INPLASY PROTOCOL

To cite: Tedla et al. Effect of High-Definition Transcranial Direct Current Stimulation (HDtDCS) on higher mental functions: A systematic review. Inplasy protocol 202120049. doi: 10.37766/inplasy2021.2.0049

Received: 16 February 2021

Published: 16 February 2021

Corresponding author:
Jaya Shanker Tedla

jtedla@kku.edu.sa

Author Affiliation:
Department of Medical Rehabilitation Sciences, College of Applied Medical Sciences, King Khalid University, Saudi Arabia

Support: **King Khalid University.**

Review Stage at time of this submission: **Preliminary searches.**

Conflicts of interest:
None declared.

Effect of High-Definition Transcranial Direct Current Stimulation (HDtDCS) on higher mental functions: A systematic review

Tedla, JS[1]; Sangadala, DR[2]; Reddy, RS[3]; Gular, K[4]; Kakaraparthi, VN[5].

Review question / Objective: **The purpose of this systematic review is to determine the effect of high definition transracial direct current stimulation on higher mental functions.**
Condition being studied: **Transcranial direct current stimulation is an emerging non-invasive brain stimulation approach that modulates the cortical excitability bypassing the small direct current (2mA) to the scalp. Thereby Transcranial direct current stimulation enhances brain functions in neurological disorders and neuropsychiatric disorders. It also has a promising strategy in improving cognitive functions in healthy populations as well as subjects with neurological disorders. However conventional tDCS has the disadvantage of diffuse stimulation of brain regions based on the placement of electrodes and size of the electrodes. Because of this reason, the focal stimulation of the selected brain region can be weaker and the neuromodulation effects of stimulation can be less long-lasting. Hence, the High definition of Transcranial direct current stimulation (HD-tDCS) is a novel scalp montage using a 4X1 ring electrode configuration that has been evolved. This montage has the advantage of focal stimulation of specific brain regions and has the long-term neuromodulation effects of stimulation.**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 16 February 2021 and was last updated on 16 February 2021 (registration number INPLASY202120049).

INTRODUCTION

Review question / Objective: **The purpose of this systematic review is to determine the effect of high definition transracial direct current stimulation on higher mental functions**

Rationale: **In the literature, there are systematic reviews on the effect of HD-tDCS for rehabilitating neuropsychiatric**

disorders. There is a lack of reviews on the effect of HD-tDCS on higher mental functions. Hence, we are analyzing the evidence by performing a systematic review on the effect of HD-tDCS on higher mental functions.

Condition being studied: Transcranial direct current stimulation is an emerging non-invasive brain stimulation approach that modulates the cortical excitability bypassing the small direct current (2mA) to the scalp. Thereby Transcranial direct current stimulation enhances brain functions in neurological disorders and neuropsychiatric disorders. It also has a promising strategy in improving cognitive functions in healthy populations as well as subjects with neurological disorders. However conventional tDCS has the disadvantage of diffuse stimulation of brain regions based on the placement of electrodes and size of the electrodes. Because of this reason, the focal stimulation of the selected brain region can be weaker and the neuromodulation effects of stimulation can be less long-lasting. Hence, the High definition of Transcranial direct current stimulation (HD-tDCS) is a novel scalp montage using a 4X1 ring electrode configuration that has been evolved. This montage has the advantage of focal stimulation of specific brain regions and has the long-term neuromodulation effects of stimulation.

METHODS

Search strategy: The electronic databases such as Campbell Library, Data Base of Promoting Health Effectiveness (DoPHER), Cochrane Database of Systematic Reviews (CDRS), Pub Med Database of Abstracts of Reviews of Effects (DARE), CINHAHL EMBASE, NHS EED, PROSPERO, PsycINFO, MEDLINE (Ovid) and SCOPUS will be used for conducting the search. The Medical subject headings(MeSH) such as HD-tDCS, higher mental function, cognition, memory, speech, and consciousness will be utilized for search as keywords in the above-mentioned databases to find the relevant articles. Authors will also search in Google scholar for full-text articles. Furthermore, authors will obtain relevant articles by searching the grey literature like manual screening of reference lists from the retrieved full-text articles.

Participant or population: Healthy volunteers including both adults and children. Subjects with higher mental functions impairments due to neurological disorders.

Intervention: Studies which used Anodal HD-tDCS, Cathodal HD-tDCS and Bi hemispheric HD-tDCS as intervention will be included for the review.

Comparator: Studies with the HD-tDCS intervention compared with the sham HD-tDCS stimulation and conventional tDCS and with rTMS (repetitive Transcrainal Magnetic Stimulation) or other therapy modalities.

Study designs to be included: Studies with Randomized controlled trails regardless of blinding, Quasi experimental design, studies with cross over design, studies with pilot trails.

Eligibility criteria: Studies with Randomized controlled trails, studies with quasi experimental trails, studies with cross over design, studies with pilot trails, regardless of blinding published form the year 2000 to 2020 will be included in the review. The studies which are available in English language and full text-articles will be considered for the review.

Information sources: Information sources such as Campbell Library, Data Base of Promoting Health Effectiveness (DoPHER), Cochrane Database of Systematic Reviews (CDRS), Pub Med Database of Abstracts of Reviews of Effects (DARE), CINHAHL EMBASE, NHS EED, PROSPERO, PsycINFO, MEDLINE (Ovid) and SCOPUS will be used for conducting the search. Authors will also obtain necessary information pertaining to the topic from the unpublished grey literature from the university websites. Contacts from authors

and personal communication also will be included.

Main outcome(s): Higher mental functions in terms of consciousness, cognition, perception, memory, speech, etc will be considered as main outcomes.

Additional outcome(s): fMRI(functional magnetic resonance imaging) investigation and EEG Electroencephalogram study. Moreover, the safety and adverse effects of stimulation will be considered if both are available in the studies.

Data management: The reviewer team of four researchers who will be will be blinded to publishers, journals and authors will make judgments by the title, year, and abstract to include the studies. Discrepancies will be discussed by all the members of the review team. Full papers of included abstracts will be again reviewed by all the team members. A valid data extraction form will be developed and will be used by the two reviewers to extract the data independently from the included studies.

Quality assessment / Risk of bias analysis: Methodological quality assessment of all the included studies will be done by using the following scales. • Observational studies will be assessed by Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies • Case-Control studies will be assessed by Quality Assessment of Case-Control Studies • Experimental studies by Quality Assessment Tool for Before-After (Pre-Post) Studies With No Control Group • Randomized Controlled Trials will be assessed by Quality Assessment of Controlled Intervention Studies.

Strategy of data synthesis: A PRISMA flow diagram will be provided for the selection process and included studies. Descriptive (or) qualitative data such as findings and conclusions for the existing studies will be described in a narrative form including tables and charts.

Subgroup analysis: If we get sufficient numbers for each variety of higher mental functions then we will plan for a sub-group analysis.

Sensitivity analysis: Each study included will undergo a meticulous analysis by using standardized scales to assess its methodological quality.

Language: Articles published in English language were only considered for this review.

Country(ies) involved: Saudi Arabia.

Other relevant information: None.

Keywords: HDtDCS, higher mental function, cognition, memory, speech, neurological disorders, healthy volunteers.

Dissemination plans: The results of this systematic review will be published in a peer-reviewed international journal.

Contributions of each author:

Author 1 - Jaya Shanker Tedla - Author one will draft the whole manuscript.
Email: jtedla@kku.edu.sa
Author 2 - Devika Sangadala - Author two is involved in idea conception, data collection, and manuscript preparation.
Email: drani@kku.edu.sa
Author 3 - Ravi Shankar Reddy - Author three is involved in data collection and manuscript preparation.
Email: rshankar@kku.edu.sa
Author 4 - Kumar Gular - Author four will collect the data, read, provided feedback, and approved the final manuscript.
Email: kmeny@kku.edu.sa
Author 5 - Venkata Nagaraj Kakaraparthi - Author five will collect the data, read, provided feedback, and approved the final manuscript.
Email: vnraj@kku.edu.sa