

INPLASY PROTOCOL

To cite: Yu et al. Systematic review and Meta-analysis on the effect of cognitive training on executive function behavior of children with ADHD. Inplasy protocol 202140065. doi: 10.37766/inplasy2021.4.0065

Received: 10 April 2021

Published: 11 April 2021

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Support: National Natural
Science Found CHN.

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

Conflicts of interest:
None declared.

INTRODUCTION

Review question / Objective: To evaluate the intervention effect of cognitive training on the executive function of children with attention deficit hyperactivity disorder (ADHD).

Systematic review and Meta-analysis on the effect of cognitive training on executive function behavior of children with ADHD

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Review question / Objective: To evaluate the intervention effect of cognitive training on the executive function of children with attention deficit hyperactivity disorder (ADHD). **Condition being studied:** Attention deficit hyperactivity disorder (ADHD) is a chronic neurodevelopmental disorder that begins in childhood and is characterized by different combinations of inattention and emotional and behavioral impulsivity, regardless of situational hyperactivity, and may persist into adolescence and adulthood. However, due to the side effects of medications and the risk of secondary substance abuse, the long-term effects may not meet the broad clinical needs of most ADHD patients, leading to questions about the effectiveness of medications. Therefore, in order to control the clinical symptoms of ADHD and actively improve function, the 2019 American Academy of Pediatrics clinical guidelines suggest appropriate treatments for each age developmental stage, and cognitive training is currently being used as a non-pharmacological treatment. Non-pharmacological treatments need to be supported by sufficient evidence. Due to the impact of the novel coronavirus epidemic, teletherapy and rehabilitation have received much attention from psychiatrists and patients, especially the effects of cognitive interventions based on the home environment need to be further evaluated.

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 11 April 2021 and was last updated on 11 April 2021 (registration number INPLASY202140065).

Rationale: Cognitive training is rehabilitation science and neuroscience of brain plasticity as a basis for improving clinical symptoms and executive function deficits in patients. Executive function in a broad sense is the coordination of various goal-based cognitive processes that orient

behavior in the prefrontal cortex. Pathological studies have shown that prefrontal damage triggers behavioral problems such as inattention and hyperactive impulsivity, as well as correlations in the results of neuropsychological tests of executive function. The common cognitive training components corresponding to the neuropsychological mechanisms of ADHD include attentional control, working memory, inhibitory control, and cognitive flexibility. Cortese et al. investigated the effect of cognitive training of working memory in ADHD children under laboratory conditions, but fewer studies had included the evaluation of executive functioning in non-laboratory ecological settings. Comprehensive cognitive training had a more significant effect on ADHD symptoms compared to working memory training alone, but the difference in training effects of cognitive training on children's executive functioning behaviors in a family-state environment needs further study.

Condition being studied: Attention deficit hyperactivity disorder (ADHD) is a chronic neurodevelopmental disorder that begins in childhood and is characterized by different combinations of inattention and emotional and behavioral impulsivity, regardless of situational hyperactivity, and may persist into adolescence and adulthood. However, due to the side effects of medications and the risk of secondary substance abuse, the long-term effects may not meet the broad clinical needs of most ADHD patients, leading to questions about the effectiveness of medications. Therefore, in order to control the clinical symptoms of ADHD and actively improve function, the 2019 American Academy of Pediatrics clinical guidelines suggest appropriate treatments for each age developmental stage, and cognitive training is currently being used as a non-pharmacological treatment. Need to be supported by sufficient evidence. Due to the impact of the novel coronavirus epidemic, teletherapy and rehabilitation have received much attention from psychiatrists and patients, especially the effects of

cognitive interventions based on the home environment need to be further evaluated.

METHODS

Search strategy: Cochrane Library #1 MeSH descriptor: [Attention Deficit Disorder with Hyperactivity] this term only #2 ('ADHD' OR 'ADDH'):ti,ab,kw OR ('attention deficit*'):ti,ab,kw OR ('hyperactive*'):ti,ab,kw OR ('hyperkine*'):ti,ab,kw (Word variations have been searched) #3 ('cognitive training'):ti,ab,kw OR ('working memory training'):ti,ab,kw OR ('cognitive remediation'):ti,ab,kw OR ('executive function training'):ti,ab,kw OR ('attention training'):ti,ab,kw (Word variations have been searched) #4 ('random*'):ti,ab,kw OR ('placebo'):ti,ab,kw OR ('double-blind'):ti,ab,kw (Word variations have been searched) #5 (#1 OR #2) AND #3 AND #4.

Participant or population: The children with attention deficit hyperactivity disorder.

Intervention: Cognitive training involving one or more of the working memory attentional inhibition control cognitive flexibility, etc.

Comparator: Comparator including placebo training condition, waitlist control.

Study designs to be included: Randomized controlled trial.

Eligibility criteria: The children who meet the diagnosis of ADHD (under 18 years old), the diagnostic criteria include the American Diagnostic and Statistical Manual of Mental Disorders, 4th edition, International Classification of Diseases, 10th edition, and the Chinese Guidelines for the Prevention and Treatment of Attention Deficit Hyperactivity Disorder, 2nd edition, excluding the children with autism spectrum disorder, behavior disorder, learning disorder and other mental diseases

Information sources: The search databases include CNKI, China Biomedical Literature Database, Wanfang Database, Embase, PubMed, Cochranelibrary, Psycnet, and the

search period is from the establishment of the database to September 2020. The database search will be supplemented by a manual search of the reference lists of included articles.

Main outcome(s): The Behavior Rating Inventory of Executive Function (BRIEF) parent form is a questionnaire that assesses EF behaviors in daily life environments, includes eight subscales: initiation, working memory, planning, organization of materials, monitoring, inhibition, shifting, and emotional control.

Data management: Two authors will independently extract data. Any disagreement will be resolved by discussion until consensus is reached or by consulting a third author. The following data will be extracted: author, year of publication, country where the study was conducted, total number of people included in the study, interventions and comparator, age, duration of treatment/ follow-up.

Quality assessment / Risk of bias analysis: Two reviewers will independently assess the quality of the included literature, using the risk of bias assessment tool for parallel design trials (ROB 2) recommended by the Cochrane Handbook, covering the randomization process Deviations from established interventions Missing outcome data Outcome measures Outcome selection is reported in five domains, and an overall risk of bias assessment of the reported outcomes of individual studies is made based on the evaluation of several signal questions set within each domain.

Strategy of data synthesis: Data from the post-test measurements of the intervention and control groups in the included randomized controlled studies were used and entered into RevMan 5.2 software for data analysis. The outcome evaluation indicators were all continuous variables, and the effect indicators were expressed as standard weighted mean differences (SMD) and their 95% confidence intervals. Heterogeneity was evaluated by Cochrane Q test and I² statistic. When $p < 0.1$ or $I^2 >$

50% indicates statistical heterogeneity, the random effect model is used to calculate the results, otherwise the fixed effect model is considered.

Subgroup analysis: If there is high heterogeneity in the included studies, we will perform subgroup analyses to explore the differences in age, cognitive training program and course of the intervention time.

Sensitivity analysis: After excluding a low quality study, the combined effect size was re-estimated and compared with the results of the Meta-analysis before exclusion to explore the extent of the effect of the study on the combined effect size and the robustness of the results. If the results did not change significantly after exclusion, it indicates that the sensitivity is low and the results are more robust and credible; on the contrary, if large differences or even diametrically opposite conclusions are obtained after exclusion, it indicates that the sensitivity is high and the robustness of the results is low, and great care should be taken when interpreting the results and drawing conclusions, suggesting the existence of important and potentially biased factors related to the effects of the intervention, and the source of the controversy needs to be further clarified.

Country(ies) involved: China.

Keywords: Attention deficit disorder with hyperactivity; Cognitive training; Executive function; Meta analysis.

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