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The Effects of Exercise Intervention for Restricted and Repetitive Behavior in Children with Autism Spectrum Disorder: a Network Meta-Analysis

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 20 October 2024 and was last updated on 20 October 2024.

INTRODUCTION

Review question / Objective Follow the PICOS principle for the development of literature inclusion criteria, from the intervention object, the type of literature included, the intervention, the outcome indicators, and the experimental design of the five aspects of screening and assessment.1. Subjects included in the article must be confirmed by the authority of the children and adolescents diagnosed with ASD, the age of less than 14 years old, before and after the experimental characteristics of the same, the subject's nationality, gender, race is not limited; 2. Type of study: Randomized controlled experiment; 3. Interventions were means related to exercise interventions, including physical activities such as ball, yoga, hand clapping, etc., and the control group took no interventions; 4. Outcome indicators: Assessment tools were domestic and internationally recognized for measuring the repetitive stereotyped behavior scales for children with ASD, including the RBS-R scale, GARS-2 scale, etc.; 5. The experimental design plan was complete and strictly followed, and the outcome report was complete and detailed. Literature including any of these criteria was excluded: review and conference papers; animal experimental studies; subjects with other diseases, such as attention deficit hyperactivity disorder, etc.; incomplete or unable to extract data from the articles; duplicate publications; interventions that include other means of rehabilitation; inconsistency of outcome indicators; incomplete experimental design.

Condition being studied Autism spectrum disorder (ASD), also known as autism, occurs most often in childhood, and its core symptoms are social impairment and repetitive stereotypic behavior(Carter, 2014), of which, Restricted and Repetitive Behavior (RRB) is a high-frequency, unchanging pattern of repetitive, behaviors that crave monotony in the environment(Lin & Koegel, 2018). As a neurological disorder, the progress in developing treatments for autism spectrum

disorder (ASD) is slow, and the associated treatment costs are exceedingly high. According to the 2022 Blue Book of the Child Developmental Disabilities Rehabilitation Industry, the global population affected by ASD exceeds 10 million individuals. Furthermore, the Report on the Development Status of China's Autism Education and Rehabilitation Industry indicates that the prevalence of autism in China is 0.7%, resulting in a population of over 10 million people with ASD. Notably, among these 10 million individuals, approximately 3 to 5 million are children aged 0-14 years old.(Research Center for Public Health et al., 2020). The healthy development of children is of paramount importance to millions of families. Currently, the intervention methods for autism spectrum disorder (ASD) primarily encompass structured education (TEACCH), applied behavioral therapy (ABA), the Danish Early Stage Model (ESDM), and exercise therapy, among others. Studies have demonstrated that traditional rehabilitation means, when combined with exercise therapy(Paavola et al., 2020), constitute a more efficacious approach to rehabilitation.

Repetitive and stereotyped behaviors, as a core symptom of autism spectrum disorder (ASD) in children, can significantly impact their daily life and social activities. Currently, interventions for these behaviors in ASD children primarily involve psychological guidance, sports interventions, and pharmacological treatments. However, long-term medication use can hinder children's brain development and impose a substantial economic burden on their families. In recent years, sports have increasingly gained popularity in non-pharmacological treatments due to their recreational and social attributes, as well as their cost-effectiveness in reducing the financial strain on families. Research has shown that engaging in exercise of appropriate intensity can improve the behavioral habits of children with ASD. Physical activity, while maintaining a stable heart rate, enhances their concentration abilities. Furthermore, engaging in enjoyable activities, such as ball games and equestrianism, can attract the interest of children with ASD even more, thereby alleviating their social interaction disorder symptoms while simultaneously reducing repetitive and stereotyped behaviors.(Mastrominico et al., 2018).

METHODS

Search strategy A comprehensive literature search was conducted across multiple databases, including the Cochrane Library, PubMed, Web of Science, MEDLINE, PsycINFO, Embase, CNKI, Baidu Academic, WanFang, and others. The search employed a combination of free-text and subject-specific terms in both English and Chinese. The English search terms included "Autism Spectrum Disorder," "Autism," "Asperger," "PDD-NOS," "Loner," "PDD," "pervasive developmental disorder," "Asperger Syndrome," as well as "Stereotypic Behaviors," "Stereotypic Movement Disorder," "self-stimulatory behaviors," "self-stimulation," and "restricted and repetitive behaviors." The corresponding Chinese terms were also used. The search was focused on identifying studies related to physical exercise interventions, utilizing terms such as "physical exercise," "Exercise intervention," "outdoor activity," "sports games," "aerobic," "anaerobic," "jog," "walk," "yoga," "judo," "riding," "dance," "ball games," "water sport," and "martial arts." The final search was conducted on July 21, 2024, and the entire process of searching and selecting studies was handled by the first author.

Participant or population The 10 RCT trials included involved a total of 245 children with ASD, of which 124 were in the experimental group and a total of 121 were in the control group, all patients were divided into experimental and control groups according to the principle of random assignment.

Intervention The test group involved nine physical activity interventions.

Comparator The control group were all routine activities for ASD patients.

Study designs to be included Randomized clinical trials.

Eligibility criteria Literature including any of these criteria was excluded: review and conference papers; animal experimental studies; subjects with other diseases, such as attention deficit hyperactivity disorder, etc.; incomplete or unable to extract data from the articles; duplicate publications; interventions that include other means of rehabilitation; inconsistency of outcome indicators; incomplete experimental design.

Information sources Cochrane Library, PubMed, Web of Science, MEDLINE, PsycINFO, Embase,CNKI, Baidu Academic, WanFang, and others.

Main outcome(s) Literature screening and data extraction involved extracting key details such as the first author's name, publication year, sample size, age of participants, intervention specifics (including content, duration, frequency, and single intervention time), and outcome evaluation indices.

This process was conducted independently by two researchers, who then cross-checked their work upon completion. In the event of any discrepancies, these were referred to a third researcher for further discussion and a definitive decision.

Quality assessment / Risk of bias analysis Two authors independently reviewed the titles and abstracts of the literature to exclude those that did not meet the inclusion criteria. For the literature that passed the initial screening, the full texts were read to make a final determination on inclusion, with cross-checking to ensure accuracy. In cases where there was disagreement, the authors discussed the inclusion with a third party. Additionally, the quality of the studies was assessed using the Jadad scale, which ranges from 0 (worst score) to 5 (highest score). Studies with a score of 2 or below were considered low-quality clinical trials, while those with a score above 2 were considered high-quality clinical trials.

Strategy of data synthesis A meta-analysis was conducted using Review Manager 5.3 software, employing a random-effects model to analyze the intervention effects. The outcome indicators were all continuous variables, and when combining them to calculate the effect size, the literature outcome was a mixed indicator, represented as the Standardized Mean Difference (SMD). Depending on the heterogeneity level (I^2), a fixed-effect model was selected when $I^2 \leq 50\%$, and a random-effects model was chosen when $I^2 > 50\%$. In cases where $I^2 > 50\%$ and $P < 0.1$, indicating high heterogeneity, sensitivity analysis and subgroup analysis were conducted. Funnel plots were utilized to assess potential bias in the study. Additionally, a Network Meta-Analysis was performed using Stata software with the Network command and a random effects model, with each effect size expressed as a 95% confidence interval (95% CI).

Subgroup analysis The effect of intervention varies according to the length of the intervention period(Yushen et al., 2023) and the age of the interviewees(Monshed et al., 2024), and as a special group of children with ASD, we need to look at the effect of intervention at different stages and in different intervention cycles more comprehensively, so the study was analyzed in subgroups according to the intervention cycle and the age of the interviewees.

Sensitivity analysis A funnel plot was utilized to analyze publication bias.

Country(ies) involved China.

Keywords exercise intervention; children with autism spectrum disorders (ASD); repetitive stereotyped behavior; Network Meta-Analysis.

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