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Comparing different non-invasive brain stimulation interventions for attention deficit hyperactivity disorder: a meta-analysis of randomized controlled trials

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ADMINISTRATIVE INFORMATION

Support - Currently none.

Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202440034

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 07 April 2024 and was last updated on 07 April 2024.

INTRODUCTION

Review question / Objective PICOS criteria: (1) Patient: participants with a diagnosis of attention deficit hyperactivity disorder; (2) Intervention: any non-invasive brain stimulation; (3) Comparison: sham, active, or waitlist controls; (4) Outcome: changes in overall attention deficit hyperactivity disorder symptoms, attention symptoms, hyperactivity symptoms, dropout rates and serious adverse events; and (5) Study design: randomised controlled trials.

Condition being studied Attention deficit hyperactivity disorder is a neurodevelopmental disorder characterized by symptoms such as inattention, hyperactivity, and impulsivity, which may adversely affect an individual's learning, work, and social functioning. Non-invasive brain stimulation is a therapeutic approach aimed at modulating brain activity to improve specific neurological disorders or symptoms. These methods typically do not require surgery and involve external stimulation to influence brain activity. The development and application of brain stimulation techniques are continuously advancing, including research into their adjunctive treatment of mental health disorders. Current research focuses on evaluating the effectiveness and safety of non-invasive brain stimulation for treating attention deficit hyperactivity disorder. Researchers are exploring different forms of brain stimulation techniques, such as transcranial magnetic stimulation and transcranial direct current stimulation, to understand their efficacy in modulating brain function.

METHODS

Participant or population Participants with a diagnosis of attention deficit hyperactivity disorder.

Intervention Any non-invasive brain stimulation intervention.

Comparator Sham, active, or waitlist controls.

Study designs to be included Randomized controlled trial.

Eligibility criteria The criteria for inclusion were: (1) studies involving human participants; (2) participants diagnosed with attention deficit hyperactivity disorder based on a valid method (i.e. using the Diagnostic and Statistical Manual of Mental Disorders, International Classification of Diseases, or diagnosis by a certified specialist); (3) participants receive non-invasive brain stimulation treatment; (4) studies providing both pre- and post-intervention scores or score changes regarding overall core symptoms using an attention deficit hyperactivity disorder assessment scale; (5) randomized controlled trial that utilised either sham, active or waitlist controls and employed either a crossover or parallel study design. Conversely, studies were excluded based on the following criteria: (1) not randomized controlled trial; (2) case series or reports, conference papers, and non-peer-reviewed articles; (3) those not reporting the outcome of interest; (4) overlapping datasets with another larger study. Inclusion criteria comprised (1) randomized controlled trial (RCT) with placebo-controlled; (2) a diagnosis of major depressive disorder or postpartum depressionbipolar depression using diagnostic criteria, such as Diagnostic and Statistical Manual of Mental Disorders; (3) depression severity quantified with eligible scale, both before and after zuranolone regimen. Exclusion criteria consisted of (1) non-randomized trials, such as literature reviews and case reports/series; (2) letters to editors or editorial comments; (3) RCT without placebo controls.

Information sources PubMed, Embase, and Cochrane CENTRAL, from the inception of each database until 1 March 2024, without language restriction.

Main outcome(s) Two main outcomes were examined in this study, including efficacy and acceptability. Efficacy was expressed as a change (pre- and post-intervention data) in the assessment score of overall core symptoms after non-invasive brain stimulation. Acceptability was expressed as the dropout rate, defined as the percentage of participants who discontinued the study for any reason before study completion.

Additional outcome(s) Attention-deficit or hyperactivity symptoms related to subdomains of the overall symptom category were considered secondary outcomes of efficacy. Serious adverse events during the study period as the secondary outcome of acceptability.

Quality assessment / Risk of bias analysis Cochrane risk of bias tool version 2.

Strategy of data synthesis We conducted network meta-analysis to assess the pre-post changes for continuous variables and incidence rates for categorical variables. We estimated standardised mean differences with 95% confidence intervals for continuous variables and odds ratios and 95% confidence intervals for categorical variables. We applied a 0.5 zero-cell correction for studies with zero events in either treatment arm. Random-effects and frequentist models were generally used for pairwise meta-analyses and network meta-analysis. Heterogeneity among the included studies was evaluated using the tau value, the estimated standard deviation of the effects across the studies.

Subgroup analysis No.

Sensitivity analysis No.

Language restriction No.

Country(ies) involved Taiwan.

Keywords ADHD, efficacy, non-invasive brain stimulation, safety.

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