



Application and Efficacy of tDCS in pediatric patients with Autism Spectrum Disorder: a Systematic Review

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INTRODUCTION & OBJECTIVE

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that affects approximately 1 in 36 children [1]. It is characterized by difficulties in social communication and by restricted and repetitive patterns of behaviour [2]. At the cognitive level, impairments are commonly observed in attention, social cognition, and executive functions, although the cognitive profile is highly heterogeneous [3].

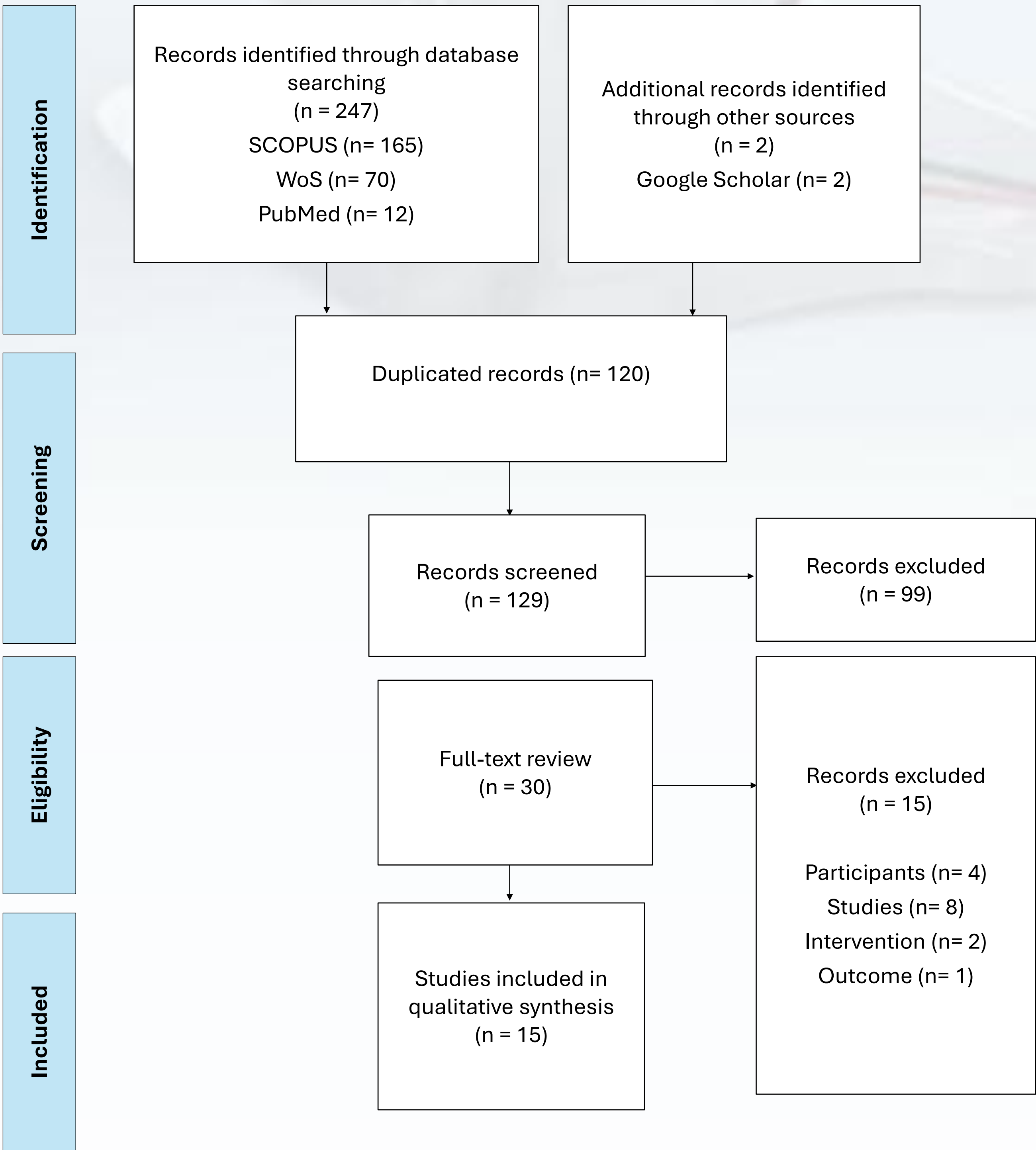
Current ASD interventions are primarily multimodal, but the transfer of acquired skills to everyday contexts remains challenging. Transcranial direct current stimulation (tDCS) is a promising non-invasive neuromodulation technique that may enhance neuroplasticity and improve emotional regulation, social cognition, and executive functions. Although evidence in children is still limited, its safety profile appears favorable.

The aim of this systematic review was to analyze recent scientific evidence regarding the application, efficacy, and safety of tDCS in children and adolescents diagnosed with ASD, to evaluate its potential as a complementary intervention to early therapeutic approaches.

METHOD

A systematic review was conducted in accordance with PRISMA guidelines. Literature searches were carried out in PubMed, Scopus, and Web of Science, complemented by a snowballing strategy through manual screening of reference lists from eligible studies. Studies published in English between 2021 and 2025 were considered for inclusion. Eligible studies were experimental or quasi-experimental investigations assessing the efficacy and/or safety of transcranial direct current stimulation (tDCS) in children and adolescents (aged 1–18 years) diagnosed with ASD. Reviews, theoretical papers, animal studies, studies involving only adults, and those examining neuromodulation techniques other than tDCS were excluded. Following duplicate removal and screening of titles, abstracts, and full texts, 15 studies met the inclusion criteria. Data extraction focused on study design, participant characteristics, stimulation protocols, outcome measures, efficacy outcomes, and reported adverse effects.

RESULTS



The included studies comprised randomized controlled trials, pilot studies, and quasi-experimental designs conducted across various countries, with sample sizes ranging from fewer than 20 to over 50 participants. Most studies applied anodal stimulation over the left dorsolateral prefrontal cortex, typically using 1 mA intensity for approximately 20 minutes across 10 to 20 sessions. Outcome measures primarily assessed core ASD symptoms, social behavior, executive functions, and attention, using standardized clinical scales and, in some cases, neurophysiological measures such as electroencephalography. Overall, findings suggest modest but relatively consistent improvements in social cognition, adaptive behavior, attention, and executive functioning in active stimulation groups compared to sham conditions. Neurophysiological changes associated with improved functional connectivity were also reported in some studies. Across all studies, tDCS demonstrated a favorable safety profile, with only mild and transient adverse effects such as tingling, itching, or mild scalp redness. However, methodological heterogeneity and small sample sizes limit the generalizability of findings.

CONCLUSIONS

Current evidence suggests that tDCS may represent a promising and safe complementary intervention for children and adolescents with ASD, particularly when combined with established therapeutic approaches. Nevertheless, variability in stimulation protocols, outcome measures, and methodological quality highlights the need for larger, well-controlled trials to clarify its clinical efficacy and optimize treatment parameters.

References

[1] Centers for Disease Control and Prevention. (2023). *Autism and Developmental Disabilities Monitoring Network 2023 Report*. U.S. Department of Health and Human Services.

[2] American Psychiatric Association. (2022). *Diagnostic and statistical manual of mental disorders* (5^a ed., texto rev.). American Psychiatric Publishing.

[3] World Health Organization. (2021). *International Classification of Diseases (ICD-11)*.