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Neurocognitive and Humoral Changes induced by EEG-Biofeedback: a Systematic Review of the Applicability and Therapeutic Effect in Patients with Schizophrenia Spectrum Disorders, Psychosis or Clinical High risks for Psychosis

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INTRODUCTION & AIM

Schizophrenia Spectrum Disorders (SSD) are complex psychiatric conditions characterized by positive symptoms, negative symptoms, and significant cognitive impairments. Despite the availability of pharmacological and psychotherapeutic treatments, many patients continue to struggle with persistent symptoms, particularly in the domains of cognition and emotional regulation.

EEG-biofeedback is a non-invasive technique that provides real-time feedback on brain activity, enabling patients to consciously modulate their neural functioning. By fostering neuroplasticity and re-establishing adaptive brain network connectivity, this approach offers a novel, complementary strategy to traditional treatments.

This systematic review evaluates the efficacy of EEG-biofeedback in improving neurocognitive performance, emotional regulation, and biochemical markers in patients with SSD.

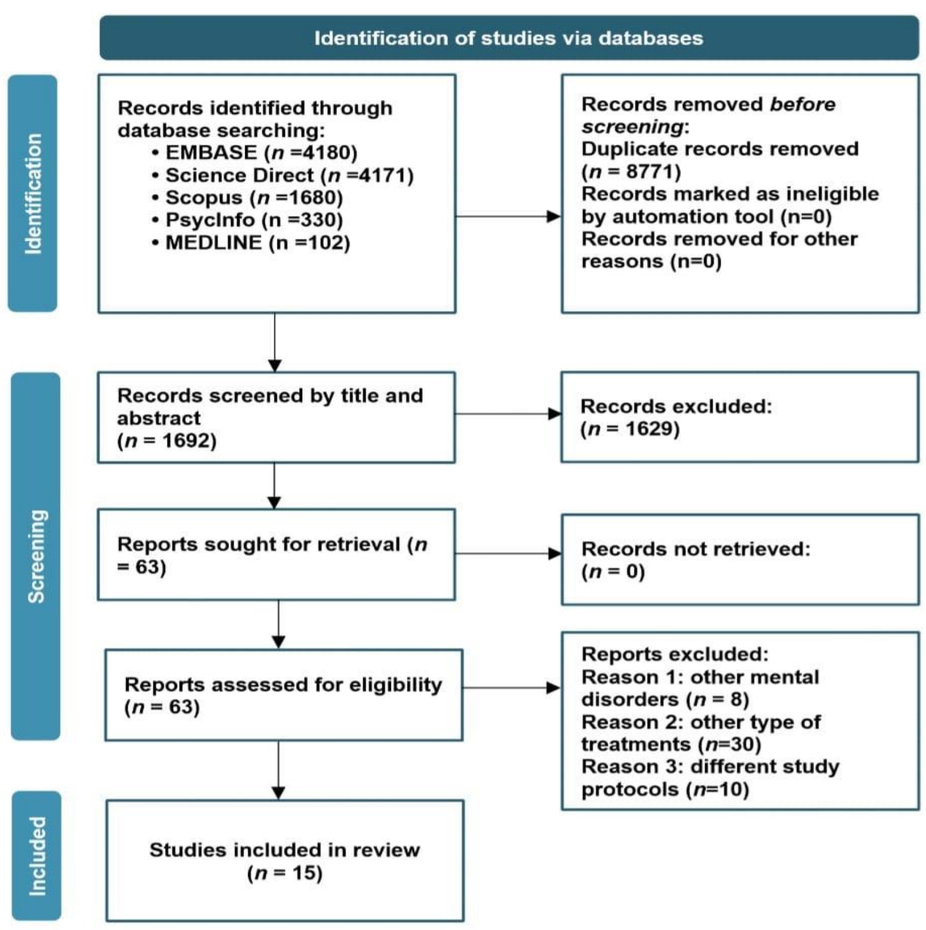
Figure 1. EEG-biofeedback demonstration session.
*The photo shows one of the researchers in our team.

METHOD

The study was conducted following the PRISMA guidelines for systematic reviews, ensuring a rigorous and transparent process. From September 2024 until November 2024, our research team searched the main databases for relevant studies.

Eligible studies included clinical trials and RCTs involving SSD patients who underwent EEG-biofeedback interventions, with primary outcomes focused on neurocognitive and humoral changes.

The quality of included studies was assessed using the Cochrane Risk-of-Bias Tool for randomized or non-randomized trials, ensuring the robustness of findings. Following a meticulous selection process, 15 studies were included, encompassing 10 RCTs and 5 clinical trials.



RESULTS & DISCUSSION

The results highlight that EEG-biofeedback demonstrates significant potential across various domains. Reviewed studies reported improvements in **processing speed, working memory, and social functioning**. Additionally, emotional regulation was enhanced, with reduced activity in brain regions associated with auditory hallucinations, such as the superior temporal gyrus (STG).

Another innovative aspect of EEG-biofeedback is its impact on biomarkers like brain-derived neurotrophic factor (BDNF) and reelin, which are crucial for neuroplasticity. Increased levels of these markers suggest a profound and lasting effect on brain remodeling, potentially surpassing the capabilities of conventional treatments.

However, the review also identified limitations, including variability in protocols and outcomes. Patients with lower baseline neurocognitive reserves exhibited less pronounced benefits, emphasizing the need for personalized interventions.

CONCLUSION

EEG-biofeedback emerges as a promising adjunctive therapy for SSD, with documented effects on cognitive functions, emotional regulation, and neuroplastic biomarkers. Unlike conventional treatments that primarily address symptoms, this technique aims to rewire dysfunctional brain circuits, offering a transformative approach to care. Nonetheless, challenges such as the lack of standardized protocols and the need for more extensive research limit its immediate clinical adoption.

FUTURE WORK / REFERENCES

Future directions for EEG-biofeedback research include:

- **Developing adaptive interventions tailored to individual neurocognitive profiles.**
- **Combining neurofeedback with pharmacological and psychotherapeutic strategies to enhance overall effectiveness.**

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