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A Double-Blinded RCT of Transcranial Direct Current Stimulation for the Affective Symptoms of Chronic Low Back Pain

Timothy Y. Mariano[3], Frederick Burgess[2], Marguerite Bowker[2], Jason Kirschner[1,2], Mascha van't Wout-Frank[1,2], Christopher W. Halladay[2], Richard Jones[1,2], Michael Stein[1], Benjamin D. Greenberg[1,2]

[1]Department of Psychiatry and Human Behavior, Warren Alpert Medical School, Brown University
[2]Center for Neurorestoration and Neurotechnology, Providence Veterans Affairs Medical Center
[3]Department of Psychiatry, Brigham and Women's Hospital, Harvard Medical School

Methodological Question Being Addressed
The present study is the first to use a double-blinded randomized placebo-controlled clinical trial (RCT) design to test multiple sessions of a novel low-intensity noninvasive neuromodulation technique for *selective* improvement of the emotional symptoms of chronic low back pain (CLBP). The study employed a combination of newer and traditional validated survey-based measures to quantify pain intensity, acceptance, disability, and distress. We selected a deeper midline cortical target implicated in pain-related emotional symptoms--in contrast to many other studies focusing on sensory symptoms--to determine if modulation of these symptoms dissociates from the sensory symptoms.

Introduction
"Pain" has sensory (nociceptive) and affective (emotional) components. CLBP has affective symptoms that underlie associated disability and psychiatric comorbidity. However, treatments (e.g. cognitive behavioral therapy) directed at these symptoms are limited; consequently, there is over-reliance on opioid analgesics with deleterious side effects. tDCS may noninvasively modulate pain-related affective distress. We present full analysis of a first multi-site, double-blinded, placebo-controlled RCT of transcranial direct current stimulation (tDCS) targeting left dorsal anterior cingulate cortex, a region implicated in pain's affective component, in CLBP patients. We hypothesized that this approach would result in selective reduction in pain-related distress symptoms but leave pain intensity unchanged over the course of tDCS sessions and at six-week follow-up.

Methods
We recruited participants with CLBP duration ≥6 months, pain intensity ≥4 out of 10 on the Defense and Veterans Pain Rating Scale (DVPRS), and at least one trial of physician-recommended medication. Twenty-one participants completed the study. Carbon-rubber electrodes within 5x7 cm saline-saturated sponges were placed over FC1 (10-20 EEG coordinates) and the contralateral mastoid. We adapted this empirically-based montage from our prior work, verifying it with post-hoc electric field modeling. Participants received 10 daily sessions of sham or active tDCS (20 minutes/session, 2mA, cathodal polarity relative to return electrode) and rated pain-related intensity (DVPRS), acceptance (CPAQ-8), interference (WHYMPI General Activity Subscale), disability (RMDQ), and anxiety (PASS-20), as well as general depression (PHQ-9), general anxiety (GAD-7), treatment expectations (CEQ) and treatment satisfaction (CSQ-8). Sham tDCS briefly ramps the electric current up and then down in order to reproduce transient sensations (e.g. skin tingling) associated with active tDCS, enhancing blinding.

Results
Regression analysis following an intention-to-treat approach noted significantly improved WHYMPI General Activity (p=0.002), RMDQ (p=0.001), and PHQ-9 (p=0.003) scores at 6-week follow up with active vs. sham tDCS. CEQ scores were significantly increased at Day 10 (p=0.038) with active vs. sham tDCS. Participants prescribed opioids significantly differed from non-opioid participants only in Day 1 CPAQ-8 (p<0.001), which was lower for the opioid participants.

Conclusions
To the authors knowledge, this is the first double-blinded placebo-controlled RCT of multiple tDCS sessions targeting left dACC in an attempt to modulate the affective component of CLBP. Participants who received active tDCS showed improvements in pain disability and depression. Future studies would benefit from larger double-blinded RCTs to increase power.

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