International Platform of Registered Systematic Review and Meta-analysis Protocols

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Systematic Review and Randomized Controlled Trial Meta-Analysis of the Effects of Physical Activity Interventions and Their Components on Repetitive Stereotyped Behaviors in Patients with Autism Spectrum Disorder

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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 14 February 2025 and was last updated on 14 February 2025.

INTRODUCTION

Review question / Objective This study intends to use meta-analysis method to systematically review previous randomized controlled trials (RCT), take stereotyped behavior as the main outcome index, and explore the effects of different exercise patterns (such as ball games, equestrian training, sensorimotor training, etc.), exercise cycle, exercise frequency, exercise time and organizational form on stereotyped behavior. And try to construct the best exercise intervention scheme. Through systematic quantitative analysis, the aim is to provide more accurate evidence-based basis for future non-drug intervention research on stereotyped ASD behavior.

Condition being studied Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder whose core features include deficits in social communication and Restricted and Repetitive Behaviors (RRBs) [1]. Stereotyped behaviors include repetitive movements (such as flipping hands, spinning), highly fixated interests, and behavior patterns that strictly follow specific rules, which may lead to a decline in an individual's ability to adapt to the environment and hinder the development of flexible behaviors [2]. In recent years, the global prevalence of ASD has continued to rise, reaching 1.5% in developed countries [3], and 2021 data from the Centers for Disease Control and Prevention (CDC) in the United States show that the prevalence of ASD in children aged 0-8 years has increased to 2.47%[4]. However, there are currently no effective pharmacological interventions for the core symptoms of ASD, and existing treatments focus on symptom relief rather than fundamental improvement.

METHODS

Search strategy The literature published in foreign databases was retrieved from the establishment of the database until January 2025. By combining

subject words with free words, The key words in English "Movement/Physical exercise/Physical activity/exercise/sport/Training, Exercise/Physical Exercises/training/ motion/activity/physical therapy/sport ", “autistic disorder/Autism Spectrum Disorders/Autistic Spectrum Disorders/ Disorder, Autistic/Spectrum/Early Infantile Autism/ Disorders, Asperger/Syndrome, Asperger ", "Stereotyped Behavior/ Behaviors, Stereotyped/ Behavior, Stereotyped/ Stereotyped Behaviors", “randomized controlled trial/ randomized/ controlled/trial/randomized controlled trial/random/ random "allocation/RCT/RCTs" was searched in PubMed, Web of Science, EBSCOhost and Cochrane Library. At the same time, the references of the included literatures and related reviews were traced back to ensure the comprehensiveness of the retrieved literatures.

Participant or population The study included individuals of different ages, genders and ethnicities. These enrolled ASD participants were diagnosed with the Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5) or other standard diagnostic tools such as the Autism Diagnostic Interview Revision (ADI-R) and the Childhood Autism Rating Scale (CARS). Participants with other types of neurodevelopmental disorders, such as attention deficit hyperactivity disorder (ADHD) or mental illness, were excluded.

Intervention Due to the special nature of ASD treatment, participants must receive regular rehabilitation therapy, so both the intervention group and the control group in this study required regular rehabilitation training. The intervention group received an additional physical activity intervention on top of this, regardless of the type of exercise. In contrast, the control group was strictly prohibited from receiving any exercise intervention other than prescribed rehabilitation training. This restriction is implemented to ensure that participants maintain their original lifestyle or receive standard rehabilitation training without the need for additional exercise interventions.

Comparator Due to the special nature of ASD treatment, participants must receive regular rehabilitation therapy, so both the intervention group and the control group in this study required regular rehabilitation training. The intervention group received an additional physical activity intervention on top of this, regardless of the type of exercise. In contrast, the control group was strictly prohibited from receiving any exercise intervention other than prescribed rehabilitation training. This restriction is implemented to ensure that participants maintain their original lifestyle or receive standard rehabilitation training without the need for additional exercise interventions.

Study designs to be included Randomized Controlled Trial.

Eligibility criteria Inclusion criteria: (1) Study type: randomized controlled trial (RCT); (2) Research object: Have been diagnosed with ASD or meet The criteria of the Diagnostic and Statistical Manual of Mental Disorders (The Fourth Edition of Diagnostic and Statistical Manual of Mental Disorders, DSM-IV or -V) ASD diagnostic criteria for people with autism spectrum disorder; (3) Intervention measures: the control group received routine rehabilitation treatment or no intervention, and the experimental group increased physical exercise on the basis of the control group; (4) Outcome indicators: Outcome indicators or partial outcome indicators are repetitive and stereotyped behaviors.
Exclusion criteria: (1) review, review, animal experiments, repeated publications, etc.; (2) Literature with unclear description of experimental data, incomplete data, unable to obtain original data after contacting the author, unable to transform data, and poor quality assessment; (3) the subject has other physical diseases; (4) Literature with unclear diagnostic criteria or intervention protocols.

Information sources The literature published in foreign databases was retrieved from the establishment of the database until January 2025. By combining subject words with free words, The key words in English "Movement/Physical exercise/Physical activity/exercise/sport/Training, Exercise/Physical Exercises/training/ motion/ activity/physical therapy/sport ", “autistic disorder/ Autism Spectrum Disorders/Autistic Spectrum Disorders/Disorder, Autistic/Spectrum/Early Infantile Autism/ Disorders, Asperger/Syndrome, Asperger ", "Stereotyped Behavior/ Behaviors, Stereotyped/ Behavior, Stereotyped/ Stereotyped Behaviors", “randomized controlled trial/ randomized/controlled/trial/randomized controlled trial/random/random "allocation/RCT/RCTs" was searched in PubMed, Web of Science, EBSCOhost and Cochrane Library. At the same time, the references of the included literatures and related reviews were traced back to ensure the comprehensiveness of the retrieved literatures.

Main outcome(s) Using established and proven measurement tools to evaluate research results is critical. Primary outcome measures focus on assessing the overall severity of an individual with

autism, and outcome measures assess stereotypical behaviors, typically using scales such as the Autism Treatment Assessment Checklist (ATEC) and the Autism Rating Scale for Children (CARS) Autism Behavior Checklist (ABC).

Quality assessment / Risk of bias analysis In this part of the analysis, the risk of bias (ROB) for each included study was independently assessed by two authors using tools from the Cochrane Collaboration Network (JPT et al., 2023), covering seven items: Random sequence generation, assignment hiding, participant and person blindness, outcome evaluation blindness, incomplete outcome data, selective reporting, and other sources of bias. The ROB for each project was rated as low, unclear, or high risk of bias. Differences in quality assessments were resolved in consultation with the third author. (See Appendix 5 for ROB standards).

Strategy of data synthesis We used RevMan 5.4 ((RevMan), 2020) for all data analysis. For continuous variables, the mean difference (MD) or standard mean difference (SMD) is used for analysis. When different measurement tools or units are used for the same result, the SMD with 95% confidence interval (CIs) is chosen as the merge statistic. In contrast, when using the same assessment tool across studies, we calculated MD for 95% CI. If we encounter a continuous data merge in the opposite direction (i.e., a higher score in some studies represents a better effect, while a lower score in others represents a better effect), we take the opposite approach to data processing, i.e., invert the mean and standard deviation, and then merge the results again. To assess heterogeneity among the findings, we used I2 statistics. Heterogeneity was measured by I^2 statistics, and 75%, 50% and 25% were the boundary values of high and medium-low heterogeneity, respectively [20]. When $I^2 > 50\%$, the random effects model was used and the source of heterogeneity.

Subgroup analysis We further performed subgroup analyses based on the characteristics of the interventions, including the type, duration, frequency, and form of participation in physical activity. Subgroup analysis was performed according to the characteristics of intervention patients and further age.

Sensitivity analysis Conducting sensitivity analyses to assess the robustness of our findings, including excluding individual studies to assess their impact on the overall results.

Country(ies) involved China - Shanghai Lixin University of Accounting and Finance.

Keywords exercise intervention; Movement elements; Autism spectrum disorder; Repetitive and stereotypical behavior; meta-analysis.

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