Clinical Trial Protocol
Iranian Registry of Clinical Trials

10 Jun 2026

Comparing the Effects of Transcranial Direct and Pulsed Current Stimulation on Endurance and Cognitive Performance in Physical Education Students

Protocol summary

Study aim

The study aims to compare the effects of tDCS and tPCS on endurance performance, Stroop color-word test results, choice reaction time, perceived exertion, pleasure, arousal level, pain perception, and the countdown task during endurance exercise in physical education students.

Design

This study uses a within-subject (crossover) design with randomization of experimental conditions, conducted double-blind with sham control. The order of exposure to the three conditions will be randomized using a Latin square method via www.random.org. A total of 15 participants will be recruited as the appropriate sample size for this study.

Settings and conduct

Participants will complete Stroop and choice reaction time tests before and after receiving electrical stimulation and performing an exhaustive cycling task. A one-minute countdown task will be administered at RPE 15. Perceptual–physiological variables (pain, pleasure, arousal, RPE, and heart rate) will be assessed every three minutes during exercise.

Participants/Inclusion and exclusion criteria

Inclusion Criteria: Age 18–29 years; male physical education students at Razi University, third semester or higher; body mass index (BMI) 18.5–24.9 kg/m²; right-handed. Exclusion Criteria: Presence of any cardiovascular, pulmonary, or metabolic disease; history of seizures, epilepsy, or other neurological disorders; presence of implanted medical devices or pacemakers; use of tobacco or alcohol; color blindness or other visual impairments.

Intervention groups

Group 1: Received tDCS stimulation in the DLPFC region; Group 2: Received tPCS stimulation in the DLPFC region; Group 3 (or placebo group): Received sham stimulation.

Main outcome variables

Endurance performance, Stroop test, reaction time, countdown task, heart rate, rating of perceived exertion, pleasure, and arousal.

General information

Reason for update

The endurance testing protocol was modified from a 15-kilometer time-trial to a cycling endurance time to exhaustion test.

Acronym

IRCT registration information

IRCT registration number: **IRCT20250812066842N1**
Registration date: **2025-08-16, 1404/05/25**
Registration timing: **prospective**

Last update: **2026-02-08, 1404/11/19**
Update count: **1**

Registration date

2025-08-16, 1404/05/25

Registrant information

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Fereidoon Mouloodpoor
Name of organization / entity
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Iran (Islamic Republic of)
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Recruitment status

Recruitment complete

Funding source

Expected recruitment start date

2025-09-23, 1404/07/01

Expected recruitment end date
2025-11-21, 1404/08/30
Actual recruitment start date
empty
Actual recruitment end date
empty
Trial completion date
empty

Scientific title
Comparing the Effects of Transcranial Direct and Pulsed Current Stimulation on Endurance and Cognitive Performance in Physical Education Students

Public title
Non-invasive brain stimulation and Endurance function
Purpose
Supportive
Inclusion/Exclusion criteria
Inclusion criteria:
Age range: 18–29 years Male physical education students at Razi University, third semester or higher Body mass index (BMI): 18.5–24.9 kg/m² Right-handed
Exclusion criteria:
Presence of any cardiovascular, pulmonary, or metabolic disease History of seizures, epilepsy, or other neurological disorders Presence of implanted medical devices or pacemakers Use of tobacco or alcohol Color blindness or other visual impairments
Age
From **18 years** old to **29 years** old
Gender
Male

Phase
N/A
Groups that have been masked

- Participant
- Investigator

Sample size
Target sample size: **15**
More than 1 sample in each individual
Number of samples in each individual: **3**
In each individual, the following samples/measurements are collected once per condition (tDCS, tPCS, sham), resulting in three sets per participant: Primary outcome 1. Endurance performance: time to exhaustion test on a cycloergometer. 2. Cognitive performance measures: Stroop Color-Word Test results (color, word, and color-word interference scores), reaction time in the choice reaction time test, and countdown task performance (correct responses and accuracy). 3. Physiological and perceptual measures (taken during and/or immediately after exercise): Heart rate, Rating of perceived exertion (RPE), Pleasure rating, Arousal level, Pain perception. Each participant completes all measurements under all three stimulation conditions, with at least 48 hours washout between sessions.
Randomization (investigator's opinion)
Randomized
Randomization description
To randomize the order in which participants are exposed to the three conditions in this study, a Latin square design will be employed. For this purpose, each participant will first be assigned a unique identification number between 1 and 15 using the website www.random.org. Next, the letters B, A, and C will be assigned to the three intervention conditions, and a Latin square will be constructed. In this configuration, a Latin square with three rows and three columns will be created. Finally, participants numbered 1 to 5 will follow the sequence in the first row, participants numbered 6 to 10 will follow the sequence in the second row, and participants numbered 11 to 15 will follow the sequence in the third row.
Blinding (investigator's opinion)
Double blinded
Blinding description
Both the participants and the principal investigator will be blinded to the type of stimulation received in each session. This information will remain accessible only to an individual outside the research team until the completion of the study. To maintain blinding of the stimulation order from the principal investigator, all procedures related to the random assignment of stimulation sequences for each participant will be conducted by this external individual. Additionally, to blind participants to the type of stimulation in each session, the tDCS device will be concealed from view using a cover, and the principal investigator will not be present in the laboratory during electrode placement, throughout the 20-minute stimulation period, or during electrode removal.
Placebo
Used
Assignment
Crossover
Other design features

Secondary Ids

empty

Ethics committees

1

Ethics committee
Name of ethics committee
Ethics committee of Razi University
Street address
Razi University, Bagh Abrisham blvd,
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Kermanshah
Postal code
6714414971
Approval date
2025-07-02, 1404/04/11
Ethics committee reference number
IR.RAZI.REC.1404.019

Health conditions studied

1

Description of health condition studied
This study involves healthy male physical education students aged 18–29 years with no cardiovascular, pulmonary, metabolic, neurological, musculoskeletal, or visual disorders. The research does not study a specific disease but examines neuromodulation effects on endurance and cognitive performance in a healthy, physically active population.

ICD-10 code

ICD-10 code description

Primary outcomes

1

Description
The primary outcome variable is the endurance performance, specifically measured as the time to exhaustion on ergometer cycling test. This is the main variable expected to change as a result of the interventions (tDCS, tPCS, or sham), and it is the outcome used for calculating the sample size.

Timepoint
The primary outcome (endurance performance – time to exhaustion) is measured once in each experimental session, immediately after the application of the intervention (tDCS, tPCS, or sham). There is no multiple follow-up measurements planned — the timepoint is directly after intervention within the same session

Method of measurement
The primary outcome variable, namely endurance performance, will be assessed using a cycling test time to exhaustion on a cycle ergometer (Cyclus). During the initial session, participants' peak power output will be determined by performing an incremental exercise test. In the three main experimental sessions, participants will be required to cycle at 85% of their determined peak power output until exhaustion, and the time to exhaustion will be recorded as the indicator of endurance performance.

Secondary outcomes

empty

Intervention groups

1

Description
Intervention group 1: Participants will receive anodal transcranial direct current stimulation (tDCS) over the left dorsolateral prefrontal cortex (L-DLPFC) with the anode at F3 and the cathode at AF4, at 2 mA intensity for 20 minutes.

Category
Treatment - Devices

2

Description
Intervention group 2: Participants will receive anodal transcranial pulsed current stimulation (tPCS) over the left dorsolateral prefrontal cortex (L-DLPFC) with the same electrode placement, at 1.5 mA intensity for 20 minutes.

Category
Treatment - Devices

3

Description
Control group: Participants will receive sham stimulation with identical electrode placement; however, current will be delivered for only the first 30 seconds and then stopped, mimicking the sensation without providing actual stimulation.

Category
Placebo

Recruitment centers

1

Recruitment center

Name of recruitment center
Exercise Metabolism and Performance Laboratory, Faculty of Sport Sciences, Razi University

Full name of responsible person
Fereidoon Mouloodpoor

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Sponsors / Funding sources

1

Sponsor

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Grant name
Razi University

Grant code / Reference number

Is the source of funding the same sponsor organization/entity?
Yes

Title of funding source
Razi University

Proportion provided by this source
100

Public or private sector
Public

Domestic or foreign origin
Domestic

Category of foreign source of funding
empty

Country of origin

Type of organization providing the funding
Academic

Person responsible for general inquiries

Contact

Name of organization / entity
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Sharing plan

Deidentified Individual Participant Data Set (IPD)
Undecided - It is not yet known if there will be a plan to make this available

Study Protocol
Undecided - It is not yet known if there will be a plan to make this available

Statistical Analysis Plan
Not applicable

Informed Consent Form
Undecided - It is not yet known if there will be a plan to make this available

Clinical Study Report
Undecided - It is not yet known if there will be a plan to make this available

Analytic Code
Not applicable

Data Dictionary
Not applicable