https://jos.unsoed.ac.id/index.php/jipa

ARTICLE REVIEW

Is Neurofeedback More Effective than Other Non-Pharmacological Interventions? A Meta-Analysis of Randomized Controlled Trials in Children and Adolescents with ADHD

Muhammad Jealani Saputra[1], Muhammad Faiz Zamzami[1], Nabila Suroyya[1], Yuka Permata Sakinah[1], Inke Kusumastuti[2*]

ABSTRACT

Background: Difficulties in maintaining attention, hyperactivity, and impulsivity remain major challenges faced by children and adolescents with Attention-Deficit/Hyperactivity Disorder (ADHD). Several randomized controlled trials (RCTs) have evaluated the effect of neurofeedback training (NFB-T) in reducing these symptoms. However, the clinical efficacy remains inconsistent. This meta-analysis aimed to evaluate the efficacy of NFB-T compared with other non-pharmacological therapies in reducing ADHD symptoms. **Methodology:** A comprehensive systematic literature search was conducted across 5 databases; PubMed, Scopus, ScienceDirect, Taylor & Francis, and Wiley. The risk of bias among the included studies was evaluated using the Cochrane Risk-of-Bias tool for randomized trials (RoB 2). All meta-analytical statistical analyses were performed using a random-effects model in Review Manager version 5.4. **Result:** The initial search has a total of 1,297 articles for early screening. However, only 17 RCTs involving 993 participants were eligible for the analysis. NFB-T significantly reduced inattention compared with other non-pharmacological interventions (standardized mean difference [SMD] −0.32; 95% confidence interval [CI] −0.55 to −0.08; p = 0.008), with substantial heterogeneity (I^2 = 66%). Sensitivity analysis excluding one outlier study showed consistent effect with reduced heterogeneity (I^2 = 47%). In contrast, NFB-T did not significantly improve hyperactivity/impulsivity (SMD 0.17; 95% CI −0.26 to 0.61; p = 0.44), and remained non-significant after sensitivity analysis despite reduced heterogeneity (I^2 = 60%). **Conclusion:** NFB-T may improve inattention symptoms in children and adolescents with ADHD, while its effect on hyperactivity/impulsivity remains unclear.

Keywords: Attention-deficit/hyperactivity Disorder, Inattention, Hyperactivity, Neurofeedback

1. Faculty of Medicine, University of Jember, Jember, Indonesia
2. Laboratory of Psychiatry, Profession of Medical Program, Faculty of Medicine, University of Jember, Jember, Indonesia

* ✉ email: inke@unej.ac.id

INTRODUCTION

For millions of families worldwide, a diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD) marks a persistent, often exhausting search for a balance between cognitive stability and maintaining a child's natural personality. Approximately 7.6% of children and 5.6% of adolescents globally are experiencing the condition[1], characterized by patterns of inattention, hyperactivity, and impulsivity. The disorder often results in significant impairment across academic, social, and vocational domains[2]. Traditionally, the clinical management of ADHD has been dominated by pharmacological interventions, particularly stimulants like methylphenidate, the primary "first-line" treatment. While these medications yield substantial acute symptom reduction, with meta-analyses reporting large effect sizes, their long-term utility frequently raise concerns over side effects and waning efficacy over time. Data from the Multimodal Treatment Study of ADHD (MTA) suggests that the initial superiority of medication often diminishes after 24 months, while side effects such as sleep disturbances and growth suppression often lead to high rates of non-compliance as patients reach adolescence[3].

This clinical reality has spurred an intensive search for non-pharmacological interventions (NIPs) that can provide durable relief without the biological burden of stimulants. Among these, physical activity (PA) and structured exercise have emerged as popular lifestyle-based alternatives. The neurobiological rationale is compelling, as exercise stimulates the release of dopamine and norepinephrine, theoretically mimicking the mechanism of action found in pharmacological agents[4]. However, children with ADHD, naturally, struggle with the executive functions required to maintain a consistent physical regimen. This potentially leads to a poor adherence with this program, with recent data indicating that children with ADHD are significantly less likely to meet consistent movement guidelines than their neurotypical peers[5]. Furthermore, clinical results of exercises remain notably inconsistent, while some studies show improvements in inhibitory control, the overall impact on core behavioral symptoms varies, proving to be a maintenance-heavy intervention where benefits disappear once the activity ceases[6].

In contrast to the fluctuating outcomes of physical activity, Neurofeedback Training (NFB-T) offers a more physiologically stable and reliable alternative. By utilizing operant conditioning to train self-regulation of specific brain wave patterns, such as the theta/beta ratio (TBR) or slow cortical potentials (SCP), NFB-T aims to induce lasting neuroplastic change within the prefrontal cortex. Evidence suggests that the clinical benefits of neurofeedback are not only maintained but may even intensify six to twelve months after the conclusion of the training[7]. This implies that once the skill of self-regulation is mastered, the results are far more durable than other physiological arousal provided by aerobic exercise or physical activity. While pharmacological interventions may still excel in terms of immediate, high-magnitude symptom suppression, NFB-T is increasingly recognized as the superior choice within the non-pharmacological category. Recent individual trials have begun to delineate a clear physiological advantage for neurofeedback. This includes head-to-head Randomized Controlled Trials (RCTs) comparing NFB-T to active physical activity (PA) interventions. This study demonstrated that while exercise may improve motor proficiency, only neurofeedback consistently induces significant reductions in theta power, which acts as a key neurophysiological marker for ADHD that correlates directly with behavioral symptom relief[8]. Synthesizing the latest evidence from RCTs, this meta-analysis aimed to evaluate whether the neuromodulatory precision of NFB-T provides the reliable efficacy that families have long been searching for in a non-drug treatment.

METHODS

Comprehensive search was conducted using the following databases: PubMed, Taylor & Francis, Scopus, OpenAlex, Science Direct, and Springer until 30th March 2026 **Supplement 1**. The population focused on children and adolescents diagnosed with ADHD. The intervention studied was neurofeedback training, compared to nonpharmacological control groups. The main outcomes observed were improvements in inattention and hyperactivity/impulsivity symptoms. To ensure strong and reliable evidence, only randomized controlled trials (RCTs) were selected for this review.

The methodological quality of the included studies was assessed systematically for each outcome and study design using the Risk of Bias Tool for Randomized Trials (RoB 2). This systematic review and meta-analysis were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a transparent and structured reporting process. Data synthesis and statistical analyses were performed using Review Manager (RevMan) version 5.4, which facilitated the organization, analysis, and presentation of the pooled results.

Symptom improvement was quantified based on score changes in standardized clinical rating scales used across the primary studies. These tools consisted of symptomatic rating scales (ADHD RS-IV, CRS, SNAP-IV, SWAN, and DSM-based criteria), neuropsychiatric interviews (MINI), self-reported behavioral questionnaires (BPAQ, BIS), and objective cognitive assessments (CPT) These scales provided a structured method to calculate the severity of inattention, hyperactivity, and impulsivity before and after the intervention, with lower post-treatment scores indicating clinical improvement.

RESULTS

Study Selection

A total of 1,297 articles were retrieved from the database search. Following duplicates elimination, 1004 articles were obtained for screening. After an initial screening of titles and abstracts, a full-text screening, and the exclusion of articles not meeting the inclusion criteria, 17 articles with a total of 993 participants were ultimately included in the analysis as shown in **Figure 1**. **Supplement 2** summaries the participants and study characteristics of all the included studies in this meta-analysis. All studies (*n=17*) are employing neurofeedback training (NFB-T) as the primary intervention, with diverse control types. Sample sizes of the studies are ranging from 14 - 140 participants, and follow-up periods of 6 weeks to 25 months to track symptom reduction.

The risk of bias in the included studies was evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool, which examines five key domains: the randomization process (D1), deviations from intended interventions (D2), missing outcome data (D3), measurement of outcomes (D4), and selection of reported results (D5). Of the studies reviewed, seven (Arnold, 2021; Kwon, 2024; Li, 2025; Liao, 2022; Luo, 2023; Minder, 2018; and Rahmani, 2022) were considered to have a low overall risk of bias, reflecting generally strong methodological quality[9-15]. In contrast, two studies (Bink, 2016; Moreno-Garcia, 2017) were rated as having a high risk of bias, mainly due to concerns related to outcome measurement (D4) and incomplete outcome data (D3)[16,17]. The remaining eight studies were judged to have some concerns, most often linked to limitations in the randomization process (D1) and deviations from the intended interventions (D2)[8,18-24]. Overall, although a considerable number of studies demonstrated good methodological rigor, the presence of bias concerns in a substantial proportion of the evidence suggests that the findings should be interpreted with appropriate caution.

Data extraction from included studies was performed using Microsoft Excel 2019 for outcome measures and effect size calculations (mean, SD), as shown in **Supplement 3.** Data synthesis was conducted using Review Manager (RevMan) version 5.4, where outcomes were pooled to generate forest plots visualizing intervention effects.

Inattention

Figure 2 presents a forest plot derived from the random-effects model meta-analysis of 16 RCTs evaluating NFB-T and other non-pharmacological interventions for managing inattention in children and adolescents with ADHD[8-17,19-24]. The pooled standardized mean difference (SMD) across all studies was -0.32 (95% CI: -0.55 to -0.08), indicating statistically significant overall reduction in inattention symptoms with NFB-T over other non-pharmacological interventions. Substantial heterogeneity was observed (I^2 = 66%, p = 0.008), reflecting between-study variability, potentially driven by differences in sample size or follow up periods. Sensitivity analysis excluding one outlier study (Luo et al.[13]) substantially reduced heterogeneity to (I^2 = 47%, p = 0.01), enabling a switch to fixed-effect model assumptions. The revised pooled SMD remained statistically significant at -0.24 (95% CI: -0.43 to -0.05) under this more conservative approach **Figure 3**.

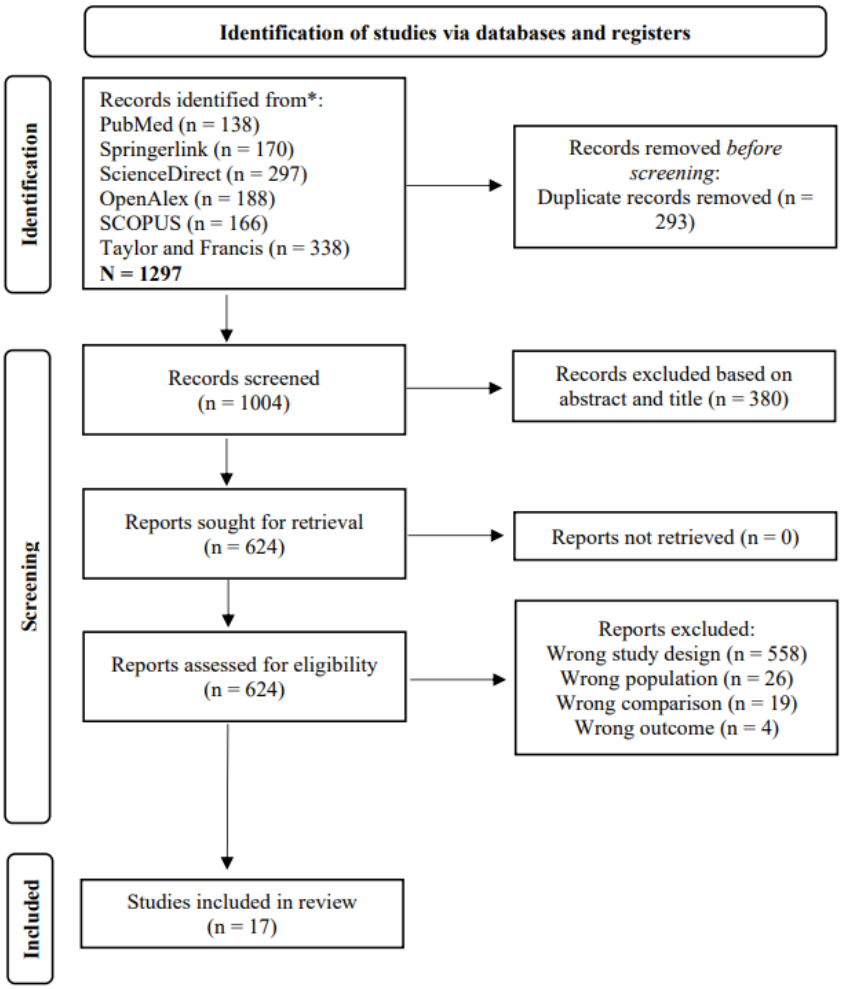
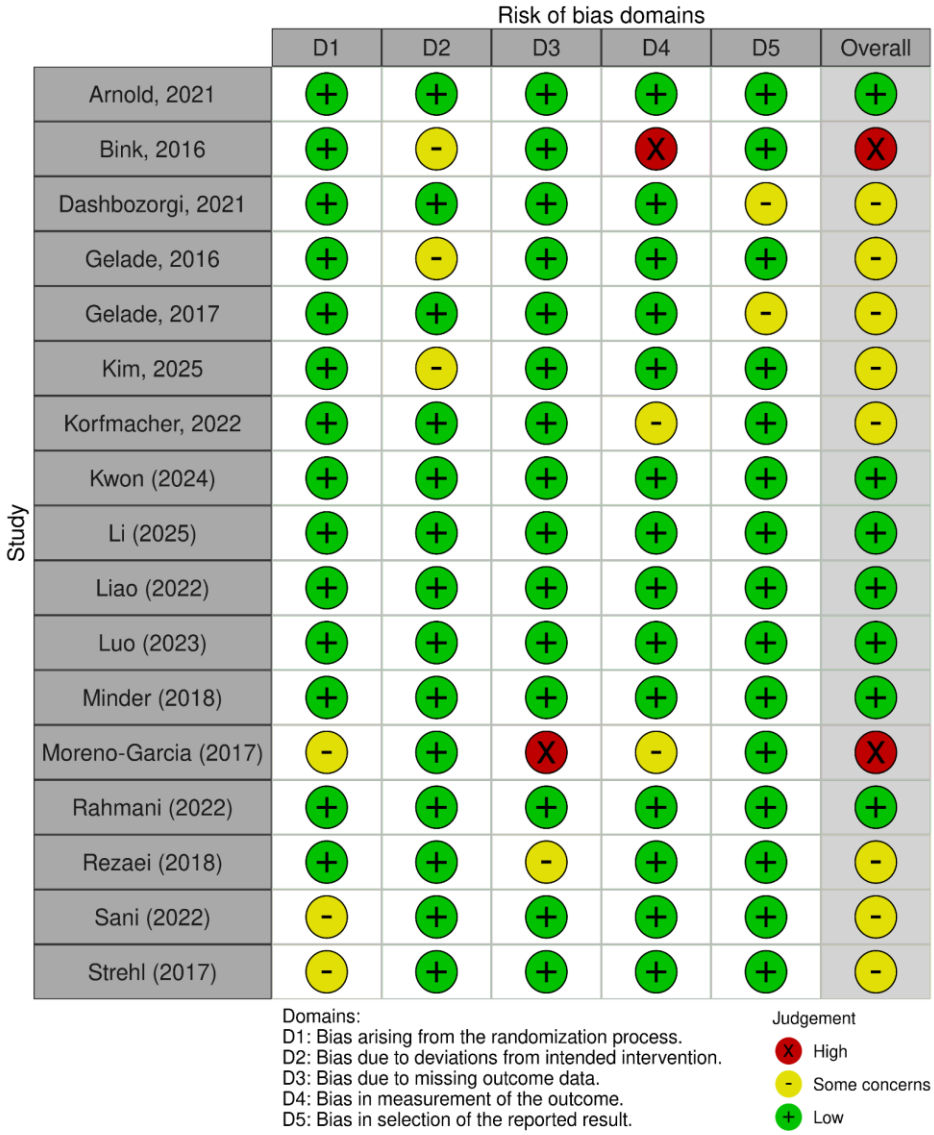


Figure 1. PRISMA Diagram

Hyperactivity and Impulsivity

Figure 4 presents a forest plot derived from the random-effects model meta-analysis of 16 RCTs evaluating NFB-T and other non-pharmacological interventions for managing hyperactivity and impulsivity in children and adolescents with ADHD[8,9,10,12-24]. The pooled standardized mean difference (SMD) across all studies was 0.17 (95% CI: -0.26 to 0.61), indicating statistically non-significant overall reduction in hyperactivity and impulsivity symptoms with NFB-T over other non-pharmacological interventions. Substantial heterogeneity was observed (I^2 = 90%, p = 0.44), reflecting between-study variability, potentially driven by differences in sample size or follow up periods. Sensitivity analysis excluding one outlier study (Bink et al.[16]) substantially reduced heterogeneity to (I^2 = 60%, p = 0.26). Even under this more conservative approach, the revised pooled SMD remained statistically non-significant at -0.13 (95% CI: -0.35 to 0.10) **Figure 5**.

Table 1. Risk of Bias



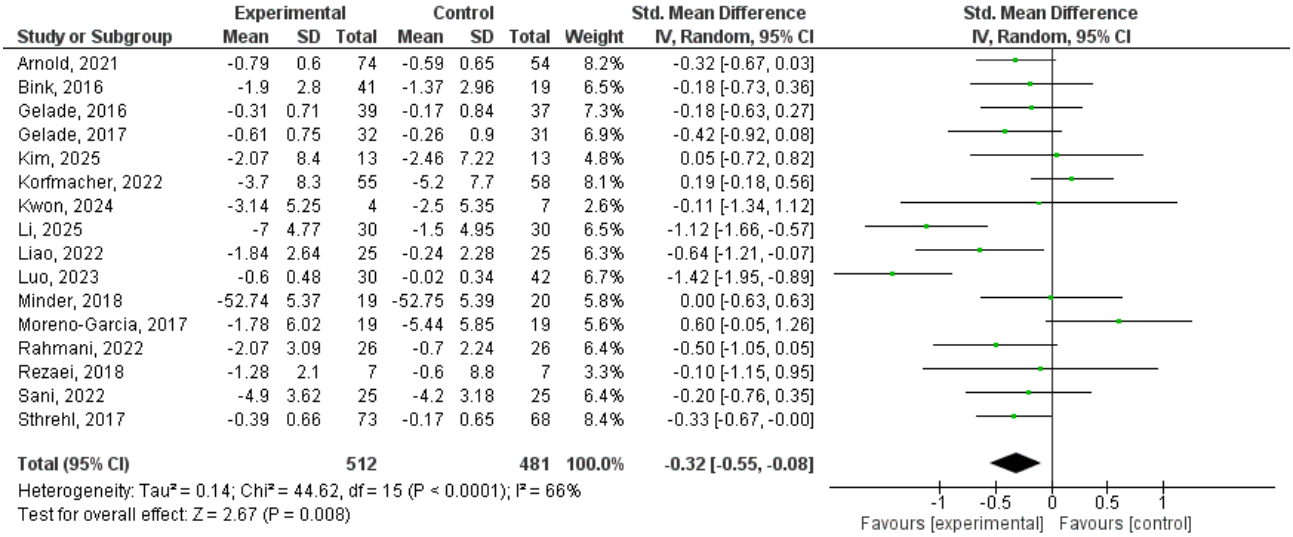


Figure 2. Forest Plot of Inattention Meta-Analysis

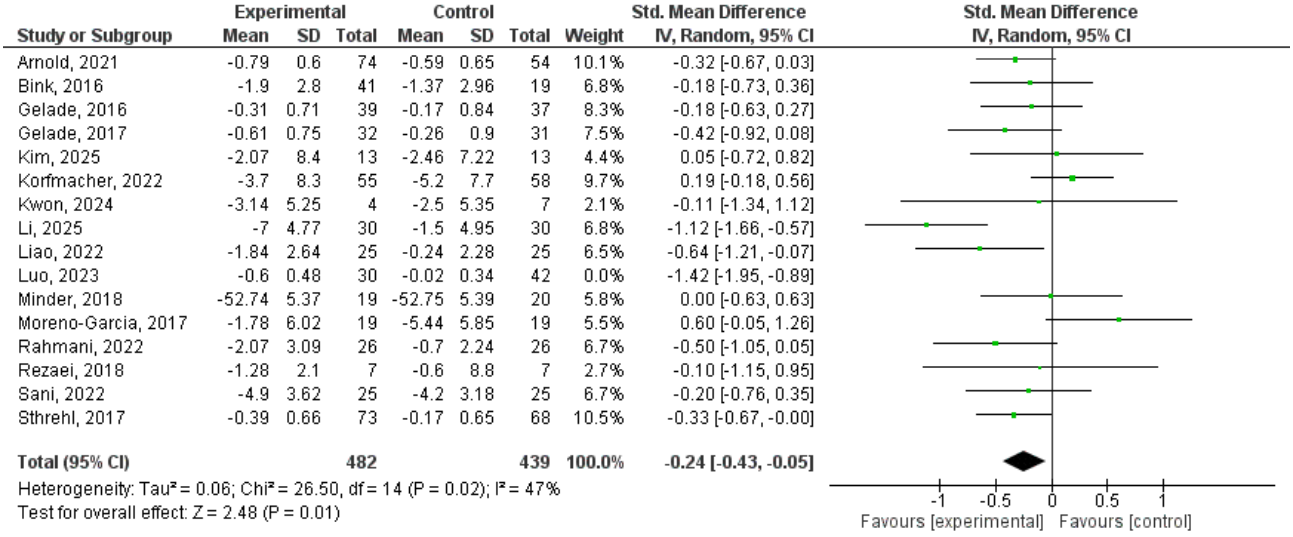


Figure 3. Forest Plot of Inattention Meta-Analysis after Sensitivity Analysis

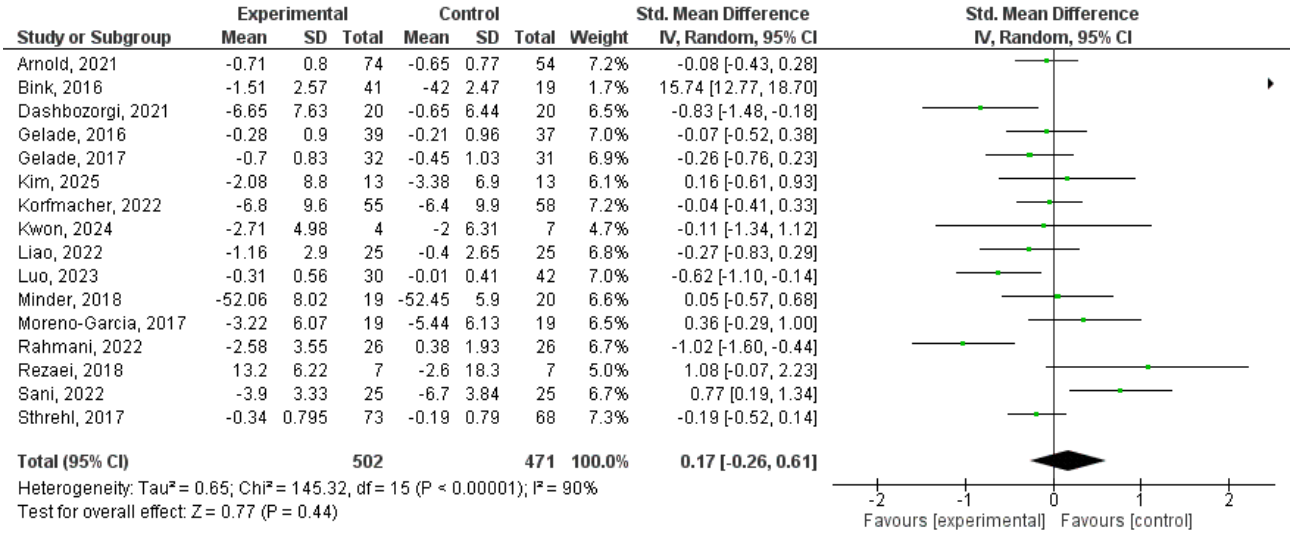


Figure 4. Forest Plot of Hyperactivity and Impulsivity Meta-Analysis

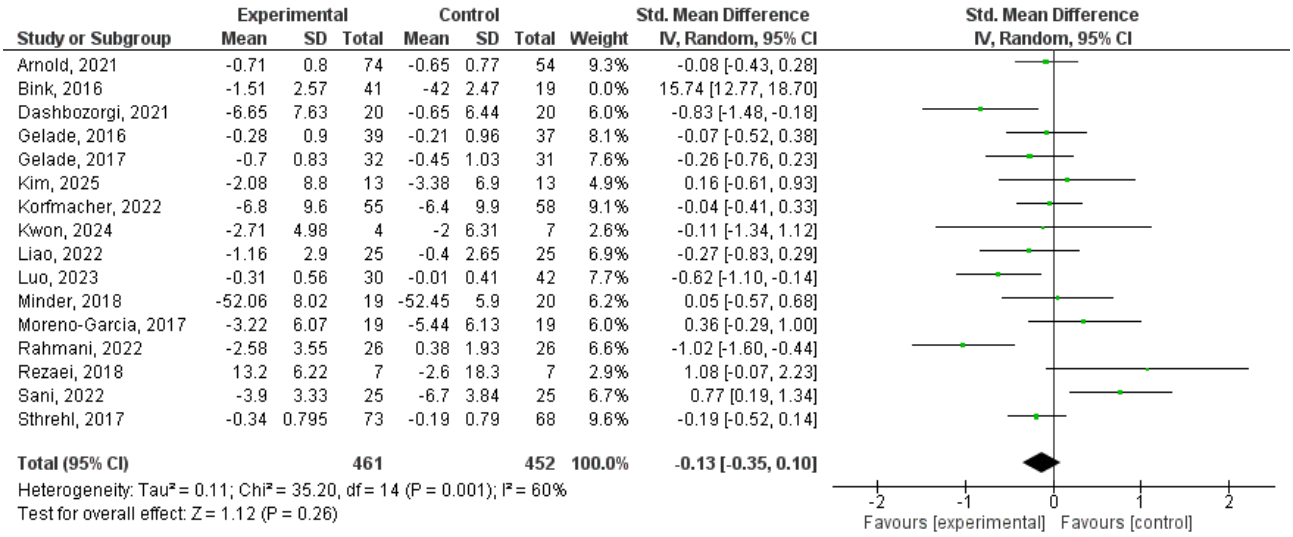


Figure 5. Forest Plot of Hyperactivity and Impulsivity Meta-Analysis after Sensitivity Analysis

DISCUSSION

The present systematic review and meta-analysis evaluated the efficacy of NFBT compared to other non-pharmacological interventions for improving inattention and hyperactivity/impulsivity in children and adolescents with ADHD. The overall findings suggest that NFBT provides significant benefits in alleviating inattention symptoms, whereas no significant improvement was observed for hyperactivity and impulsivity. Furthermore, sensitivity analysis supported the stability of all findings, suggesting that the overall conclusion remained consistent despite the exclusion of influential studies.

The superior efficacy of NFB-T for inattention symptoms may be attributed to the specific neuromodulatory target of the protocols. Standard NFB protocols, such as Theta/Beta Ratio (TBR) training, are designed to increase cortical arousal. ADHD-related inattention is a direct manifestation of cortical hypoarousal in the prefrontal cortex, which plays critical roles in sustained attention and executive control. By repeatedly training this area with neurophysiological regulation, NFBT may enhance attentional processing and eventually improve individual's ability to resist distraction and stay focused[26]. Another possible explanation lies in the principle of neuroplasticity. Different from other symptomatic interventions that primarily inhibit behavioral manifestations, NFBT enables repeated stimulation, activation, and reinforcement of neural pathways that are associated with behavior control. Repeated NFBT sessions may improve the connections between brain cells within areas that are related to attention, leading to gradual but sustained improvements in attentional performance[27].

In contrast, NFBT did not demonstrate significant improvement in hyperactivity and impulsivity. It might be due to the involvement of more complex neurobiological mechanisms that play role in the emergence of these symptoms. These including the basal ganglia, cerebellum, supplementary motor areas, and dopaminergic reward pathways. Hyperactivity and impulsivity are also often more sensitive to environmental factors and behavioral contingencies, suggesting that motor symptoms may require more intensive training durations or the integration of behavioral therapy to achieve statistically significant changes in clinical rating scales. Consequently, interventions that are focusing on the normalization of cortical EEG activity may have limited effect on motoric regulation and impulsivity[26,28,29].

Moreover, methodological factors could also be a reason why NFBT did not

demonstrate significant improvement in hyperactivity and impulsivity. These might be related to variations in the included studies, including the protocols, training duration, session frequency, comparator interventions, and outcome assessment methods. Additionally, hyperactivity and impulsivity symptoms are often evaluated using a parent or teacher reporting scale. This may lead to reporting bias and reduce sensitivity to detect subtle behavioral changes.

The study possesses several strengths that reinforce its clinical relevance. It represents the first systematic review and meta-analysis specifically designed to evaluate the efficacy of NFB-T in children and adolescents with ADHD. To ensure a high standard of evidence, the review exclusively included randomized controlled trials (RCTs), involving a total of 993 participants. Furthermore, the inclusion of diverse populations and broad participant characteristics ranging from 14 to 140 participants per study across multiple countries enhances the generalizability of the findings to a wider clinical context.

Despite the promising findings, this systematic review and meta-analysis has certain limitations that must be acknowledged. A primary concern is the methodological quality of the included studies, as a significant number were categorized as having a high risk of bias or some concerns according to the RoB 2 tool. Additionally, the analysis revealed substantial heterogeneity across the results, particularly in the assessment of inattention and hyperactivity/impulsivity. This variability may stem from differences in sample sizes, follow-up durations, and the specific neurofeedback protocols employed across the 17 included trials.

Future research should prioritize the integration of neurofeedback into personalized, multimodal treatment frameworks to enhance clinical outcomes. Utilizing Quantitative EEG (qEEG) to identify specific neurophysiological subtypes, such as cortical hypoarousal or hyperarousal can allow for tailored protocols that address an individual's unique brainwave profile rather than a one-size-fits-all approach. Furthermore, combining neurofeedback with adjuncts like repetitive transcranial magnetic stimulation (rTMS), artificial intelligence-driven protocols, or nutritional supplements like Vitamin D has shown potential for achieving more significant and faster symptom reduction. To justify the investment required for these interventions, high-intensity protocols exceeding 21 hours must be validated through rigorous, long-term follow-ups ranging from 6 to 25 months.

The development and validation of mobile neurofeedback (MNF) systems represent a significant step toward improving treatment accessibility and cost-effectiveness. These wearable technologies allow for continuous monitoring and training in naturalistic settings, such as at home or in schools, potentially reaching a broader demographic. While initial studies on MNF as an adjunct to medication have shown promising neurophysiological modulation, such as enhanced Theta-Gamma Coupling (TGC), large-scale, double-blind, sham-controlled trials are still needed to definitively confirm its efficacy. Advancements in cloud-based platforms and AI-powered data analysis will further refine these personalized protocols, enabling real-time adjustments and remote clinical supervision to ensure the safety and precision of at home brain training.

CONCLUSION

The findings of this study demonstrate some clinical benefits regarding inattention and hyperactivity/impulsivity in children and adolescents with ADHD. Sensitivity analyses confirm the robustness of these results, as evidenced by the forest plot. Furthermore, the study maintains high external validity due to the diverse age ranges and geographical representation of the participants. Although NFB-T shows some clinical benefits as a non-invasive option, it is better suited as an

adjuvant to pharmacological, behavioral, or educational therapies due to its lack of significant effects on hyperactivity and impulsivity. Nevertheless, further investigation into statistical heterogeneity through subgroup analysis is required, alongside a more rigorous assessment of risk of bias.

ACKNOWLEDGMENTS

The authors would like to thank the individuals and institutions who contributed to this study. No specific acknowledgements to declare.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest related to this study.

FUNDINGS

This study was conducted without external funding.

SUPPLEMENTARY MATERIALS

Supplementary Files for Is Neurofeedback More Effective than Other Non-Pharmacological Interventions? A Meta-Analysis of Randomized Controlled Trials in Children and Adolescents with ADHD

REFERENCES

1. N. Salari, H. Ghasemi, N. Abdoli, A. Rahmani, and M. H. Shiri, “The global prevalence of ADHD in children and adolescents : a systematic review and meta-analysis,” pp. 1–12, 2023.
2. S. Cortese *et al.*, “Comparative efficacy and tolerability of medications for attention-deficit hyperactivity disorder in children , adolescents , and adults : a systematic review and network meta-analysis,” *The Lancet Psychiatry*, vol. 5, no. 9, pp. 727–738, doi: 10.1016/S2215-0366(18)30269-4.
3. M. H. Sibley *et al.*, “Non-pharmacological interventions for attention-deficit hyperactivity disorder in children and adolescents,” vol. 7, no. 6, pp. 415–428, 2024, doi: 10.1016/S2352-4642(22)00381-9.Non-pharmacological.
4. A. J. Cerrillo-Urbina, A. García-Hermoso, M. Sánchez-López, M. J. Pardo-Guijarro, V. Martínez-Vizcaíno, and J. L. Santos Gómez, “The effects of physical exercise in children with attention deficit hyperactivity disorder: a systematic review and meta-analysis of randomized control trials,” *Child. Care. Health Dev.*, vol. 41, no. 6, pp. 779–788, 2015, doi: 10.1111/cch.12255.
5. M. Parnes, E. Gonzalez, N. Tran, M. A. Stein, J. Mendoza, and P. Tandon, “Adherence to 24-Hour Movement Guidelines and Behavioral Health in Children With Attention Deficit Hyperactivity Disorder in the United States,” vol. 22, no. 9, pp. 1143–1152, 2026, doi: 10.1123/jpah.2024-0497.Adherence.
6. H. Wang, S. Wang, and G. Cheng, “A multilevel meta-analysis of the effects of exercise interventions on inhibitory control in children with ADHD,” no. February, pp. 1–19, 2026, doi: 10.3389/fpsyt.2026.1742882.
7. J. Van Doren, M. Arns, H. Heinrich, M. A. Vollebregt, U. Strehl, and S. K. Loo, “Sustained effects of neurofeedback in ADHD : a systematic review and meta - analysis,” *Eur. Child Adolesc. Psychiatry*, vol. 28, no. 3, pp. 293–305, 2019, doi: 10.1007/s00787-018-1121-4.
8. K. Geladé, T. W. P. Janssen, M. Bink, R. Van Mourik, A. Maras, and J. Oosterlaan, “Behavioral Effects of Neurofeedback Compared to Stimulants and Physical Activity in Attention-Deficit/Hyperactivity Disorder: A Randomized Controlled Trial,” *J Clin Psychiatry*, vol. 77, no. 10, pp. e1270–e1277, 2016, doi: dx.doi.org/10.4088/JCP.15m10149.
9. L. E. Arnold *et al.*, “Double-Blind Placebo-Controlled Randomized Clinical Trial of Neurofeedback for Attention-Deficit/Hyperactivity Disorder With 13 Month Follow-up,” pp. 1–26, 2022, doi: 10.1016/j.jaac.2020.07.906.Double-Blind.
10. S. Y. Kwon *et al.*, “The Effect of Mobile Neurofeedback Training in Children with Attention Deficit Hyperactivity Disorder : A Randomized Controlled Trial,” vol. 22, no. 1, pp. 67–78, 2024.
11. Y. Li, C. Tian, L. Xu, L. Pei, X. Huang, and X. Wang, “Guided Adaptive Learning : A New Neuroeducational Approach to the Facilitation of Cognitive Control in ADHD Children,” *Child. Care. Health Dev.*, vol. 50, no. 6, p. e70011, 2025, doi: https://doi.org/10.1111/cch.70113.
12. Y.-C. Liao and H. Tsai, “Effects of Twenty Hours of Neurofeedback- Based Neuropsychotherapy on the Executive Functions and Achievements among ADHD Children,” no. 1, 2022, doi: 10.1177/15500594221101693.
13. X. Luo, L. Zhang, L. Xia, and X. Zhou, “Efficacy of behavior modification training combined with electroencephalographic biofeedback therapy for attention deficit hyperactivity disorder in children: a randomized controlled trial,” no. November, pp. 1–8, 2023, doi: 10.3389/frcha.2023.1235310.

14. F. Minder, A. Zuberer, D. Brandeis, and R. Drechsler, “Informant - related effects of neurofeedback and cognitive training in children with ADHD including a waiting control phase : a randomized - controlled trial,” *Eur. Child Adolesc. Psychiatry*, vol. 27, no. 8, pp. 1055–1066, 2018, doi: 10.1007/s00787-018-1116-1.
15. M. Rahmani, A. Mahvelati, A. H. Farajinia, S. Shahyad, and M. Khaksarian, “Comparison of Vitamin D , Neurofeedback , and Neurofeedback Combined with Vitamin D Supplementation in Children with Attention-Deficit / Hyperactivity Disorder,” *Acad. Med. Sci. I.R. Iran*, vol. 25, no. 5, pp. 285–393, 2022, doi: 10.34172/aim.2022.47.
16. M. Bink, I. L. Bongers, A. Popma, T. W. P. Janssen, and C. Van Nieuwenhuizen, “1-year follow-up of neurofeedback treatment in adolescents with attention-deficit hyperactivity disorder : randomised controlled trial,” pp. 107–115, 2016, doi: 10.1192/bjpo.bp.115.000166.
17. I. Moreno-garcía, S. Meneres-sancho, C. C. De Rey, and M. Servera, “A Randomized Controlled Trial to Examine the Posttreatment Efficacy of Neurofeedback , Behavior Therapy , and Pharmacology on ADHD Measures,” 2017, doi: 10.1177/1087054717693371.
18. Z. Dashbozorgi *et al.*, “Effect of Neurofeedback Training on Aggression and Impulsivity in Children With Attention- Deficit/Hyperactivity Disorder: A Double-Blinded Randomized Controlled Trial,” vol. 12, no. 5, pp. 693–702, 2021.
19. K. Geladé *et al.*, “A 6 - month follow - up of an RCT on behavioral and neurocognitive effects of neurofeedback in children with ADHD,” *Eur. Child Adolesc. Psychiatry*, 2017, doi: 10.1007/s00787-017-1072-1.
20. J. W. Kim, B. Kim, J. I. Kim, C. Yang, and J. Kwon, “Effects of Mobile Neurofeedback on Theta – Gamma Coupling and Clinical Outcomes in Children with ADHD : A Double-Blind , Sham-Controlled Randomized Clinical Trial,” no. December, pp. 2733–2746, 2025.
21. A. Korfmacher, O. Hirsch, M. Chavanon, and B. Albrecht, “Self-management training vs . neurofeedback interventions for attention deficit hyperactivity disorder : Results of a randomized controlled treatment study,” no. August, pp. 1–17, 2022, doi: 10.3389/fpsyt.2022.969351.
22. M. Rezaei, T. S. Kamarzard, and M. N. Razavi, “The Effects of Neurofeedback , Yoga Interventions on Memory and Cognitive Activity in Children with Attention Deficit / Hyperactivity Disorder : A Randomized Controlled Trial,” vol. 6, no. 4, pp. 17–27, 2018, doi: http://dx.doi.org/10.29252/aassjournal.6.4.17.
23. N. G. Sani *et al.*, “Neurofeedback Training Versus Perceptual-motor Exercises Interventions in Visual Attention for Children With Attention- Deficit/Hyperactivity Disorder: A Randomized Controlled Trial,” vol. 13, no. 2, pp. 215–224, 2022.
24. U. Strehl *et al.*, “Neurofeedback of Slow Cortical Potentials in Children with Attention-Deficit / Hyperactivity Disorder : A Multicenter Randomized Trial Controlling for Unspecific Effects,” vol. 11, no. March, pp. 1–15, 2017, doi: 10.3389/fnhum.2017.00135.
25. A. W. Keizer, R. S. Verment, and B. Hommel, “NeuroImage Enhancing cognitive control through neurofeedback : A role of gamma-band activity in managing episodic retrieval,” *Neuroimage*, vol. 49, no. 4, pp. 3404–3413, 2010, doi: 10.1016/j.neuroimage.2009.11.023.
26. Arns M, Heinrich H, Strehl U. Evaluation of neurofeedback in ADHD: The long and winding road. Biological Psychology. 2014 Jan;95(1):108–15.
27. S. Enriquez-Geppert, R. J. Huster, and C. S. Herrmann, “EEG-Neurofeedback as a Tool to Modulate Cognition and Behavior: A Review Tutorial,” *Frontiers in Human Neuroscience*, vol. 11, p. 51, 2017, doi: 10.3389/fnhum.2017.00051.
28. Arns M, de Ridder S, Strehl U, Breteler M, Coenen A. Efficacy of neurofeedback treatment in ADHD: The effects on inattention, impulsivity and hyperactivity: A meta-analysis. Clinical EEG and Neuroscience. 2009;40(3):180–9.
29. K. Rubia, “Cognitive Neuroscience of Attention Deficit Hyperactivity Disorder (ADHD) and Its Clinical Translation,” *Frontiers in Human Neuroscience*, vol. 12, p. 100, 2018, doi: 10.3389/fnhum.2018.00100.