

INPLASY202460105

doi: 10.37766/inplasy2024.6.0105

Received: 25 June 2024

Published: 25 June 2024

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ADMINISTRATIVE INFORMATION**Support** - None.**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202460105**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 25 June 2024 and was last updated on 25 June 2024.**INTRODUCTION**

Review question / Objective With the incidence of autism in children and adolescents increasing year by year, various treatment options are receiving increasing attention, and physical activity has great potential as a treatment option without side effects. However, which type of physical activity is the most effective is still in the exploratory stage. Therefore, the purpose of this systematic review and network meta-analysis was to evaluate comparative studies on the effects of various physical activity interventions on social and communication skills in children and adolescents with autism spectrum disorders (ASD).

Population (P):

Children and adolescents (ages 3-18) diagnosed with autism spectrum disorder (ASD).

Interventions (I):

Various physical exercise interventions

Comparators (C):

standard care or no intervention

Outcomes (O):

Sociability: Measured through standardized scales or observational assessments.

Secondary Outcome:

Communication: Measured through standardized scales or observational assessments.

Study Design (S):

Randomized controlled trials (RCTs)

Controlled clinical trials (CCTs).

Condition being studied Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder characterized by challenges in social interaction and communication, as well as the presence of repetitive behaviors or restricted interests. ASD affects individuals differently, with symptoms ranging from mild to severe, and is usually diagnosed in early childhood, with lasting effects into adulthood. The exact etiology of ASD is not fully understood, but it may involve a combination of genetic and environmental factors. The exact cause of ASD is not fully understood, but it may involve a combination of genetic and environmental factors.

METHODS

Search strategy

PubMed

#1 "Autism Spectrum Disorder"[Mesh]

#2 (((((((((((Autistic Spectrum Disorder[Title/Abstract]) OR (Autistic Spectrum Disorders[Title/Abstract])) OR (Disorder, Autistic Spectrum[Title/Abstract])) OR (Disorder, Autistic[Title/Abstract])) OR (Disorders, Autistic[Title/Abstract])) OR (Kanner's Syndrome[Title/Abstract])) OR (Kanner Syndrome[Title/Abstract])) OR (Kanners Syndrome[Title/Abstract])) OR (Autism, Infantile[Title/Abstract])) OR (Infantile Autism[Title/Abstract])) OR (Autism[Title/Abstract])) OR (Autism, Early Infantile[Title/Abstract])) OR (Early Infantile Autism[Title/Abstract])) OR (Infantile Autism, Early[Title/Abstract]))

#3 #1 AND #2

#4 (((sport[Title/Abstract]) OR (Exercise[Title/Abstract])) OR (Locomotor Activit[Title/Abstract])) OR (Physical therap[Title/Abstract])) OR (physical activit[Title/Abstract])) OR (motor activit[Title/Abstract])) OR (Training[Title/Abstract])) OR (Movement[Title/Abstract])) OR (Workout[Title/Abstract])) OR (Energy expenditure[Title/Abstract])) OR (Athletic[Title/Abstract])) OR (Physical education[Title/Abstract])) OR (Physical Activity[Title/Abstract])) OR (Soccer[Title/Abstract])) OR (Swim[Title/Abstract])) OR (Aquatic[Title/Abstract])) OR (Football[Title/Abstract])) OR (Pin pang[Title/Abstract])) OR (Ping-pong[Title/Abstract])) OR (Basketball[Title/Abstract])) OR (Cricket[Title/Abstract])) OR (Tennis[Title/Abstract])) OR (Rugby[Title/Abstract])) OR (Danc[Title/Abstract])) OR (Martial art[Title/Abstract])) OR (Netball[Title/Abstract])) OR (Hockey[Title/Abstract])) OR (Gym[Title/Abstract])) OR (Horse rid[Title/Abstract])) OR (Horseback rid[Title/Abstract])) OR (Equestrian[Title/Abstract])) OR (Baseball[Title/Abstract])) OR (Yoga[Title/Abstract])) OR (Badminton[Title/Abstract])) OR (Taekwondo[Title/Abstract])) OR (Judo[Title/Abstract])) OR (Cycling[Title/Abstract])) OR (Physical fitness[Title/Abstract])) OR (Bicycling[Title/Abstract])) OR (Boxing[Title/Abstract])) OR (Golf[Title/Abstract])) OR (Tai Ji[Title/Abstract])) OR (Skating[Title/Abstract])) OR (Snow sports skiing[Title/Abstract])) OR (Wrestling[Title/Abstract])) OR (Weight lifting[Title/Abstract])) OR (Games recreational[Title/Abstract])) OR (Weight bearing exercise[Title/Abstract])) OR (Strength training[Title/Abstract])) OR (Running[Title/Abstract])) OR (Trampoline[Title/Abstract])) OR (Snowshoeing[Title/Abstract])) OR (Exergaming[Title/Abstract])) OR (Walking[Title/Abstract])) OR (Treadmill[Title/Abstract]))

#5 (((((((((((randomized controlled trial) OR (randomized)) OR (placebo)) OR (randomised)) OR (random)) OR (rct)) OR (controlled clinical trial)) OR (Pilot Study)

#6 (((Social skills[Title/Abstract]) OR (Social behavior[Title/Abstract])) OR (Social ability[Title/Abstract])) OR (Social competence[Title/Abstract])) OR (Interpersonal skills[Title/Abstract])) OR (Social isolation[Title/Abstract])) OR (Social anxiety[Title/Abstract])) OR (Social dysfunction[Title/Abstract])) OR (Social disorder[Title/Abstract])) OR (Social segregation[Title/Abstract])) OR (Communication[Title/Abstract])) OR (Communicate[Title/Abstract])) OR (Social responsiveness[Title/Abstract])) OR (Sociability[Title/Abstract])) OR (Socialization[Title/Abstract])) OR (Social motivation[Title/Abstract])) OR (Social awareness[Title/Abstract])) OR (Social cognition[Title/Abstract]))

#7 #3 AND #4 AND #5 AND #6

Web of Science

#1 TS=(Autism Spectrum Disorders or Autistic Spectrum Disorder or Autistic Spectrum Disorders or Disorder,Autistic Spectrum or Disorder,Autistic or Disorders,Autistic or Kanner's Syndrome or Kanner Syndrome or Kanners Syndrome or Autism,Infantile or Infantile Autism or Autism or Autism,Early Infantile or Early Infantile Autism or Infantile Autism,Early)

#2 TS=(sport or Exercise or Locomotor Activit or Physical therap or physical activit or motor activit or Training or Movement or Workout or Energy expenditure or Athletic or Physical education or Physical Activity or Soccer or Swim or Aquatic or Football or Pin pang or Ping-pong or Basketball or Cricket or Tennis or Rugby or Danc or Martial art or Netball or Hockey or Gym or Horse rid or Horseback rid or Equestrian or Baseball or Yoga or Badminton or Taekwondo or Judo or Cycling or Physical fitness or Bicycling or Boxing or Golf or Tai Ji or Skating or Snow sports skiing or Wrestling or Weight lifting or Games recreational or Weight bearing exercise or Strength training or Running or Trampoline or Snowshoeing or Exergaming or Walking or Treadmill)

#3 TS=(Child or Adolescent or Young Adult or Minor)

#4 AB=(randomized controlled trial or randomized or placebo or randomised or random or rct or controlled clinical trial or trial or Pilot Study)

#5 AB=(Social skills or Social behavior or Social ability or Social competence or Interpersonal skills or Social isolation or Social anxiety or Social dysfunction or Social disorder or Social segregation or Communication or Communicate or Social responsiveness or Sociability or

Socialization or Social motivation or Social awareness or Social cognition)
#6 #1 AND #2 AND #3 AND #4 AND #5

Cochrane Library

#1 (Autism Spectrum Disorder):ti,ab,kw OR (Autistic Spectrum Disorder):ti,ab,kw OR (Autistic Spectrum Disorders):ti,ab,kw OR (Disorder, Autistic Spectrum):ti,ab,kw OR (Disorder, Autistic):ti,ab,kw OR (Disorders, Autistic):ti,ab,kw OR (Kanner's Syndrome):ti,ab,kw OR (Kanner Syndrome):ti,ab,kw OR (Kanners Syndrome):ti,ab,kw OR (Autism, Infantile):ti,ab,kw OR (Infantile Autism):ti,ab,kw OR (Autism):ti,ab,kw OR (Autism, Early Infantile):ti,ab,kw OR (Early Infantile Autism):ti,ab,kw OR (Infantile Autism, Early):ti,ab,kw

#2 (sport):ti,ab,kw OR (Exercise):ti,ab,kw OR (Locomotor Activit):ti,ab,kw OR (Physical therap):ti,ab,kw OR (physical activit):ti,ab,kw OR (motor activit):ti,ab,kw OR (Training):ti,ab,kw OR (Movement):ti,ab,kw OR (Workout):ti,ab,kw OR (Energy expenditure):ti,ab,kw OR (Athletic):ti,ab,kw OR (Physical education):ti,ab,kw OR (Physical Activity):ti,ab,kw OR (Soccer):ti,ab,kw OR (Swim):ti,ab,kw OR (Aquatic):ti,ab,kw OR (Football):ti,ab,kw OR (Pin pang):ti,ab,kw OR (Ping-pong):ti,ab,kw OR (Basketball):ti,ab,kw OR (Cricket):ti,ab,kw OR (Tennis):ti,ab,kw OR (Rugby):ti,ab,kw OR (Danc):ti,ab,kw OR (Martial art):ti,ab,kw OR (Netball):ti,ab,kw OR (Hockey):ti,ab,kw OR (Gym):ti,ab,kw OR (Horse rid):ti,ab,kw OR (Horseback rid):ti,ab,kw OR (Equestrian):ti,ab,kw OR (Baseball):ti,ab,kw OR (Yoga):ti,ab,kw OR (Badminton):ti,ab,kw OR (Taekwondo):ti,ab,kw OR (Judo):ti,ab,kw OR (Cycling):ti,ab,kw OR (Physical fitness):ti,ab,kw OR (Bicycling):ti,ab,kw OR (Boxing):ti,ab,kw OR (Golf):ti,ab,kw OR (Tai Ji):ti,ab,kw OR (Skating):ti,ab,kw OR (Snow sports skiing):ti,ab,kw OR (Wrestling):ti,ab,kw OR (Weight lifting):ti,ab,kw OR (Games recreational):ti,ab,kw OR (Weight bearing exercise):ti,ab,kw OR (Strength training):ti,ab,kw OR (Running):ti,ab,kw OR (Trampoline):ti,ab,kw OR (Snowshoeing):ti,ab,kw OR (Exergaming):ti,ab,kw OR (Walking):ti,ab,kw OR (Treadmill):ti,ab,kw

#3 (randomized controlled trial):ti,ab,kw OR (randomized):ti,ab,kw OR (placebo):ti,ab,kw OR (randomised):ti,ab,kw OR (random):ti,ab,kw OR (rct):ti,ab,kw OR (controlled clinical trial):ti,ab,kw OR (trial):ti,ab,kw OR (Pilot Study):ti,ab,kw

#4 (Social skills):ti,ab,kw OR (Social behavior):ti,ab,kw OR (Social ability):ti,ab,kw OR (Social competence):ti,ab,kw OR (Interpersonal skills):ti,ab,kw OR (Social isolation):ti,ab,kw OR (Social anxiety):ti,ab,kw OR (Social dysfunction):ti,ab,kw OR (Social disorder):ti,ab,kw

OR (Social segregation):ti,ab,kw OR (Communication):ti,ab,kw OR (Communicate):ti,ab,kw OR (Social responsiveness):ti,ab,kw OR (Sociability):ti,ab,kw OR (Socialization):ti,ab,kw OR (Social motivation):ti,ab,kw OR (Social awareness):ti,ab,kw OR (Social cognition):ti,ab,kw
#5 #1 And #2 And #3 And #4.

Participant or population This review will focus on children and adolescents aged 3 to 18 years who have been formally diagnosed with autism spectrum disorder (ASD) based on recognized diagnostic criteria (DSM-5 or ICD-10/ICD-11). Participants will come from diverse geographical and cultural backgrounds and may receive interventions in various settings, including schools, clinics, community centers, and home environments. Studies involving participants with co-occurring developmental disorders or severe intellectual disabilities will be excluded unless ASD is the primary diagnosis and focus.

Intervention Various physical activity interventions, such as water sports, horseback riding, yoga, sports games, ball games, aerobics, and therapeutic means of combining physical activities, etc.

Comparator Children and adolescents with autism who include other types of physical activity as well as daily physical activity, or who do not participate in physical activity at all.

Study designs to be included Randomized controlled trials (RCTs) or Controlled clinical trials (CCTs).

Eligibility criteria Inclusion criteria:

1. the type of study must be a RCT or a CCT.
2. participants are children and adolescents between the ages of 3-18 years with autism.
3. the intervention is a variety of physical exercise or physical activity.

Exclusion Criteria:

1. incomplete data.
2. very small sample size.
3. intervention was not consistent with physical activity.
4. type of study not rct or cct.

Information sources We searched English databases, including Web of Science, PubMed, Cochrane library, Scopus, Embase. We also searched the CNKI and Wanfang data platforms. Search strings included physical activity interventions, age ranges, and study types with outcomes associated with individuals with autism.

The search was performed up to May 2024october 2022.

Main outcome(s) Effectiveness of different physical exercise interventions on social functioning and communication functioning in children and adolescents with autism.

Quality assessment / Risk of bias analysis Physiotherapy Evidence Database scale (PEDro).

Strategy of data synthesis For each outcome (sociability and communication), we will perform pairwise meta-analyses using random-effects models to account for heterogeneity across studies. Summary effect sizes will be calculated as standardized mean differences (SMD) with 95% confidence intervals (CIs) for continuous outcomes and risk ratios (RR) with 95% CIs for dichotomous outcomes.

Heterogeneity will be assessed using the I^2 statistic and Cochran's Q test, with substantial heterogeneity indicated by an I^2 value greater than 50%.

A network meta-analysis (NMA) will be conducted to compare the effectiveness of multiple physical exercise interventions simultaneously. This approach allows for the estimation of direct and indirect treatment effects, providing a comprehensive ranking of the interventions.

A Bayesian framework will be employed for the NMA, using Markov Chain Monte Carlo (MCMC) methods. Convergence of the MCMC chains will be assessed using the Gelman-Rubin diagnostic.

Consistency between direct and indirect evidence will be evaluated using node-splitting models and the design-by-treatment interaction model.

Inconsistency in the network will be assessed by comparing the fit of consistency and inconsistency models. If significant inconsistency is detected, potential sources will be explored, and sensitivity analyses will be conducted to determine the robustness of the findings.

Subgroup analysis None.

Sensitivity analysis None.

Language restriction English and Chinese.

Country(ies) involved China.

Keywords Physical Exercise Interventions; Autism Spectrum Disorder (ASD); Network Meta-Analysis (NMA); Communication Skills.

Contributions of each author

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