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Review Article

# Physical fitness of children and adolescents with autistic spectrum disorder: a systematic review

## *Aptidão física de crianças e adolescentes com transtorno do espectro autista: uma revisão sistemática*

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## Abstract

**Objective:** To analyze the body of knowledge on the physical fitness of children and adolescents with autism spectrum disorder (ASD) in comparison with their typically developing peers. **Method:** This systematic review included observational studies published in English that involved children and adolescents diagnosed with ASD and assessed components of physical fitness. The searches were conducted in the Scopus, PubMed, Web of Science, and LILACS databases, and the methodological quality of the studies was analyzed using the Newcastle-Ottawa Quality Assessment Scale (NOS). **Results:** A total of 7,347 articles were retrieved in the initial searches, and nine were included after the eligibility criteria were applied. The findings showed that the physical fitness of children and adolescents with ASD was significantly lower than that of their typically developing peers. **Conclusion:** Based on the evidence gathered from nine observational studies classified as moderate to high quality, children and adolescents with ASD showed lower physical fitness than their typically developing peers when assessed through physical fitness tests.

**Keywords:** Autistic Disorder; Autism Spectrum Disorder; Child; Physical Fitness.

## *Resumo*

**Objetivo:** Analisar a produção do conhecimento sobre o tema aptidão física de crianças e adolescentes com transtorno do espectro autista (TEA) em comparação com seus pares com desenvolvimento típico. **Método:** Nesta revisão sistemática, foram incluídos artigos observacionais publicados em língua inglesa, com população

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de crianças e adolescentes com diagnóstico de TEA, que avaliaram componentes da aptidão física. As buscas foram conduzidas nas bases de dados Scopus, PubMed, Web of Science e LILACS, e a qualidade metodológica dos estudos foi analisada com por meio da *Newcastle-Ottawa Quality Assessment Scale* (NOS). **Resultados:** Ao todo, 7.347 artigos foram recuperados nas buscas iniciais, e nove foram incluídos após a aplicação dos critérios de elegibilidade. Os achados evidenciaram que a aptidão física das crianças e adolescentes com TEA foi significativamente inferior à de seus pares com desenvolvimento típico. **Conclusão:** Com base nas evidências levantadas a partir de nove estudos observacionais classificados como de moderada a alta qualidade, crianças e adolescentes com TEA apresentaram aptidão física inferior à de seus pares com desenvolvimento típico quando avaliadas por meio de testes de aptidão física.

**Palavras-chave:** Autismo, Transtorno do Espectro Autista, Criança, Aptidão Física.

## Introduction

Autism spectrum disorder (ASD) is considered a complex and heterogeneous condition that interferes with the typical course of child development and affects about 1% of school-aged children (American Psychiatric Association, 2013; Maenner et al., 2021).

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, Text Revision (DSM-5-TR), the diagnostic criteria for ASD involve a dyad of symptoms: (a) persistent deficits in social communication and social interaction and (b) restricted and repetitive patterns of behavior, interests, or activities. These characteristics are present from the early developmental periods and cause significant impairment in social and academic functioning and in activities of daily living (ADLs) (American Psychiatric Association, 2022).

Deficits in social interaction encompass several aspects, including an inability or difficulty initiating interactions with others, sharing emotions, engaging in conversations, or maintaining eye contact during interactions (Fernandes et al., 2021; Vives-Vilarroig et al., 2022).

Impairments in social communication include difficulties in the verbal and nonverbal aspects of language and range from absence of speech to language delay, difficulty understanding spoken language, or difficulty understanding the nonverbal aspects of communication, such as imitation, visual communication, shared attention, and understanding facial expressions (Lima et al., 2017). Additionally, ASD is classified according to the individual's level of difficulty. This classification is based on the severity of the symptoms characteristic of ASD in each individual, determining the level of support required by the person with autism.

Level 1 includes individuals who require support. These individuals are able to engage in communication, despite difficulties, and tend to show attempts to make friends that are perceived as unsuccessful or odd; they also tend to resist changes in activities because, when they are not receiving professional support, they show difficulties that impair social interaction with other people, such as initiating a conversation. Level 2 includes individuals who require substantial support and who, even with support, present significant deficits in verbal and nonverbal social communication, demonstrate inflexibility of behavior, and may have their behavior affected by changes in their everyday routine; stereotypies are common and noticeable to others. Level 3 corresponds

to individuals who require very substantial support from others, present very significant difficulty communicating and performing ADLs, and require professional support throughout life (American Psychiatric Association, 2022).

Even individuals with ASD who have good vocabulary and grammar skills may present impairments in reciprocal social communication because of a literal use of language, which leads to difficulties understanding content that should not be interpreted literally and understanding the other person's gestures or body posture during social interactions (Sharma et al., 2018).

Although motor issues are not among the primary diagnostic elements of ASD, important limitations in movement coordination, motor skill acquisition, and motor control are documented early in children who later receive an ASD diagnosis (Pan, 2014). Other motor signs, such as toe walking and atypical gait, including lack of coordination, are cited in the DSM-5 as deficits frequently present in these individuals (American Psychiatric Association, 2022).

Therefore, social, behavioral, and motor difficulties may interfere with several opportunities to engage in physical activity and place this population at risk of not reaching optimal levels of physical activity. According to the World Health Organization (World Health Organization, 2019), children and adolescents between 5 and 17 years of age should perform at least 60 minutes of varied physical activity per day at moderate to vigorous intensity (World Health Organization, 2020). However, children and adolescents with ASD have greater difficulty being physically active when compared with their typically developing peers because of several barriers to physical activity during childhood. Deficits in social interaction are among the barriers reported in the literature as obstacles to a more physically active life for individuals with ASD; other factors include inattention and motor deficits observed in this population, which tend to reduce children's participation in play involving other children, thus limiting opportunities for physical activity (Obrusnikova & Cavalier, 2011; Pan & Frey, 2006).

As a consequence, this limits children and adolescents with ASD from reaching optimal levels of physical fitness, which is defined as the body's ability to adapt to the demands of physical exertion at moderate or vigorous levels without complete exhaustion (Caspersen et al., 1985), and is viewed as an indicator of good health. Thus, they tend to develop overweight and obesity because of their predominantly sedentary behaviors (Curtin et al., 2010). Studies support this argument by showing lower scores on physical fitness tests in children with ASD when compared with children with typical development (Pan et al., 2016; Tyler et al., 2014). The components of physical fitness may be related to health, such as cardiovascular endurance, body composition, muscular strength, muscular endurance, and flexibility (American College of Sports Medicine, 2016), and to sports performance, such as agility, coordination, balance, power, reaction time, and speed (American College of Sports Medicine, 2016; Blair et al., 2001; Corbin et al., 2000).

Although recent systematic reviews (Jones et al., 2017; Liang et al., 2020) have shown reduced levels of physical activity and elevated sedentary behavior in children with ASD, the small sample size and methodological weaknesses of the studies ultimately limited the synthesis of evidence in those reviews. Whereas the review by Jones et al. (2017) excluded studies that assessed the physical fitness of these children, the review by Liang et al. (2020) synthesized that better physical fitness was associated

with higher levels of physical activity in children with ASD. Finally, although both reviews raised important evidence for the field, more specific comparisons between physical fitness components in children and adolescents with and without ASD were not conducted.

In an attempt to answer the following research question, What information exists in the literature on the physical fitness of children and adolescents with ASD compared with their typically developing peers?, this systematic review aimed to analyze the body of knowledge on the physical fitness of children and adolescents with ASD compared with their peers with typical development. The hypothesis was that the literature in the field would show that children and adolescents with ASD present scores significantly lower than those of their typically developing peers in the physical fitness components.

## Method

This systematic review followed all recommendations contained in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021) and was submitted to the International Prospective Register of Systematic Reviews (PROSPERO) for registration. To improve alignment in the study, the PECO acronym strategy was used, establishing the following:
**Population (P)**: children and adolescents 3 to 18 years of age;
**Exposure (E)**: autism spectrum disorder;
**Comparator (C)**: typically developing peers;
**Outcome (O)**: physical fitness components.

Accordingly, the following descriptors were selected: "Autism Spectrum Disorders", "Autism", "Physical Fitness", "ASD", "Autism Physical Activity", "Muscle Strength", "Muscle Power", "Agility", "Physical Endurance", "Exercise Tolerance", and "Child".

### Eligibility criteria

This systematic review included original observational studies, whether cross-sectional, case-control, or cohort in design, that assessed the physical fitness of children and/or adolescents aged 3 to 18 years with a clinical diagnosis of ASD in comparison with their typically developing peers. Eligible studies were required to assess at least one component of physical fitness using specific techniques or instruments and to compare the results between groups.

Studies published in any period up to the cutoff date of 10 September 2025 were included. Qualitative studies, review studies, and studies involving children without a clinical diagnosis of ASD were excluded, as were those that, even while including children and/or adolescents, encompassed age groups other than those defined as the target population of this study.

### Information sources and descriptors

The studies were searched in the PubMed, LILACS, Scopus, and Web of Science databases. In addition, the reference lists of the included articles were reviewed to identify possible additional studies of interest. To facilitate retrieval of the studies of interest, the

following search strings were constructed with the aid of the Boolean operators AND and OR, as described in Table 1.

**Table 1.** Search strings used in the databases.

| Database | String |
|---|---|
| PubMed | a) ("Autism Spectrum Disorder" OR "Autistic Disorder") AND ("Physical Fitness" OR "Muscle Power") AND Child* |
| | b) ("Autism Spectrum Disorder" OR "Autistic Disorder") AND ("Physical Fitness" OR "Muscle Strength") AND Child* |
| | c) ("Autism Spectrum Disorder" OR "Autistic Disorder") AND ("Physical Fitness" OR "Exercise Tolerance") AND Child* |
| | d) ("Autism Spectrum Disorder" OR "Autistic Disorder") AND ("Physical Fitness" OR "Physical Endurance") AND Child* |
| Web of Science | TS=(("Autism Spectrum Disorder" OR "Autistic Disorder" OR "ASD") AND ("Physical Fitness" OR "Muscle Strength" OR "Muscle Power" OR "Exercise Tolerance" OR "Physical Endurance" OR "Agility") AND Child*) |
| Scopus | ("Autism Spectrum Disorder" OR "Autistic Disorder" OR ASD) AND ("Physical Fitness" OR "Muscle Strength" OR "Muscle Power" OR "Exercise Tolerance" OR "Physical Endurance" OR "Agility") AND Child* |
| LILACS | ("Autism Spectrum Disorder" OR "Autistic Disorder" OR ASD) AND ("Physical Fitness" OR "Muscle Strength" OR "Muscle Power" OR "Exercise Tolerance" OR "Physical Endurance" OR "Agility") AND Child* |

## Searches and study selection

The searches were conducted in the databases indicated above, independently, by three researchers (the first, second, and third authors), all of whom had experience with systematic reviews. In each database, the searches began and ended on the same day, with one database searched at a time. A new search in another database was initiated only after the searches in the previous database had been completed. Study selection followed these stages: initial search in the databases, checking for duplicate articles across databases using the RAYYAN tool, selection of titles of interest that contained at least one of the listed descriptors, selection of abstracts of interest, and selection of full texts of interest through application of the eligibility criteria. All stages of study selection were conducted independently by the same three researchers, and disagreements were resolved by consensus.

## Synthesis of the results

The synthesis of the studies was descriptive and was based on the following information: study design, sample and age range of the children and/or adolescents, physical fitness variables investigated, instruments used to assess the physical fitness

variables, and the main findings of each study. For the comparative analysis of the scores obtained in the physical fitness tests between children and/or adolescents with ASD and their typically developing peers, the significance level (*p*-value) was adopted as the reference. Therefore, one of the following options was assigned in the comparison between groups: (i) ASD ↓ controls; (ii) ASD ↑ controls; or (iii) ASD = controls, when, respectively, the scores obtained by children and/or adolescents with ASD were significantly ($p$ <0.05) lower than, higher than, or equal to those obtained by the typically developing controls.

### Risk-of-bias analysis

The Newcastle-Ottawa Quality Assessment Scale (NOS) was used for the risk-of-bias analysis. The NOS is specific to observational studies and has versions for cohort, case-control, and cross-sectional studies (Luchini et al., 2017). The scale evaluates three elements of the articles' methodology: 1) selection of participants, verifying whether basic characteristics were met in the studies; 2) comparability, verifying whether the groups are equivalent in some specific characteristics of the study population; and 3) exposure/outcome, analyzing the outcome of the variables. Scoring is based on a system of stars distributed across evaluation categories. Methodological quality was classified as follows: >7, high quality; 5–6, moderate quality; and <4, low quality (Luchini et al., 2017).

In this study, the version for studies with a cross-sectional design was used. In this version, the selection category contains 4 items; in the 4th item, up to 2 stars may be awarded if the study meets alternative "a", with 5 stars being the maximum score in this category. Comparability has 1 item and may receive a maximum of 2 stars; the exposure/outcome category is composed of 2 items and may receive a maximum of 3 stars. The highest score in this version of the scale is 10 stars (Luchini et al., 2017).

The risk-of-bias assessment of the studies was conducted independently by two researchers (the first and second authors), and disagreements were resolved by consensus. Disagreement rates were calculated and presented to ensure inter-rater reliability.

## Results

A total of 7,347 studies were identified in the initial search of the databases and, after duplicate checking, 7,257 remained. After title and abstract screening, 16 articles were read in full. Of these, nine articles comprised the final sample because they met the eligibility criteria established in the study. No studies were added after manual checking of the reference lists of the included articles. The detailed flowchart of study selection is presented in Figure 1.

Table 2 presents a synthesis of the characteristics and main findings of the studies included in this systematic review. All studies were cross-sectional in design, with a total of 856 participating children and/or adolescents. Of these, 413 were children and/or adolescents with ASD, and 443 were typically developing children and/or adolescents. Ages ranged from 4 to 18 years, with mean ages of 11.44 (±1.38) and 10.32 (±1.31) years for children and/or adolescents with ASD and typically developing children and/or adolescents, respectively. An ASD diagnosis was reported according to DSM criteria

in five of the nine studies (Bricout et al., 2018; Latorre-Román et al., 2019; Pace & Bricout, 2015; Ludyga et al., 2021; Pan et al., 2016).

Regarding the physical fitness components assessed, flexibility and muscular strength were the most frequent, appearing in sux of the nine studies (Bricout et al., 2018; Coffey et al., 2021; Lourenço et al., 2020; Odeh et al., 2020; Pace & Bricout, 2015; Ludyga et al., 2021; Pan et al., 2016; Tyler et al., 2014), whereas lower-limb muscular strength and endurance, abdominal strength and endurance, speed, and aerobic capacity were the least assessed, appearing in only four of the nine studies (Bricout et al., 2018; Pace & Bricout, 2015; Pan et al., 2016; Tyler et al., 2014). Respectively, the Eurofit sit-and-reach test and the BOT-2 muscular strength subtest were the instruments most frequently used to assess flexibility and muscular strength (Bricout et al., 2018; Coffey et al., 2021; Lourenço et al., 2020; Odeh et al., 2020; Pace & Bricout, 2015; Tyler et al., 2014).

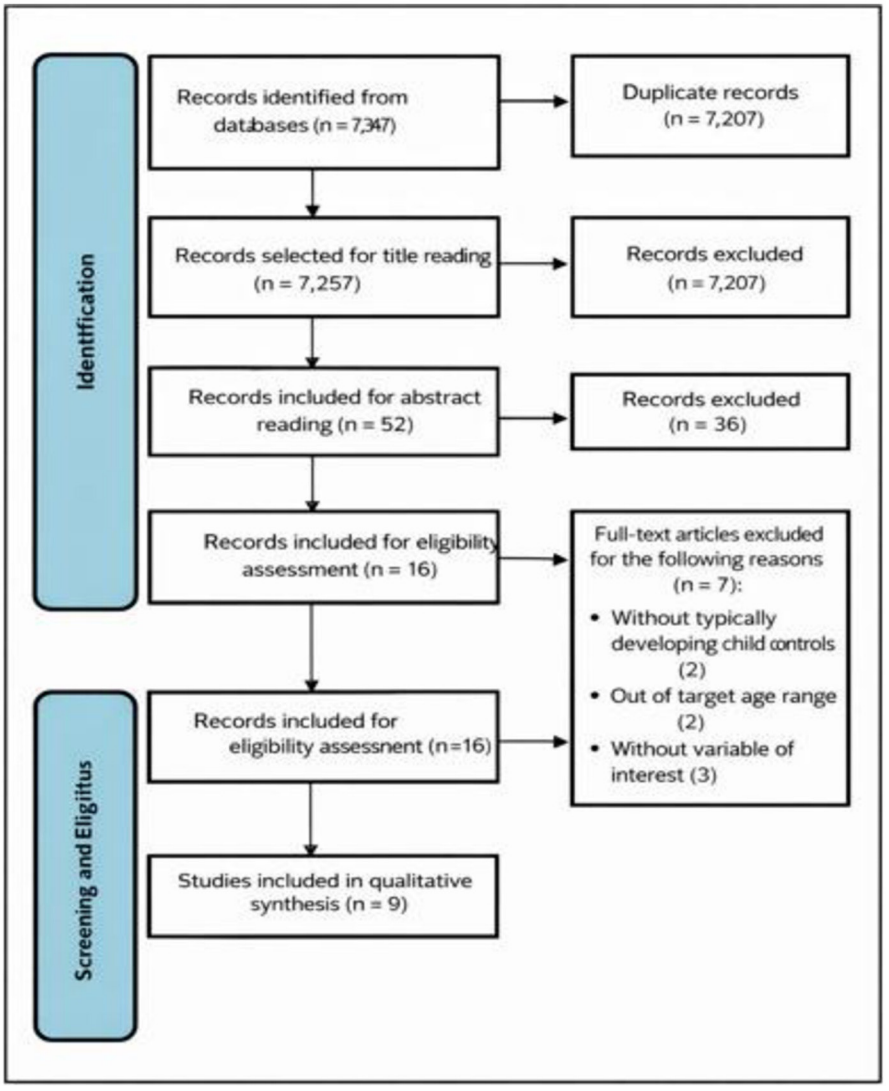


**Figure 1.** Flowchart describing the search strategy and article selection criteria according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

**Table 2.** Synthesis of the characteristics of the included articles.

| Authors (year) | Study design | Total sample | ASD group (n) | Mean age (SD) | Control group (n) | Mean age (SD) | ASD diagnosis | Physical fitness components | Physical fitness assessment | Study objective | Main results |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lourenço et al. (2020) | Cross-sectional | 20 | 10 | 6.9 (1.97) | 10 | 7.0 (1.83) | Not reported | Speed/agility; muscular strength | BOT-2, Running Speed and Agility subtest; BOT-2, Strength subtest | To assess the motor proficiency of Portuguese children with ASD and compare it with that of typically developing children | Speed/agility and muscular strength: ASD ↓ controls |
| Odeh et al. (2020) | Cross-sectional | 24 | 12 | 8.71 (1.69) | 12 | 8.74 (2.42) | ADOS-2; CARS-2 | Muscular strength; speed/ agility | BOT-2, Strength subtest; BOT-2, Speed/Agility subtest | To establish a robust motor profile in children with ASD across a broader range of motor competencies by using professionally administered standardized motor assessments together with a parent-report measure to capture a comprehensive view of motor performance in comparison with neurotypical peers | Muscular strength and speed/agility: ASD ↓ controls |
| Latorre-Román et al. (2019) | Cross-sectional | 31 | 13 | 4.18 (0.63) | 18 | 4.27 (0.92) | DSM-5; Autism Diagnostic Interview-R; ADOS | Cardiorespiratory endurance; explosive strength; handgrip strength | Latorre et al. physical fitness test: 10 × 20 m test; standing long jump; hand dynamometer; 20 m sprint test | To assess physical fitness in preschool children with ASD | Cardiorespiratory endurance, explosive strength, and handgrip strength: ASD ↓ controls |

**Note:** PACER-20 m – Progressive Aerobic Cardiovascular Endurance Run; DSM-5 – Diagnostic and Statistical Manual of Mental Disorders, 5th edition; ASSQ – Autism Spectrum Screening Questionnaire.

**Table 2.** Continued...

| Authors (year) | Study design | Total sample | ASD group (n) | Mean age (SD) | Control group (n) | Mean age (SD) | ASD diagnosis | Physical fitness components | Physical fitness assessment | Study objective | Main results |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bricout et al. (2018) | Descriptive cross-sectional | 40 | 20 | 10.7 (1.2) | 20 | 10.0 (1.6) | DSM-5; ADOS | Aerobic capacity; handgrip strength; explosive strength; flexibility | Eurofit: maximal treadmill test; hand dynamometer; standing long jump; sit-and-reach test | To investigate, in the laboratory, the physical fitness of children with ASD in comparison with typically developing children by measuring maximum oxygen consumption rate (VO2max) | Aerobic capacity, handgrip strength, explosive strength, and flexibility: ASD ↓ controls |
| Pace and Bricout (2015) | Cross-sectional | 20 | 10 | 10.10 (1.45) | 10 | 10.20 (1.40) | Medical certificate; DSM-IV; ICD-10 | Flexibility; lower-limb explosive strength; muscular endurance; abdominal strength and endurance; speed | Eurofit: flexibility test (sit-and-reach); standing long jump and vertical jump test; handgrip strength test with dynamometer; abdominal muscular endurance test; 9 m sprint/reactive speed | To investigate how heart rate adjusts during different physical phases. To test and assess physical fitness components in children with ASD and compare these results with those of typically developing children matched by age and gender | Flexibility, explosive leg power, hand and forearm muscular strength, abdominal strength and endurance, and speed: ASD ↓ controls |

**Note:** PACER-20 m – Progressive Aerobic Cardiovascular Endurance Run; DSM-5 – Diagnostic and Statistical Manual of Mental Disorders, 5th edition; ASSQ – Autism Spectrum Screening Questionnaire.

**Table 2.** Continued...

| Authors (year) | Study design | Total sample | ASD group (n) | Mean age (SD) | Control group (n) | Mean age (SD) | ASD diagnosis | Physical fitness components | Physical fitness assessment | Study objective | Main results |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Coffey et al. (2021) | Cross-sectional | 244 | 92 | 8.3 (2.1) | 152 | 8.3 (2.1) | GARS-2 | Cardiorespiratory endurance; muscular strength; flexibility; muscular endurance | Eurofit: 20 m run test; standing long jump; sit-and-reach test; handgrip strength test with dynamometer | To investigate whether differences exist in physical fitness levels between children with ASD and typically developing peers according to age by using a modified Eurofit test battery | Cardiorespiratory endurance, muscular strength, flexibility, and muscular endurance: ASD ↓ controls. GARS-2 was used to measure the degree of ASD symptoms in the participating children |
| Ludyga et al. (2021) | Cross-sectional | 376 | 139 | 10.5 (0.2) | 101 | 10.3 (0.2) | Kiddie Schedule for Affective Disorders and Schizophrenia; DSM-5; ASSQ | Muscular strength | Fitnessgram battery | To investigate the association of ASD, muscular strength, and body mass index with executive function and information processing among participants in the Healthy Brain Network cohort | Muscular strength: ASD ↓ controls |

**Note:** PACER-20 m – Progressive Aerobic Cardiovascular Endurance Run; DSM-5 – Diagnostic and Statistical Manual of Mental Disorders, 5th edition; ASSQ – Autism Spectrum Screening Questionnaire.

**Table 2.** Continued...

| Authors (year) | Study design | Total sample | ASD group (n) | Mean age (SD) | Control group (n) | Mean age (SD) | ASD diagnosis | Physical fitness components | Physical fitness assessment | Study objective | Main results |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tyler et al. (2014) | Cross-sectional | 29 | 17 | 12.6 (2.3) | 12 | 9.0 (1.8) | ADOS | Aerobic capacity; flexibility; handgrip strength | 20-meter Multistage Shuttle Run; sit-and-reach test; handgrip dynamometer | To examine physical activity and physical fitness in school-aged children with ASD in comparison with their typically developing peers | Aerobic capacity and flexibility: ASD = controls; handgrip strength: ASD ↓ controls |
| Pan et al. (2016) | Cross-sectional | 70 | 35 | 14.55 (1.54) | 35 | 14.81 (1.55) | DSM-5 | Aerobic functioning; upper-limb muscular strength and endurance; abdominal muscular strength and endurance; flexibility | 20 m PACER run; push-ups; curl-up exercises; sit-and-reach test | To compare physical activity and physical fitness between male secondary school students with ASD and their typically developing peers, and to assess the possible interrelationship between physical activity and physical fitness in each group | Aerobic functioning, upper-limb and abdominal muscular strength and endurance, and flexibility: ASD ↓ controls |

**Note:** PACER-20 m – Progressive Aerobic Cardiovascular Endurance Run; DSM-5 – Diagnostic and Statistical Manual of Mental Disorders, 5th edition; ASSQ – Autism Spectrum Screening Questionnaire.

**Table 3.** Analysis of the methodological quality of the studies according to the Newcastle–Ottawa Quality Assessment Scale (NOS).

| Study | Study design | Selection 1 | Selection 2 | Selection 3 | Selection 4 | Comparability 1a | Comparability 1b | Outcome 1 | Outcome 2 | Total NOS score |
|---|---|---|---|---|---|---|---|---|---|---|
| (Lourenço et al., 2020) | Cross-sectional | N/A | N/A | N/A | N/A | * | N/A | **(b) | * | 4/10 (40%) |
| (Odeh et al., 2020) | Cross-sectional | N/A | * | * | ** | * | * | **(b) | * | 9/10 (90%) |
| (Latorre-Román et al., 2019) | Cross-sectional | N/A | N/A | N/A | ** | N/A | N/A | **(b) | * | 5/10 (50%) |
| (Bricout et al., 2018) | Cross-sectional | N/A | N/A | * | ** | * | * | **(b) | * | 8/10 (80%) |
| (Pace & Bricout, 2015) | Cross-sectional | N/A | N/A | N/A | ** | N/A | N/A | **(b) | * | 5/10 (50%) |
| (Coffey et al., 2021) | Cross-sectional | N/A | N/A | N/A | ** | * | N/A | **(b) | * | 6/10 (60%) |
| (Ludyga et al., 2021) | Cross-sectional | * | N/A | N/A | ** | * | N/A | **(b) | * | 7/10 (70%) |
| (Tyler et al., 2014) | Cross-sectional | N/A | N/A | N/A | ** | * | N/A | **(b) | N/A | 5/10 (50%) |
| (Pan et al., 2016) | Cross-sectional | N/A | N/A | N/A | ** | * | * | **(b) | N/A | 6/10 (60%) |

N/A - Not applicable. *corresponds to one point. **corresponds to two points.

All nine studies (Bricout et al., 2018; Coffey et al., 2021; Latorre-Román et al., 2019; Lourenço et al., 2020; Odeh et al., 2020; Pace & Bricout, 2015; Ludyga et al., 2021; Pan et al., 2016; Tyler et al., 2014) found that children and/or adolescents with ASD had significantly lower physical fitness than typically developing children ($p$ <0.05), considering the components of speed/agility, muscular strength, cardiorespiratory endurance, explosive strength, handgrip strength, speed, abdominal muscular endurance, lower-limb explosive strength, and muscular endurance. However, one study found no significant differences between the groups in aerobic capacity and flexibility (Tyler et al., 2014).

**Table 3** presents the analysis of the methodological quality of the articles included in this review. Most were classified as having moderate methodological quality, corresponding to five of the nine studies (Coffey et al., 2021; Latorre-Román et al., 2019; Pace & Bricout, 2015; Pan et al., 2016; Tyler et al., 2014), according to the NOS criteria. Selection item 4 (ascertainment of exposure) and Outcome items 1 and 2 (assessment of outcome and statistical test) received the highest scores, whereas Selection items 1 and 2 (representativeness of the sample and sample size) received the lowest scores. Three studies scored between 70% and 90% and were classified as high quality (Bricout et al., 2018; Odeh et al., 2020; Ludyga et al., 2021), and one article, with 40%, was classified as low quality (Lourenço et al., 2020). Among all included studies, Selection item 1 (representativeness of the sample) and Selection item 2 (sample size) received the lowest scores, with only one star each.

## Discussion

The objective of this systematic review was to analyze the body of knowledge on the physical fitness of children/adolescents with ASD in comparison with their typically developing peers. The hypothesis was that the literature in this field would show that children/adolescents with ASD present significantly lower scores in the physical fitness components than their typically developing peers. This hypothesis was confirmed, as children with ASD showed a physical fitness profile, based on most of the components assessed, that was inferior to that of their typically developing peers in 100% of the included studies. This means that the overall physical fitness condition of children with ASD is probably significantly poorer than that of their typically developing peers.

Although most articles showed moderate to high methodological quality, only one of the nine included studies received a score for Selection item 1, which was expected because of the scarcity of studies with a robust number of participants, considering the ASD population and the difficulties in recruiting this group, which commonly presents severe adaptive restrictions affecting engagement in physical activities and completion of physical tests. Moreover, the Comparability item of the NOS deserves attention because it did not receive a score in two studies (Latorre-Román et al., 2019; Pace & Bricout, 2015). Age thus became an important confounding factor in the interpretation of the findings between the groups of children/adolescents with and without ASD. The literature recognizes this factor as an influence on physical fitness test results (Luguetti et al., 2010; Teixeira & Pereira, 2010). Nevertheless, the remaining

articles controlled for age; therefore, the methodological quality of this review may be considered reliable.

This systematic review showed that speed was the component with the greatest impairment in the physical fitness of children/adolescents with ASD, presenting the lowest values in the results of the included articles. This finding also appears in the study by Takanashi et al. (2020), in which 14 children aged 5 to 12 years, most of them boys (85.71%) with an ASD diagnosis, were assessed with the KTK to analyze motor performance, and greater impairments were identified in speed and laterality. The study by Borremans, Rintala, and McCubbin (2010) supports these findings. Those authors assessed 30 young adults with ASD in comparison with a typically developing group and found significantly lower values in the ASD group for running speed, limb speed, coordination, strength, and cardiorespiratory endurance.

Flexibility was assessed in five articles included in this review (Bricout et al., 2018; Coffey et al., 2021; Pace & Bricout, 2015; Pan et al., 2016; Tyler et al., 2014), and only two of them (Bricout et al., 2018; Pan et al., 2016) found a significant difference between the groups with and without ASD. These authors justify the absence of a significant difference by pointing to a similar trend in flexibility development among those with and without ASD (Coffey et al., 2021), which differs from the current literature, which shows significant deficits in this component in ASD groups (Borremans et al., 2010; Maciel et al., 2020; Pan, 2014).

In all studies included in this systematic review, the ASD group showed an inferior physical fitness profile when compared with their typically developing peers, and even in the components analyzed individually that did not show significant differences, the ASD group obtained lower values than the control group. The studies included in this review raise some hypotheses. For example, Odeh et al. (2020), Bricout et al. (2018), and Pace & Bricout (2015) suggest that a lack of interest in participating in unstructured activities, such as recreational activities and ball games, limits these individuals' practice of physical activity, and that their level of engagement may be insufficient for participation in these activities, leading to a less active lifestyle than that of children/adolescents with typical development, which would justify the deficits found in this population. Barriers related to motor proficiency are also limiting factors, because less skilled children and adolescents tend not to participate in activities that require a high level of motor proficiency (De Meester et al., 2018), thereby depriving themselves of participation in activities that stimulate improvement in physical fitness components. The study by Maciel et al. (2020) supports these data, as it showed that more than 60% of the 387 parents of children with ASD stated that their children did not engage in physical activity and were classified as having a sedentary lifestyle.

All studies included in this systematic review raise sedentary lifestyle or lower involvement in physical activity, compared with their typically developing peers, as a hypothesis to justify the poorer physical fitness condition of individuals with ASD. This also agrees with the findings of the systematic review conducted by Liang et al. (2020), who observed that higher levels of physical fitness act as important mediators of higher levels of physical activity in children with ASD. Taken together, the review by Liang et al. (2020) and this systematic review show

that children and adolescents with ASD have a poorer physical fitness condition. A recent systematic review (Shahane et al., 2024) adds that significant improvements may be observed in physical fitness components, such as strength and endurance, in young people with autism who undergo physical exercise interventions. Despite the heterogeneity, the most effective protocols for improving the physical fitness of individuals with ASD involved aerobic exercise sessions and training of sports skills.

Thus, early interventions are necessary for children with ASD, encouraging a more active lifestyle and providing an environment favorable to engagement in physical activity. Additionally, according to the Physical Activity Guide for People with ASD (Brasil, 2025), engagement in practice constitutes the greatest barrier observed. People with ASD need teachers, coaches, and family members to review strategies and try to create a more structured environment that can facilitate adaptations, especially when considering the restrictions commonly observed regarding the color, texture, and shape of objects, sound and lighting conditions in the environment, and the excess of stimuli, commands, and activities in the practice setting.

It is therefore suggested that the evidence produced here on the poorer physical fitness condition, combined with a careful and in-depth reading of the Physical Activity Guide (Brasil, 2025), should provide fundamental support for positive returns to society. In this way, physical activity settings may become more inclusive for the participation of children and adolescents with ASD and also offer appropriate possibilities for physical conditioning, improving their levels of strength, endurance, aerobic capacity, and flexibility. These physical fitness components are directly related to better overall health and functioning, which in turn may reduce the restrictions that cause stress and benefit these individuals' overall well-being and quality of life.

From this perspective, the evidence produced here that children and adolescents with ASD present an inadequate physical fitness condition, with levels of strength and endurance significantly lower than those of their typically developing peers, should be transferred to the practice of physical education professionals, occupational therapists, and physical therapists, because these professionals are qualified to work with human movement, both from the perspective of physical literacy, mobility, and physical conditioning and from the perspective of rehabilitation.

As a limitation, the synthesis table did not separate each physical fitness component by category, and no calculation of clinical evidence through effect size was performed, which may confuse interpretation of the findings. Despite the growing interest in investigating physical fitness in this population in recent years, the number of studies remains limited, and the sample investigated is also small, which may interfere with the level of evidence.

## Conclusion

Based on the results of this systematic review, although motor deficits are not part of the diagnostic criteria for autism spectrum disorder (ASD), children and adolescents with ASD present a physical fitness profile significantly poorer than that of their

typically developing peers, which characterizes an overall inadequate physical fitness condition.

Despite the increase in the number of studies on physical fitness in this population, more primary studies assessing physical fitness components are still needed, with a representative number of children and with evaluation and intervention models designed to attract and maintain children's engagement during practice. This may help identify the main deficits and support more effective intervention studies, as well as transfer this knowledge to the practice of professionals who work with human movement, such as occupational therapists and physical education professionals.

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**Author Contributions**

All authors were responsible for the conception of this article and have approved its final version.

**Data Availability**
The data supporting the findings of this study are available from the corresponding author upon request.

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