



Mini-Review

# Transcranial Direct Current Stimulation: An Alternative Approach to Quit Smoking

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## Article History

Received: March 03, 2018

Revised: April 17, 2019

Accepted: May 20, 2019

Published: June 11, 2019

## Authors' Contributions

GM wrote the manuscript with input from all the authors. RS, SA and MAM analysed the data. MH and SB revised the manuscript.

## Keywords

Nicotine, Addiction, Transcranial direct current stimulation, Pakistan

**Abstract** | Nicotine smoking is one of the leading causes of preventable diseases and premature death worldwide. Nicotine is a highly addictive substance, which exerts influence over different reward pathways of the brain. In Pakistan, nicotine use is very high and its consumption is expected to increase further in future. This article focuses on the increase of nicotine consumption in Pakistan and how people can get rid of smoking habit using the latest method such as transcranial direct current stimulation.

**To cite this article:** Murtaza, G., Sultana, R., Malik, M.A., Afzal, S., Hussain, M. and Bashir, S. 2019. Transcranial direct current stimulation: An alternative approach to quit smoking. *Punjab Univ. J. Zool.*, **34(1)**: 51-53. <http://dx.doi.org/10.17582/journal.pujz/2019.34.1.51.53>

## Introduction

Addiction is a chronic disease of brain reward, motivation, memory, and related circuitry characterized by drug seeking and use that is compulsive or difficult to control despite deleterious consequences. Nicotine is one of those highly addictive substances, which make their consumers difficult to quit. It is as addictive as heroin, co

caine, or alcohol. It is responsible for reinforcing behavior of tobacco smoking (Foulds *et al.*, 2004). All age groups and both genders alike consume it. Addicted people who try to restrain themselves from consuming nicotine may face anger, frustration, irritability, anxiety, depression, dizziness, weight gain, and headache. These conditions make nicotine use more difficult to get rid of (Hughes, 2007).

Tobacco consumption deleteriously affects lives of individuals as well as families. It causes around six million deaths each year. First-hand smoke causes more than five million deaths and second-hand smoke results in more

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than 600,000 deaths worldwide every year ([World health organization, 2013](#)). Physical ailments such as pulmonary and cardiovascular diseases, cirrhosis, birth disorders, stroke, cancer, and chronic kidney diseases are associated with the use of nicotine ([Jain and Jaimes, 2013](#)). High-income countries have made considerable efforts to reduce nicotine consumption with positive results ([Pierce \*et al.\*, 2010](#)). In low- and middle-income countries including Pakistan, nicotine consumption is still high. Moreover, it has been observed that people with low income and little or no education consume more cigarettes comparatively ([Hosseinpoor \*et al.\*, 2011](#)). If tobacco consumption is not intervened, it is estimated that by 2030 more than 80% of tobacco-related deaths will occur in these countries. Moreover, number of deaths due to tobacco use will be seven million every year ([Abdullah and Husten, 2004](#)).

Pakistan is a lower-middle-income country with high consumption of tobacco ([Berg \*et al.\*, 2015](#)). Pakistani population spends about 200 billion rupees annually on cigarettes. Smoking-related lung and mouth cancers are the major causes of cancer deaths in this country. All forms of tobacco products such as cigarettes, electronic cigarettes, hookah, pipes, cigars, Shisha, paan, gutka, and naswar exist in Pakistan ([Idrees \*et al.\*, 2018](#)). Government of Pakistan has taken many steps to prevent the use and spread of smoking. In 2005, Pakistan became the part of the World Health Organization (WHO) Framework Convention on Tobacco Control. Smoking is prohibited in all public places and transport. Advertisement of smoking on radio, TV, and newspapers is prohibited. Text and pictorial warnings are displayed on cigarette packs in both national and English languages. In addition to this, there are many notifications according to which cigarette sale to minors is restricted. However, the initiatives taken by the government of Pakistan are not sufficient enough to intervene tobacco consumption. The cigarette price in Pakistan is the lowest than the rest of the world. The pictorial warning covers only 20% of cigarette packs, which should be 50% according to WHO recommendations ([World health organization, 2013](#)). In some cities, there is no pictorial warning on packs of few cigarette brands. Although commercials about cigarette smoking are reduced on TV, smoking scenes are being shown in movies and drama serials. Smoking can be observed in all public places. Moreover, doctors can also be observed while smoking in hospital areas ([Khan, 2012](#)).

In the present scenario, one can expect increase in nicotine consumption and spread of tobacco-related diseases in this country in future. The majority of smokers become addicted to nicotine and found it difficult to abstain from their addictive behavior. A recent study conducted with 12969 subjects exhibited that 54% of the participants wanted to quit smoking but could not succeed due to peer pressure, anxiety, stress, tobacco dependence, mood change, and weight gain ([Irfan \*et al.\*, 2016](#)). Comprehen-

sive tobacco control efforts are needed to counter nicotine consumption in Pakistan.

There are certain strategies which can be used to reduce cigarette smoking. People who want to quit smoking can make a chart to meet their target of reducing consumption of cigarettes gradually. A proper time period of few days should be given to adjust to the new change. Tobacco related products such as cigarettes, lighters, ashtrays, and matches should be removed from surroundings. Anything that smells like smoke should be avoided. People should look at other smokers in a strange way and think of how silly it looks. People should change their habits. They should have plenty of sleep. Anything that triggers for smoke should be avoided. They should go for exercise daily and have a hectic schedule. Smokers should be diplomatically and repeatedly advised to quit smoking. It has been observed that advice from clinicians is more effective ([Hughes 2003](#); [Layoun \*et al.\*, 2017](#)).

#### *Nicotine withdrawal and transcranial direct current stimulation (tDCS)*

Treatments available for quitting tobacco consumption are limited to address the symptoms of tobacco withdrawals. Smoking cessation causes cognitive impairments and alters brain functions. The brain areas such as dorso-lateral prefrontal cortices (DLPFC), orbitofrontal cortex, and sub-cortical regions regulate working memory and executive function including the behavioral self-control and feelings of craving reward ([Miller and Cohen, 2001](#)). tDCS is a non-invasive brain stimulation technique, which targets brain regions involved in the addictive behavior ([Nitsche and Paulus, 2000](#)). During this method, a weak direct electrical current is applied through anode and cathode electrodes. In electrode assembly, a metal or conductive rubber electrode, an electrode sponge, electrolyte-based contact medium (saline, gel, or conductive cream), and any materials employed to shape these elements are present. After turning on device, a weak current passes between the electrodes and diffuses in the brain regions; for further details see ([Nitsche \*et al.\*, 2008](#)). Initially, this method was employed for the treatment of patients suffering from depression with positive results ([Fregni \*et al.\*, 2006](#)). Later, efficacy of tDCS was also tested in other neurological disorders and addictive behavior. In nicotine smokers, tDCS application was resulted in the reduction of nicotine cravings and cigarette consumption. ([Fecteau \*et al.\*, 2014](#); [Boggio \*et al.\*, 2009](#)); for further details see ([Lefaucheur, 2016](#)). Although tDCS implementation has presented significant results, the following conditions should be met for safe and effective administration of tDCS: (a) subjects should be without any unstable medical conditions and uncontrolled seizures, (b) electrodes should be of proper size and shape, placed on the scalp, and, should not be in direct contact with the skin, (c) duration of stimulation should be  $\leq 30$  min, (d) tDCS application should be

repeated at least after 24 h to a weak, (e) electrodes should be prepared with saline solution and skin with conductive cream, (f) a weak current of 1-2 mA intensity is recommended for stimulation, and (g) a well-trained person should perform tDCS; for further details see (Woods *et al.*, 2016; Sultana *et al.*, 2017).

Previous investigations support the therapeutic potential of brain stimulation by direct current for smoking cessation treatment. Thus, this is the high time to introduce and implement cheap and effective technology such as tDCS in Pakistan, where nicotine consumption is very high. It will not only help people to get rid of nicotine dependence but also reduce the burden of government on spending huge money to treat nicotine-associated diseases.

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