilience is one of the important components of psychological capital concerning addiction. Because of the protective effect of resilience in the treatment of addiction and the negative consequences of craving, it seems necessary to implement interventions to increase resilience and reduce craving [16].

One of the recommended treatments proposed to accelerate drug addiction and craving rehabilitation is the Transcranial Direct Current Stimulation (TDCS) [17]. In this method, a strong electrical current generates magnetic fields after passing through an electrode implanted in the brain. This stimulation produces a milder electrical current in the cortex and thus stimulates an action potential in the excited nerve tissue. Although its mechanism of action is not well understood, the evidence suggests that the probable changes resulting from prefrontal magnetic stimulation may be due to effects on neurotransmitters and nerve cell restorations (regenerations) [18]. The effect of frequent prefrontal cortex magnetic stimulation on dopaminergic neurotransmitters and cortical irritability has been described as a tool for the study and treatment of addiction [19].

In this regard, studies have shown that intervention with this device has been effective in reducing the craving for various drugs, including crack [20], cocaine [21], industrial alcohol [22, 23], cigarettes and tobacco [24], binge eating [25], and methamphetamine [26]. Some studies also suggest that neurofeedback and especially direct prefrontal cortex brain electrical stimulation can reduce craving in substance abusers [27, 28].

On the other hand, people who consume drugs are more likely to experience psychological problems. Attention to psychological aspects during treatment is crucial in preventing the relapse, the attrition of patients from treatment, the enhancement of post-quitting tolerance, and the improvement of psychological symptoms of addicts. Cognitive-behavioral Therapy (CBT) recognizes the effects of beliefs, maladaptive, or inefficient attitudes. Studies have reported the effect of CBT on reducing the craving in drug-dependent men and increasing their resilience [29]. At present, decreasing drug desire is the first important factor in preventing relapse. The influence of psychological symptoms in substance desire is a great challenge in Methadone Maintenance Treatment (MMT) and other treatments. The brain stimulation technologies are useful in the treatment of addiction because they use a small and portable device, without complex computer settings, or need to prepare and train the patients long hours before initiating the stimulation. However, no study has ever been conducted to compare the effect of the brain electrical stimulation device (TDCS) and CBT on the craving and resilience in drug addicts. Therefore, this research was designed to answer the question of whether the application of the TDCS is effective in reducing craving and increasing the level of resilience of addicts and its similarity or difference with CBT.

Methods

This research is a quasi-experimental study with two experimental and one control groups(s). The study population consists of all addicts who had previous heroin consumption under treatment with methadone between 6 months and one year. They were volunteered for addiction quitting in the addiction treatment clinic in Najaf Abad City (Isfahan Province, Iran) in the first half of the year 2016. Since in a quasi-experimental design

for comparing three groups, a minimum sample of 45 is required, we selected 45 addicts willing to participate in the study based on the inclusion and exclusion criteria. Then, they were randomly assigned to two experimental and one control group(s) (15 in each group). By coordinating with addiction treatment clinics in Najafabad City, the volunteer addicts referring to therapeutic centers were invited to participate in the study by attending Shahin Mehr Center. The inclusion criteria were as follows: methadone intake, lack of psychiatric and personality disorders, lack of simultaneous psychological or drug therapies, and within the age range of 25-55 years. The exclusion criteria were lack of cooperation and failure to perform assignments provided at sessions, having acute or chronic mental disorders with the diagnosis of the psychologist of the center, taking psychiatric drugs, and having physical illnesses.

After sampling from the target population and assigning the sample into two experimental and one control group(s) and receiving the informed consent of the participants, TDCS over the skull was administered on the experimental group 1, twice a week for the 10 sessions (anode electrode on the dorsal lateral region of the left prefrontal cortex and cathode electrode on the dorsal lateral region of the right prefrontal cortex with 2 mA of direct electrical current for 20 minutes) with iontophoresis Activadose device (made by Tek Activa). The current source of this device is a 7-V battery, a maximum current of 4 mA and a maximum DC voltage of 82 V. The experimental group 2 received CBT for 10 sessions (creating motivation to change the process of drugs intake and identifying triggers, coping with negative thinking and cognitive restructuring by teaching A-B-C approach, functional analysis of seemingly unrelated decisions, anger management, tension management strategies to reduce arousal, increasing enjoyable activities, problem-solving, supportive networks development). Methadone syrup intake was between 15 and 20 mL at the start of the intervention that was decreased to below 5 mL during the intervention sessions. Afterward, the patients were entered into the detoxification process with buprenorphine.

The ethical considerations observed during the implementation of the research were as follows: the participants' informed consent to participate in the research, the confidentiality of the participants' information, no discrimination in the study and conducting treatment sessions for the control group free of charge after completing the study sessions for the experimental groups.

The following tools were utilized in this study to carry out the measurement steps:

Drug craving questionnaire

A 20-item drug craving questionnaire was used to measure thoughts and fantasies related to the substance and the temptation of consumption. The questionnaire was scored on a 6-point Likert-type scale (completely true=5 to not at all true=0). The reliability of the questionnaire has been reported 0.94 based on the Cronbach alpha. Anis and Graham's situational confidence questionnaire, (P=0.001, r=0.53), positive and negative emotions and psychological craving were used to assess the validity of the questionnaire. As a result, the magnitude and direction of the correlations supported the questionnaire's validity. In the present study, the internal consistency based on the Cronbach alpha was found 0.90 for the total scale for methamphetamine users.

Conner-Davidson Resilience Questionnaire

This questionnaire can distinguish resilient from non-resilient people in clinical and non-clinical groups and is used in clinical and research settings. The questionnaire consists of 25 statements that are scored on a Likert scale (0-4); the maximum score for the entire scale is 100. Scores are found by adding the item score for all items and the resilience score of each respondent is equal to the raw score (the score obtained) divided by 100, multiplied by 100.

The reliability coefficient by calculating the Cronbach alpha method was found 89%, and the validity based on factor analysis was 87%, who Mohammadi has adapted it for use in Iran. In this study, the Cronbach alpha for the whole scale was 0.89.

The Pre-test was performed at the beginning of the intervention and the post-test was performed after the completion of treatment sessions. The summary of the treatment sessions is presented in Table 1. To analyze the data, multivariate covariance analysis was performed in SPSS v. 24.

Results

The Mean±SD age of the experimental CBT group participants was 36.40±4.28 years. The Mean±SD age of the experimental TDCS group was 33.40±3.6 years and the Mean±SD age of the control group was 33.66±3.75 years. About 60% of the CBT group and 46.7% of the TDCS group had a diploma, 26.7% of the CBT group

Table 1. Summary of cognitive-behavioral temptations intervention sessions

Sessions	Contents
First	Individual motivational feedback, providing a table for deciding whether or not to continue drug use, the disadvantages of continuous use of substances and the no-change condition, the benefits of exerting changes in substance use, the benefits of the continuous use of substances and no-change condition, the disadvantages of exerting changes in substance consumption, determining high-risk situations, practical design for high-risk situations.
Second	Determining the factors leading to substance abuse, planning methods to deal with the cravings and desire for substance use, thought stopping, balancing decision-making exercise, and delaying.
Third	Coping with negative thinking, the relationship between thinking and affection, the determination of negative thinking patterns, fighting against negative thoughts and cognitive restructuring, seemingly unrelated decisions, informing persons to high-risk situations, thought functional analysis during risk thinking.
Fourth	Planning and prediction of emergencies, the occurrence of unexpected triggers or high-risk situations, "if ... so ..." action plans, the hierarchy of coping strategies
Fifth	Teaching refusal skills to deal with direct proposals for drug use; the principle of "no thanks," designing of personal refusal sheets, role-playing to practice assertive responses.
Sixth	Criticizing and being criticized, assertive response to criticism, offering critical recommendations with assertiveness, tension management skills, role-playing.
Seventh	Anger and drug use management, determination of anger symptoms, tension management skills, cognitive restructuring with regard to anger triggering thoughts, problem-solving in anger-related narrations, role-playing.
Eighth	The pleasurable and enjoyable activities and consumption of substances, investigation of quitting pleasurable activities as a result of the substance abuse, the identification of pleasurable activities as a proper and healthy solution, planning for enjoyable activities, committing the pre-planned pleasurable events.
Ninth	Labeling and drug-related problems, problem-solving skills, problem definition, possible solutions, choosing a solution, applying that solution, evaluating the selected solution, providing practical examples at the session.
Tenth	Creating friendships that do not revolve around substance use, cutting relationships with friends and relatives who are harmful, cutting the relationship with drug dealers and consumers, and finding a group of supporters and self-help groups to free oneself from addiction.

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and 33.3% of the TDCS group had an associate degree, and 13.3% of the CBT group and 20% of the TDCS group had bachelor's degree.

Also, %13.3 of the CBT group and 13.3% of the TDCS group were single and 86.7% of the CBT group were married and 86.7% of the TDCS group were married. In terms of financial conditions, most of the participants belonged to middle-income groups and all of them had non-governmental occupations. About 30% of the participants had no history of relapse, 20% one relapse, 36.66% two relapses, and 3.13% three relapses. Table 2 presents the Mean±SD scores of the Pre-test-post-test of the craving and resilience scales for the two groups of experimental and one control.

According to Table 2, there is no significant difference between the experimental and control groups in the Pre-test; however, the craving scores decreased and the resilience scores increased in the post-test. To test the normal distribution of the Pre-test and post-test, the Kolmogorov-Smirnov test was used. The results of this test indicated that P-values in the Kolmogorov and Smirnov tests are greater than 0.05. Therefore, the distribution of data is normal. Also, according to Levene's test, the homogeneity between the covariate and dependent groups was confirmed and all of these paired groups have homogeneity with each other.

Multivariate analysis of covariance was used to evaluate the effect of the TDCS and compare it with CBT in reducing craving and increasing the resilience of addicts under the treatment. Table 3 presents the values of the Wilks' Lambda test. Values range from 0 to 1, with values close to 0 showing a significant difference between the mean score of the groups.

Table 2. Investigation and comparison of the mean and standard deviation of the Pre-test-post-test scores of research variables for the two groups of experimental and control

Variables	Source	Mean±SD					
		Cognitive-behavioral Therapy		Transcranial Direct Current Stimulation Device (TDCS)		Control Group	
Craving	Pre-test Post-test	66.40±46.13	4.23±6.02	68.06±24.20	2.81±3.48	68.40±66.73	5.30±3.97
Resilience	Pre-test Post-test	26.26±46.13	8.44±6.50	29.80±36.022	7.63±3.48	29.93±27.46	4.31±8.45

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Table 3. Wilks' Lambda test to examine the difference between score means of resilience and craving

Source	Value	F	df	Sig. diff	Eta	Statistical Power
Between-group	0.02	706.73	2	0.01	0.98	1.00
Within-group	0.03	274.25	4	0.01	0.97	1.00
Interaction effect	0.03	268.25	4	0.01	0.97	1.00

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Table 4. Between subjects and within subjects' analysis of covariance with two levels of measurement (Pre-test-post-test) for craving and resilience

Scale	Variables	Source	Sum of Squares	df	Squares Mean	F	Sig. Level	Etta	Stat. Power
Resilience	Within-group	Factor	10435.28	1.12	9240.85	203.69	0.01	0.87	1.00
		Interaction effect	11621.60	1.12	10291.38	226.85	0.01	0.89	1.00
		Error.	1434.44	31.61	45.36				
	Between-group	Group	8073.60	1	8073.60	269.76	0.01	0.90	1.00
		Error.	838.00	28	838.00				
Craving	Within-group	Factor	10143.75	1.32	7684.08	750.41	0.01	0.97	1.00
		Interaction effect	9749.75	1.32	6931.11	676.88	0.01	0.96	1.00
		Error.	378.48	36.96	10.24				
	Between-group	Group	7437.06	1	7437.06	1161.61	0.01	0.96	1.00
		Error.	179.26	28	6.40				

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As presented in Table 3, the values of 0.02, 0.03, and 0.03 for between-group, within-group and interactive effects of TDCS device, respectively and their comparison with CBT on decreasing craving and increasing resilience of addicts showed that this interventional effect is at least effective on one of the scales of craving and resilience.

In the following, Table 4 presents the results of the between-group and within-group analysis of covariance for the effect of the TDCS on reducing the craving and increasing resilience. According to Table 4 and the significance of the factors within the groups, there is a significant difference between the measurement stages for the craving and resilience scales at the P<0.01 level. Also, based on the significance of the group source among the

Table 5. Bonferroni test results for pairwise comparison between the experimental and control groups in the variables of craving and resilience

Variables	Test	Criterion Group	Comparison Group	Means Diff.	Standard Error	Sig.
Craving	Post-test	Brain electrical stimulation	Control group	-42.470	1.685	0.001
		Brain electrical stimulation	Temptation cognitive behavioral intervention	-22.248	1.707	0.001
		Temptation cognitive-behavioral intervention	Control group	-20.223.	1.717	0.001
Resilience	Post-test	Brain Electrical Stimulation	Control group	21.473	10.474	0.001
		Brain Electrical Stimulation	Temptation cognitive behavioral intervention	42.382	5.846	0.001
		Temptation cognitive-behavioral intervention	Control group	51.392	5.563	0.001

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groups, there is a significant difference between the experimental groups and the control group regarding the craving and resilience scales at the P<0.01 level. Table 5 presents the results of the Bonferroni test for pairwise comparison of experimental and control groups in the variables of craving and resilience.

According to Table 5, there is a difference in the efficacy of the TDCS and CBT of temptation on the craving of methadone consumers referring to addiction treatment clinics (P<0.001). In other words, TDCS has been more successful in reducing craving than CBT. However, CBT was more successful than TDCS in increasing resilience.

Discussion

This study aimed to compare the effect of the TDCS with CBT on the craving and resilience of volunteers for quitting addiction who referred to addiction clinics in Najafabad City in 2016. Based on the results, TDCS and CBT have influenced craving in volunteers for quitting addiction (methadone consumers). Besides, there is a difference between the effects of the TDCS and CBT on reducing the craving in methadone consumers. That is the TDCS was more successful in reducing craving than the CBT.

Since the difference between the effect of the TDCS and CBT on the craving of drug addicts has not been investigated before; it is impossible to compare the findings of this study with other studies. But regarding the effect of the TDCS and CBT on the craving of drug addicts, our result is consistent with the results of several studies [20-29]. Therefore, based on this evidence, it is assumed that an increase in the activity of either the right prefrontal or left prefrontal region can decrease craving. The prefrontal region, dorsal/lateral is one of the key areas of the prefrontal cortex responsible for distinguishing and assessing the behaviors and evaluating the consequences of current behaviors and social control.

The effect of the stimulation on the reduction of the craving for narcotics and oral drugs can be explained through exciting dopaminergic pathways that increase social control. In other words, it increases the ability of methadone consumers in suppressing their urges. Also, our results showed that the TDCS was effective on the resilience of volunteers for quitting addiction (methadone consumers). Since the effect of the TDCS on the resilience of drug addicts has not been investigated before, it is impossible to compare the findings of this study with other studies.

The present study indicates the greater effect of CBT on resilience. It should be stated that the mechanism of the CBT on resilience is through the identification of the disadvantages of inefficient thoughts and introducing high-risk situations during the first and second sessions. Also, the training of coping with the desires in the third and fourth sessions leads to stop thinking and have balance in decision making in the times of craving. With anger and tension management strategies, problem-solving skills and enhancement of enjoyable activities, decreasing rumination and mitigating anger's triggering thoughts, and applying a problem-solving approach to cope with stressful situations in the CBT, the anxiety of drug addicts who consume methadone decreases and this leads to increased resilience. To increase resilience, a comprehensive psychological intervention should pro-

vide opportunities for training and practice which can be similar to the CBT.

The effect of the TDCS on resilience seems to be due to decreased craving and consumption motivation. In other words, a person who has less motivation and craving for drugs will be more tolerant of non-consumption and thus is more resistant to stressful situations, which explains the more successful outcomes of the CBT.

Based on the theoretical explanation of the findings, it is noteworthy that stimulation of the posterior-lateral cortex by using direct electrical current is associated with a positive emotional change in the mood, and the anode stimulation of the left lateral prefrontal cortex brings about the promotion of tasks across several cognitive-behavioral tasks and the exploitation of higher levels of cognitive functioning.

Also, the stimulation of this area by exciting dopaminergic pathways reduces craving and increases the ability of methadone consumers to suppress their urges, which leads to increased resilience. Because in different situations, choosing an intervention is important in terms of time and cost efficiency, if the main goal is to reduce the craving, TDCS is preferable, and if the psychological changes, including resilience, is the target, CBT is recommended.

One of the limitations of this research is the influence of Pre-test training on post-test results. So, caution must be taken in the interpretation of the results. Also, further research on the effect of TDCS on women and with a different population is recommended to provide a basis to compare their results with findings of the current study.

Conclusion

In general, the findings of this study indicate the effect of TDCS and CBT to reduce craving and increase the resilience of methadone addicts. According to the results, TDCS is more effective in reducing craving and CBT is more successful at increasing resiliency levels. As a result, considering the location of methadone addicts and the treatment goals, these two treatments can be used to improve the psychological status of methadone addicts.

Ethical Considerations

Compliance with ethical guidelines

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Authors' contributions

All authors contributed in preparing this article.

Conflict of interests

The authors declared no conflict of interest.

References

[1] Salling M, Martinez D. Brain stimulation in addiction. Neuropsychopharmacology. 2016; 41(12):2798-809. [DOI:10.1038/npp.2016.80] [PMID] [PMCID]

[2] Yang L, Shi B, Li H, Liu Y, Zhang W, Wang Y, et al. Electrical stimulation reduces smokers' craving by modulating the coupling between dorsal lateral prefrontal cortex and para hippocampal gyrus. Soc Cogn Affect Neurosci. 2017; 12(8):1296-302. [DOI:10.1093/scan/nsx055] [PMID] [PMCID]

[3] The American Psychiatric Association. Diagnostic and statistical manual of mental disorders (5th ed). Washington DC: American Psychiatric Association; 2013 [DOI:10.1176/appi.books.9780890425596]

[4] Abrams DB. Transdisciplinary concepts and measures of craving: Commentary and feature directions. Addict. 2000; 95(2):S237-46. [DOI:10.1046/j.1360-0443.95.8s2.12.x]

[5] Potenza MN, Sofuoglu M, Carroll KM, Rounsaville BJ. Neuroscience of behavioral and pharmacological treatments for addictions. Neuron. 2011; 69(4):695-712. [DOI:10.1016/j.neuron.2011.02.009] [PMID] [PMCID]

[6] Chrysikou E, Hamilton RH. Noninvasive brain stimulation in the treatment of aphasia: Exploring interhemispheric relationships and their implications for neuro rehabilitation. J Neurol Neurosurg Psychiatry. 2011; 29(6):375-94. [DOI:10.3233/RNN-2011-0610] [PMID]

[7] Dalmaijer ES, Li KMS, Gorgoraptis N, Leff AP, Cohen DL, Parton AD, et al. Randomized, double-blind, placebo-controlled crossover study of single-dose guanfacine in unilateral neglect following stroke. J Neurol Neurosurg Psychiatry. 2018; 89(6):593-8. [DOI:10.1136/jnnp-2017-317338] [PMID] [PMCID]

[8] Dehghani Y, Rajabi S. Effectiveness of cognitive-behavior therapy on depression and craving beliefs of abusers under

methadone maintenance treatment. Jentashapir J Health Res. 2016; 7(4):e30491. [DOI:10.17795/jjhr-30491]

[9] Moshki M, Panahi-Shahri M, Najarpour F, Mirzania M. Relationship between treatment motivation, substance use, craving, withdrawal symptoms and health locus of control in addicted patients. J Res Health. 2018; 8(3):246-54. [DOI:10.29252/jrh.8.3.246]

[10] Niaura RS, Shadel WG, Abrams DB. Individual differences in cue reactivity among smokers trying to quit: Effects of gender and cue type. Addict Behav. 1998; 23(2):209-24. [DOI:10.1016/S0306-4603(97)00043-9] [PMID]

[11] Hou X, Wang H, Guo C, Gaskin J, Rost D, Wang J. Psychological resilience can help combat the effect of stress on problematic social networking site usage. Pers Individ Dif. 2017; 109:61-6. [DOI:10.1016/j.paid.2016.12.048]

[12] Jalili Nikoo S, Kharamin SH, Ghasemi Jobaneh R, Mohammad Alipoor Z. [Role of family resilience and mindfulness in addiction potential of students (Persian)]. Armaghan-e-Danesh. 2015; 20(4):357-68. http://armaghanj.yums.ac.ir/article-1-933-en.html

[13] Sadeghi M, Rahimipour T, Alimohamadi H. [The effect of resilience and psychological hardiness on mental health of mothers of children with attention deficit hyperactivity disorder (ADHD) (Persian)]. Knowl Res Appl Psychol. 2017; 18(1):30-7. http://jsr-p.khuisf.ac.ir/article_534048_en.html

[14] Foladchang M, Ghanbaritalab M. [Relationship of resilience and mental vitality with addiction potential among students (Persian)]. J Res Addic. 2015; 9(34):9-22. http://etiadpajohi.ir/article-1-270-fa.html

[15] Wagner T, Valero-Cabre A, Pascual-Leone A. Noninvasive human brain stimulation. Annu Rev Biomed. 2007; 9(1):527-65. [DOI:10.1146/annurev.bioeng.9.061206.133100] [PMID]

[16] Ziemann V. TMS included plasticity in human cortex. Rev Neurosci. 2004; 15(4):253-26. [DOI:10.1515/REVNEURO.2004.15.4.253] [PMID]

[17] Amiaz R, Levy D, Vainiger D, Grunhaus L, Zangen A. Repeate high-frequency transcranial magnetic stimulation over the dorsolateral pre-frontal cortex reduces cigarette craving and consumption. Addiction. 2009; 104(4):653-60. [DOI:10.1111/j.1360-0443.2008.02448.x] [PMID]

[18] Narimani M, Pooresmali A, Alizadeh Goradel J, Mowlaie M. [The effect of trancecranial direct current stimulation (tDCS) on reduction of craving, depression and anxiety in students with tramadol abuse: Preliminary study (Persian)]. J Res Addict. 2017; 10(40):87-102. http://etiadpajohi.ir/article-1-1115-fa.html

[19] Sharifi Fardshad M, Shams Esfandabad H, Hasani Abharian P. [Assessment of the effect of transcranial direct current stimulation (tDCS) of dorsolateral prefrontal cortex on modulation of heroin crack craving (Persian)]. J Shahrekord Univ Med Sci. 2016; 18(2):109-21. http://journal.skums.ac.ir/article-1-2412-fa.html

[20] Chib VS, Yun K, Takahashi H, Shimojo S. Noninvasive remote activation of the ventral midbrain by transcranial direct current stimulation of prefrontal cortex. Transl Psychiatry. 2013; 3(6):e268. [DOI:10.1038/tp.2013.44] [PMID] [PMCID]

[21] Garavan H, Pankiewicz J, Bloom A, Cho JK, Sperry L, Ross TJ, et al. Cue-induced cocaine craving: Neuroanatomical specificity for drug users and drug stimuli. Am J Psychiatry. 2000; 157(11):1789-98. [DOI:10.1176/appi.ajp.157.11.1789] [PMID]

[22] Boggio PS, Sultani N, Fecteau S, Merabet L, Mecca T, Pascual-Leone A, et al. Prefrontal cortex modulation using transcranial DC stimulation reduces alcohol craving: A double-blind, sham-controlled study. Drug Alcohol Depend. 2008; 92(1-3):55-60. [DOI:10.1016/j.drugalcdep.2007.06.011] [PMID]

[23] Da Silva MC, Conti CL, Klauss J, Alves LG, do Nascimento Cavalcante HM, Fregni F, et al. Behavioral effects of transcranial direct current stimulation (TDCS) induced dorsolateral prefrontal cortex plasticity in alcohol dependence. J Physiology-Paris. 2013; 107(6):493-502. [DOI:10.1016/j.jphysparis.2013.07.003] [PMID]

[24] Fecteau S, Agosta S, Hone-Blanchet A, Fregni F, Boggio P, Ciraulo D, et al. Modulation of smoking and decision-making behaviors with transcranial direct current stimulation in tobacco smokers: A preliminary study. Drug Alcohol Depend. 2014; 140:78-84. [DOI:10.1016/j.drugalcdep.2014.03.036] [PMID] [PMCID]

[25] Goldman RL, Borckardt JJ, Frohman HA, O'Neil PM, Madan A, Campbell LK, et al. Prefrontal cortex transcranial direct current stimulation (tDCS) temporarily reduces food cravings and increases the self-reported ability to resist food in adults with frequent food craving. Appetite. 2011; 56(3):741-6. [DOI:10.1016/j.appet.2011.02.013] [PMID]

[26] Boggio PS, Zaghi S, Villani AB, Fecteau S, Pascual-Leone A, Fregni F. Modulation of risk-taking in marijuana users by transcranial direct current stimulation (TDCS) of the dorsolateral prefrontal cortex (DLPFC). Drug Alcohol Depend. 2010; 112(3):220-5. [DOI:10.1016/j.drugalcdep.2010.06.019] [PMID]

[27] Shahbabaie A, Golesorkhi M, Zamanian B, Ebrahimpoor M, Keshvari F, Nejati V, et al. State dependent effect of transcranial direct current stimulation (TDCS) on methamphetamine craving. Int J Neuropsychopharmacol. 2014; 17(10):1591-8. [DOI:10.1017/S1461145714000686] [PMID]

[28] Fadardi J.S. [Persian Substance Use Questionnaire (PSUQ) (Persian)]. [PhD dissertation]. Mashhad: Ferdowsi University of Mashhad; 2005.

[29] Charmchi N, Asgari P, Hafezi F, Makvandi B, Bakhtiarpour S. [The effect of "cognitive behavior therapy" in method group on anxiety and psychological resilience of menopausal women (Persian)]. J Health Promot Manag. 2016; 5(5):15-22. [DOI:10.21859/jhpm-06013]