INPLASY

Effects of Different Exercise Interventions on Repetitive Stereotyped Behaviors in Children and Adolescents with Autism Spectrum Disorder: A Network Meta-analysis

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Data analysis.

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 18 June 2025 and was last updated on 18 June 2025.

INTRODUCTION

Review question / Objective To evaluate the effectiveness of different exercise interventions on repetitive stereotyped behaviors in children and adolescents with autism spectrum disorder through network meta-analysis, and to rank the interventions based on their effectiveness.

Rationale Repetitive stereotyped behaviors are core symptoms of autism spectrum disorder (ASD) that significantly impact the daily functioning and quality of life of affected children and adolescents. While various exercise interventions have been proposed as therapeutic approaches, there is limited evidence comparing their relative effectiveness. This network meta-analysis aims to systematically evaluate and compare different exercise interventions for reducing repetitive stereotyped behaviors in children and adolescents with ASD. The study will provide evidence-based recommendations for clinicians, educators, and families to select the most effective exercise interventions.

Condition being studied Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction, along with restricted, repetitive patterns of behavior, interests, or activities. Repetitive stereotyped behaviors are one of the core diagnostic criteria for ASD and include motor stereotypies (such as hand flapping, body rocking), repetitive use of objects (such as spinning wheels, lining up toys), insistence on sameness and adherence to routines, and highly restricted, fixated interests.
These repetitive behaviors significantly impact the daily functioning, learning, and social integration of

children and adolescents with ASD. They can interfere with skill acquisition, social participation, and overall quality of life. The prevalence of ASD has been increasing globally, with current estimates suggesting that approximately 1 in 36 children are diagnosed with ASD. Given the chronic nature of these symptoms and their impact on development, effective interventions targeting repetitive stereotyped behaviors are crucial for improving outcomes for individuals with ASD and their families.

Exercise interventions have emerged as promising therapeutic approaches due to their potential to provide sensory regulation, reduce anxiety, improve self-regulation, and offer alternative outlets for repetitive behaviors while promoting physical health and social skills development.

METHODS

Search strategy autistic spectrum disorder OR autistic spectrum disorders OR autism spectrum disorders AND "physical activities OR aerobic exercise OR Sport OR Athletics AND Children OR Youth OR Teen AND repetitive behavior OR stereotypic behaviors.

Participant or population Children and adolescents aged 3-18 years with a confirmed diagnosis of Autism Spectrum Disorder (ASD). Participants must have been diagnosed by qualified healthcare professionals or authoritative institutions using standardized diagnostic criteria such as DSM-5 or ICD-11. The population will include individuals across the autism spectrum regardless of severity level, intellectual functioning, or comorbid conditions. Studies involving participants with ASD who exhibit repetitive stereotyped behaviors will be included, as these behaviors are the primary outcome of interest in this review.

Intervention Children and adolescents aged 3-18 years with a confirmed diagnosis of Autism Spectrum Disorder (ASD). Participants must have been diagnosed by qualified healthcare professionals or authoritative institutions using standardized diagnostic criteria such as DSM-5 or ICD-11. The population will include individuals across the autism spectrum regardless of severity level, intellectual functioning, or comorbid conditions. Studies involving participants with ASD who exhibit repetitive stereotyped behaviors will be included, as these behaviors are the primary outcome of interest in this review.

Comparator

Control groups will include:

No intervention/waitlist control groups

Treatment as usual/routine rehabilitation interventions

Standard care or conventional therapy approaches

Alternative exercise interventions different from the experimental group

Non-exercise control activities (such as educational programs or social activities)

Placebo or sham interventions.

Study designs to be included Only randomized controlled trials (RCTs) will be included in this network meta-analysis. This includes parallel-group RCTs, cluster-randomized trials, and crossover RCTs with appropriate washout periods. Studies must have at least two arms comparing different exercise interventions or comparing an exercise intervention with a control condition. The RCTs must report quantitative outcome measures for repetitive stereotyped behaviors using validated assessment scales.

Eligibility criteria

Inclusion Criteria:

Based on PICOS framework:

(1) Participants (P): Children and adolescents aged 3-18 years diagnosed with Autism Spectrum Disorder (ASD) by qualified medical institutions or healthcare professionals using standardized diagnostic criteria.

(2) Interventions (I): Various types of exercise interventions, including but not limited to ball sports, martial arts, aerobic exercises, gymnastics, yoga, team sports, and structured physical training programs.

(3) Outcomes (O): Assessment scales specifically designed to evaluate repetitive stereotyped behaviors in children and adolescents with autism, such as the Repetitive Behavior Scale-Revised (RBS-R), Gilliam Autism Rating Scale-Second Edition (GARS-2), and other validated instruments.

(4) Comparators (C): Control groups including no intervention/waitlist controls, routine rehabilitation interventions, standard care, or different exercise intervention approaches from the experimental group.

(5) Study design (S): Randomized controlled trials (RCTs) only.

Exclusion Criteria:

(1) Reviews, conference abstracts, and editorial articles

(2) Animal studies

(3) Studies with incomplete data or data that cannot be extracted

(4) Duplicate publications

(5) Case studies and case series

(6) Non-randomized studies

(7) Studies not published in English or Chinese

(8) Studies with participants outside the specified age range
(9) Studies without validated outcome measures for repetitive stereotyped behaviors.

Information sources
The following electronic databases will be systematically searched:
CNKI (China National Knowledge Infrastructure)
Web of Science Core Collection
Cochrane Library (including Cochrane Central Register of Controlled Trials)
PubMed/MEDLINE
EBSCO databases (including PsycINFO, CINAHL, and SPORTDiscus)

Additional sources will include:

Reference lists of included studies and relevant systematic reviews
Clinical trial registries (ClinicalTrials.gov, Chinese Clinical Trial Registry)
Grey literature sources
Contact with experts in the field for unpublished or ongoing studies.

Main outcome(s) The primary outcome will be the change in repetitive stereotyped behaviors in children and adolescents with autism spectrum disorder, as measured by validated assessment scales. These include:
Repetitive Behavior Scale-Revised (RBS-R): A comprehensive scale measuring various types of repetitive behaviors including stereotyped behavior, self-injurious behavior, compulsive behavior, ritualistic behavior, sameness behavior, and restricted behavior.
Gilliam Autism Rating Scale-Second Edition (GARS-2): Specifically the repetitive behaviors subscale that assesses stereotyped behaviors and restricted patterns of interest.
Other validated instruments such as the Autism Behavior Checklist (ABC), Childhood Autism Rating Scale (CARS), or researcher-developed scales with established psychometric properties.
Outcomes will be measured at multiple time points including:
Immediately post-intervention (primary endpoint)
Short-term follow-up (1-3 months post-intervention)
Long-term follow-up (6 months or longer, if available)
Effect measures will include mean differences, standardized mean differences, and 95% confidence intervals. For network meta-analysis, we will calculate the relative effectiveness of different exercise interventions and rank them according to their probability of being the most effective intervention for reducing repetitive stereotyped behaviors.

Quality assessment / Risk of bias analysis The methodological quality of included studies will be assessed using the PEDro (Physiotherapy Evidence Database) scale.The PEDro scale evaluates studies across 11 criteria: eligibility criteria (not scored), random allocation, concealed allocation, baseline comparability between groups, participant blinding, therapist blinding, assessor blinding, completeness of outcome data, intention-to-treat analysis, between-group comparisons, and measures of variability. The total score ranges from 0 to 10 points (eligibility criteria are not included in the scoring), with higher scores indicating better methodological quality.
Two independent reviewers will conduct the quality assessment, and any disagreements will be resolved through discussion or consultation with a third reviewer. Studies will be categorized as high quality (PEDro score ≥6), moderate quality (PEDro score 4-5), or low quality (PEDro score <4). The quality assessment results will be presented in tabular format and will inform the interpretation of findings and assessment of overall evidence quality.

Strategy of data synthesis Network meta-analysis will be conducted using Stata 18.0 software. Since the outcome indicators in the included studies are continuous variables but use different scales to assess repetitive stereotyped behaviors, standardized mean differences (SMD) and 95% confidence intervals (CI) will be used as effect size indicators.
The consistency between direct and indirect comparisons will be assessed using the node-splitting method. When the inconsistency test is not significant (P>0.05), it indicates good consistency between direct and indirect comparisons. The overall ranking of different interventions will be determined by calculating the Surface Under the Cumulative Ranking curve (SUCRA) values. SUCRA values range from 0-100%, with higher values (closer to 100%) indicating better overall ranking and effectiveness of the intervention among all compared interventions.
Publication bias will be evaluated using comparison-adjusted funnel plots for the included studies.

Subgroup analysis Subgroup analyses will be conducted to explore potential sources of heterogeneity and to identify factors that may modify the effectiveness of exercise interventions

on repetitive stereotyped behaviors. The following subgroup analyses are planned:
Age-based subgroups:
Preschool children (3-5 years)
School-age children (6-12 years)
Adolescents (13-18 years)

Intervention duration subgroups:
Short-term interventions (≤8 weeks)
Medium-term interventions (9-16 weeks)
Long-term interventions (>16 weeks)
Intervention intensity subgroups:
Low intensity (1-2 sessions per week)
Moderate intensity (3-4 sessions per week)
High intensity (≥5 sessions per week)
Type of exercise intervention subgroups:
Individual vs. group-based interventions
Structured vs. semi-structured exercise programs
Indoor vs. outdoor exercise activities
Autism severity subgroups:
Mild to moderate ASD
Severe ASD (based on standardized diagnostic assessments)
Outcome measurement subgroups:
Studies using RBS-R scale
Studies using GARS-2 scale
Studies using other validated scales
Subgroup analyses will only be performed if there are sufficient studies (≥3 studies per subgroup) to ensure meaningful comparisons. The results will help identify which populations and intervention characteristics are associated with greater effectiveness in reducing repetitive stereotyped behaviors.

Sensitivity analysis

Sensitivity analysis will be performed to test the robustness of the network meta-analysis results by:
Excluding studies one by one (leave-one-out analysis) to identify studies that may disproportionately influence the overall results
Excluding studies with small sample sizes (n<20 per group) to assess whether effect sizes are driven by smaller studies
Excluding studies with short intervention duration (20%) to assess the impact of incomplete data on results
The consistency and stability of results across these sensitivity analyses will be evaluated, and any substantial changes in effect estimates or rankings will be reported and discussed.

Country(ies) involved China, United States, Jordan, Iran.

Keywords Exercise intervention; Network meta-analysis; Autism spectrum disorder; Children and adolescents; Repetitive stereotyped behaviors.

Contributions of each author

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