



Physical exercise and mental health in children with Autism Spectrum Disorder: an integrative review

Exercício físico e saúde mental em crianças com transtorno do espectro autista: revisão integrativa

AUTHORS

Rafaela Afonso Crepaldi¹
João Henrique Bizon Gomes¹
Paula Teixeira Fernandes¹

¹ Universidade Estadual de Campinas, Faculdade de Educação Física e Grupo de Estudos em Psicologia do Esporte e Neurociências, Campinas, São Paulo, Brazil.

CORRESPONDING

Paula Teixeira Fernandes
paulat@unicamp.br
Av. Érico Veríssimo, 701, Campinas, São Paulo, Brazil.
Zip code: 13083-851.

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ABSTRACT

Introduction: The search for intervention strategies to promote the comprehensive development of children with Autism Spectrum Disorder (ASD) has been gaining increasing prominence. In this context, physical exercise (PE) has emerged as a promising resource, with growing evidence of its positive effects on motor, behavioral, and mental health outcomes. **Aim:** To identify the main physical exercise (PE) intervention protocols in recent studies that address the contributions of these practices to the mental health of this population. **Methods:** An integrative literature review was conducted in the following databases: LILACS, SciELO, and PubMed, covering the past ten years. Thirteen studies were selected, read in full, and qualitatively analyzed to identify convergences, divergences, trends, and existing research gaps. **Results:** All studies reported positive outcomes in mental health indicators. The intervention protocols ranged from 2 to 90 weeks in duration and varied across sports modalities and conventional PE sessions. The benefits of PE are enhanced when associated with cognitive, social, and affective components. The results demonstrated that isolated aerobic exercise does not produce the same cognitive and behavioral benefits as integrated global interventions. **Conclusion:** PE appears to be an essential strategy in the care of children with ASD. However, the analyzed studies did not assess mental health in a broad and multifactorial manner, highlighting the need for further research that considers the interplay among motor, social, cognitive, affective, and economic aspects that can limit the lives of children with ASD.

Keywords: Sport psychology; Mental health; Child development; Autism Spectrum Disorder; Physical activity.

RESUMO

Introdução: A busca por estratégias de intervenção que promovam o desenvolvimento integral de crianças com transtorno do espectro autista (TEA) vem ganhando destaque. Nesse cenário, o exercício físico (EF) tem emergido como recurso promissor, com evidências crescentes de seus efeitos positivos sobre aspectos motores, comportamentais e, especialmente, sobre a saúde mental. **Objetivo:** Identificar os principais protocolos de intervenção com EF em estudos recentes que abordem as contribuições destas práticas para a saúde mental dessa população. **Métodos:** Revisão integrativa da literatura dos últimos 10 anos, nas seguintes bases de dados: LILACS, SciELO e PubMed. Foram selecionados 13 estudos, lidos na íntegra e analisados qualitativamente, buscando a identificação de convergências, divergências, tendências e lacunas vigentes. **Resultados:** Todos os estudos incluídos relataram efeitos favoráveis das intervenções sobre pelo menos um dos indicadores relacionados à saúde mental. Os protocolos variaram de 2 a 90 semanas de duração, variando também entre modalidades esportivas e sessões convencionais de EF. Os benefícios do EF são potencializados quando associados a componentes cognitivos, sociais e afetivos. Evidencia-se que exercícios aeróbicos isolados não produzem os mesmos benefícios cognitivos e comportamentais que as intervenções globais integram. **Conclusão:** O EF desponta como estratégia indispensável no cuidado de crianças com TEA. No entanto, os estudos analisados não avaliaram a saúde mental em sua totalidade, de forma ampla e multifatorial, indicando a necessidade de novos estudos que considerem a interação entre aspectos motores, sociais, cognitivos, afetivos e econômicos que circunscrevem a vida da criança com TEA.

Palavras-chave: Psicologia do esporte; Saúde mental; Desenvolvimento infantil; Transtorno do Espectro Autista; Atividade física.

Introduction

Autism Spectrum Disorder (ASD) is characterized as a complex neurodevelopmental disorder, marked by persistent impairments in communication and social in-

teraction, and by repetitive sensorimotor behavior patterns¹. In addition to these core characteristics, affected individuals may exhibit motor deficits related to difficulties in acquiring fundamental motor skills, delays in

motor milestones, alterations in gait, postural control, and balance, and difficulties in motor planning².

In addition to these manifestations, ASD is associated with the presence of concomitant conditions, such as sleep disorders, Fragile X syndrome (a genetic anomaly on the X chromosome that leads to intellectual disability and behavioral changes), Down syndrome, intellectual disability, epilepsy, attention deficit hyperactivity disorder (ADHD), anxiety disorders, and depression, among others^{1,3,4}. It is estimated that approximately 1 in 6 children with ASD have at least one of these associated conditions⁵.

The prevalence of ASD diagnoses has shown significant growth over the years. In 2000, it was estimated that 1 in 150 children would be diagnosed with ASD; in 2010, this number increased to 1 in 68; in 2016, to 1 in 54; and, more recently, data from 2022 indicate a prevalence of 1 in 31 children⁵. In Brazil, data from the 2022 Census indicate that approximately 1.1 million children and adolescents are on the spectrum, highlighting the relevance and urgency of formulating policies and practices aimed at the support, intervention, and development of this group⁶.

In recent years, the search for intervention strategies that promote the holistic development of children with ASD has gained prominence. In this context, physical exercise (PE) has emerged as a promising resource, with growing evidence of its positive effects on motor, behavioral, and, especially, mental health aspects⁷⁻⁹. Despite this, we observed a significant gap in the systematization of this information in the scientific literature.

It is important, initially, to understand mental health from a broader perspective. According to the Ministry of Health¹⁰, mental health consists of a state of well-being in which the individual is able to use their own abilities to recover from routine stress, be productive, and contribute to their community, despite the presence or absence of mental illnesses and/or disorders. In childhood, this concept takes on even more complex dimensions, as it is directly associated with the overall developmental process. It involves, for example, building a positive self-image, the ability to manage thoughts and emotions, establishing social relationships, and openness to learning and acquiring new knowledge. Ultimately, mental health is intimately linked to the possibility of active and meaningful participation in society¹¹.

It is also important to highlight that the concepts of PE and physical activity (PA) used in the current study

follow the definition found in the Physical Activity Guide for the Brazilian Population¹². According to the aforementioned document, PA refers to any voluntary movement that raises energy expenditure above the basal level, and can occur in different contexts (leisure, work, household chores, and commuting). PE, on the other hand, consists of structured, planned, and repetitive physical activity with defined objectives¹².

In this context, PE and PA emerge as effective strategies for promoting mental health in children, including neurotypical and neurodivergent children. Regular PA is widely recognized as an essential factor for healthy child development, as well as acting as an important coping mechanism in stressful situations, and providing pleasure, well-being, and emotional and social balance for the child¹³.

Therefore, the present study aims to identify intervention protocols with PE used in recent literature that address the impact on the mental health of children with ASD.

Methods

This study consists of an integrative literature review, developed by rigorously following the six planned steps. This approach was chosen because it allows the researcher to become familiar with the subject matter and to contribute their own considerations to the topic addressed¹⁴.

Initially, we identified the research topic, guided by the question “What interventions with PE that also address mental health have been carried out with children with ASD?” The search was conducted in the three most widely used databases in the field: Latin American and Caribbean Literature in Health Sciences (LILACS), Scientific Electronic Library Online (SciELO), and National Library of Medicine (PubMed). The Health Sciences Descriptors (DeCS) were combined as follows:

- (Physical Exercise) AND (Autism Spectrum Disorder) / (*Exercício Físico*) AND (*Transtorno do Espectro Autista*)
- (Physical Activity) AND (Autism Spectrum Disorder) / (*Atividade Física*) AND (*Transtorno do Espectro Autista*)

The following inclusion criteria were adopted: original articles presenting interventions with PE in children with ASD, in Portuguese or English, published in the last ten years (period from 2016 to 2025), and

available in full. Exclusion criteria included: duplicate articles, literature review studies, or evaluative studies. The titles and abstracts of the studies selected in the first screening were carefully read and analyzed. After pre-selection and exclusion of articles that met the exclusion criteria, the remainder were read in full. Thus, we selected only those that met the inclusion criteria. All selected articles underwent a second review for double-checking. After this additional analysis, there were no changes to the included articles. The study selection process is detailed in the PRISMA flowchart (2020), presented in Figure 1.

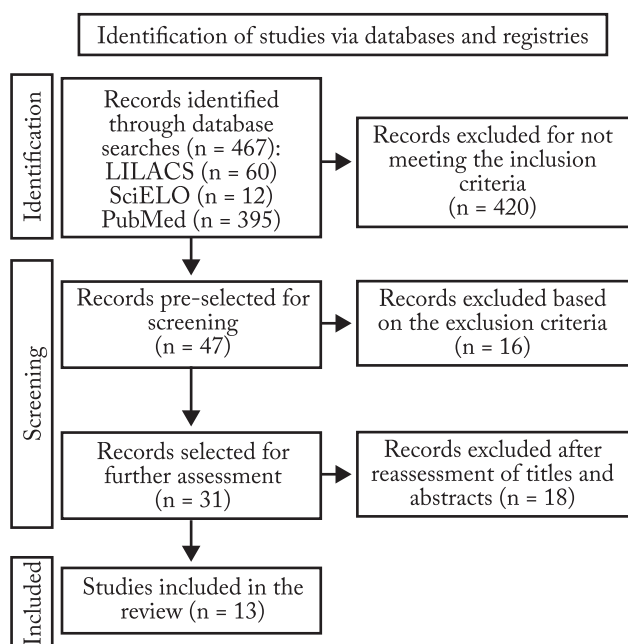


Figure 1 – PRISMA Flowchart (2020).

The selected studies ($n = 13$) were read in full and analyzed qualitatively, for categorization of the: 1. Main results; 2. Mental health aspects addressed; 3. Most recurrent PE in the intervention protocols; and 4. Assessment instruments used. During the reading of each article, the extracted data were systematized in a table containing the central information from the study. Simultaneously, the most relevant points were organized into a supplementary document to support the construction of the results and discussion section. These steps correspond to the synthesis and critical interpretation of the analyzed literature, which allows the identification of convergences, divergences, trends, and gaps in the field of study.

Results and discussion

At the end of the analysis, 18 articles were excluded for not addressing mental health. Thus, only 13 articles were selected that encompass the different types of intervention protocols with PE, methodological approaches, and variables analyzed. Table 1 presents a summary of the most relevant points of each study, including the type of intervention performed and the mental health aspects addressed.

More detailed results, along with their discussion, are presented based on the categories that emerged from the qualitative analysis of the articles included in this review.

Principal results

The present study aimed to identify, through an integrative literature review, interventions with PE focused on children with ASD, emphasizing how aspects related to mental health have been addressed. The analysis of the 13 selected studies showed that, although PE protocols demonstrate positive results in different domains, there is still a scarcity of approaches that directly consider mental health as a central research variable.

All the studies analyzed reported positive results of PE interventions on mental health indicators. We found improvements in social functioning (including cognition, social communication, and social skills), executive functions (including working memory, inhibitory control, and cognitive flexibility), self-regulation and self-efficacy, social interaction (especially among peers), emotional regulation, attention, quality of life, and sleep quality, and a decrease in repetitive and stereotyped behaviors^{8,9,15-25}.

It is important to highlight that an additional relevant aspect observed in the analyzed studies refers to the predominantly male sample composition. This fact can be justified by the higher prevalence of ASD among boys, with the diagnosis estimated to be about three times more frequent in males compared to females⁵. The chronological age of the samples ranged from three to twelve years old, with the exception of the study by Jackson et al.¹⁷ which included individuals up to 24 years of age.

Additionally, we identified a diversity of methods, types of intervention, and assessment instruments, which, on the one hand, enriches the understanding of the possible effects of PE in children with ASD, but, on the other hand, makes standardization and direct comparisons between studies difficult, constituting a

Table 1 – Summary of studies included in the review

Authors (year)	Participants	Intervention	Type of physical exercise	Aspects of mental health	Assessment instruments	Results
Castañero et al. ¹⁵ (2024)	20 (4-7 years) (3 girls; 17 boys) EG=10; CG=10	8 wks.; 3x/wk.; 60min/session	PE in a circuit	Behavior and social interaction	ADS-3	Improvements in behavior (following instructions, social interaction, and responding to verbal cues)
Chen et al. ¹⁶ (2024)	30 (3-6 years) (5 girls; 25 boys) EG=15; CG=15	8 wks.; 6x/wk.; 30min/session	Adapted sports	Executive functions	fNIRS; DST; DNT; DCCS	Improved inhibitory control and cognitive flexibility. Increased brain activation in areas related to cognition and neuronal connectivity
Jackson et al. ¹⁷ (2024)	11 (7-24 years) (1 girl; 9 boys; 1 other) EG=11	8 wks.; 2x/wk.; 60min/session	PE (aerobic + strength)	Behavior, social interaction, and sleep	SCQ-L; BASC; CSHQ; SRS	Reductions in restricted and repetitive behaviors, and in daytime sleepiness
Ji et al. ⁸ (2022)	100 (up to 12 years) (45 girls; 55 boys) EG=34; EG=33; CG=33	6 wks.; 3x/wk.; 60min/session	PE in virtual reality	Behavior and executive functions	CARS; AFT; SCWT	Improvement in executive functions (inhibitory control, cognitive flexibility, working memory)
Kruger et al. ²⁵ (2018)	9 (5-10 years) (2 girls; 7 boys) EG=5; CG=4	14 wks.; 2x/wk.; 50min/session	PE (dance)	Behavior and social interaction	CARS	The values of social interaction were maintained
Orhan et al. ¹⁸ (2024)	1 (10 years) (boy) Case report	12 wks.; 3x/wk.; 60min/session	Kata (Karate)	Behavior	MiniBoard	Improved socialization, self-expression, and independence.
Silva et al. ²¹ (2023)	10 (4-11 years) (10 boys) EG=10	90 wks.; 4x/wk.; 15min/session	PE online (motor coordination and balance)	Behavior and quality of life	Assessment of Autistic Traits	84% did not participate in the exercise program; those who did reported an improvement in their quality of life
Tse ⁹ (2020)	27 (8-12 years) (4 girls; 23 boys) EG=15; CG=12	12 wks.; 4x/wk.; 30min/session	Running	Behavior, social interaction, and emotional response	WISC; CBCL; SRS-2; ERC	Improved emotional regulation and a reduction in behavioral problems
Tse et al. ²³ (2021)	62 (8-12 years) (12 girls; 50 boys) EG=22; EG=20; CG=20	2 wks.; 5x/wk.; 60min/session	Cycling indoor x outdoor	Behavior and executive functions	WISC; SRS-2; TOL; Corsi Block Tapping Task; SCWT; GNG	Only the group that received the intervention with a cognitive component (learning to ride a bicycle) showed improvement in executive functions
Tse et al. ²² (2023)	62 (8-12 years) (12 girls; 50 boys) EG=18; EG=14; EG=12; CG=18	2 wks.; 5x/wk.; 60 min/session	Cycling	Social interaction and sleep	WISC; SRS-T; sleep diary	All interventions showed significant improvements in sleep parameters
Tse et al. ¹⁹ (2024)	64 (8-12 years) (12 girls; 52 boys) EG=23; EG=19; CG=22	2 wks.; 5x/wk.; 60min./session	Indoor or outdoor cycling vs. walking	Self-regulation, executive functions, social interaction	WISC; SRS-2; SCWT; GNG; RCS; FS	Only the bicycle learning group showed improvement in inhibition and cognitive flexibility. Both the bicycle learning group and stationary cycling group showed improvement in self-regulation
Wang et al. ²⁴ (2020)	33 (3-6 years) (5 girls; 28 boys) EG=18; CG=15	12 wks.; 5x/wk.; 40min/session	Mini basketball	Behavior, social interaction, and executive functions	CHEXI; SRS-2; RBS-R; CARS; CSHQ	Improved executive function and social communication. Reduction in repetitive behaviors
Yang et al. ²⁰ (2024)	30 (3-6 years) (4 girls; 26 boys) EG=15; CG=15	12 wks.; 5x/wk.; 40min/session	Mini basketball	Behavior, social interaction, and sleep	MRI; SRS-2; CARS; CSHQ	Improved social cognition and social communication. Reduction in repetitive behaviors. Decreased regional homeostasis in the left postcentral gyrus was positively associated with changes in social communication scores

Legend: articles listed in alphabetical order (by last name), EG = experimental group, CG = control group, PA = physical activity, PE = physical exercise, wk. = week(s), x/sem. = per week, min/session = minutes per session, x = versus. ADS-3 - Abbreviated Development Scale-3; fNIRS - functional Near-Infrared Spectroscopy; DST - Digital Span Task; DNT - Day/Night Task; DCCS - Dimensional Change Card Sorting; SCQ-L - Social Communication Questionnaire Lifetime; BASC - Behavioral Assessment System for Children; CSHQ - Children's Sleep Habits Questionnaire; SRS - Social Responsiveness Scale; CARS - Childhood Autism Rating Scale; AFT - Adapted Flanker Task; SCWT - Stroop Color-Word Test; MiniBoard; WISC - Wechsler Intelligence Scale for Children; CBCL - Child Behavior Checklist; SRS-2 - Social Responsiveness Scale - Second Edition; ERC - Emotion Regulation Checklist; TOL - Tower of London Task; Corsi Block Tapping Task; GNG - Go/No-go Task; SRS-T - Social Responsiveness Scale T-score; Sleep Diary - Sleep Record; RCS - Response to Challenge Scale; FS - Feeling Scale; CHEXI - Childhood Executive Functioning Inventory; RBS-R - Repetitive Behavior Scale - Revised; MRI - Magnetic Resonance Imaging.

challenge for the consolidation of robust and replicable evidence in the area.

Mental health aspects addressed

As previously highlighted, none of the analyzed articles evaluated mental health as a central construct in a direct, isolated, or explicit way. This finding indicates a tendency towards an indirect or fragmented approach to mental health, which may limit understanding of the real impact of interventions on this fundamental dimension of child development.

The articles addressed variables related to or components that make up the broader concept of mental health, such as behavior, social interaction, and quality of life. This observation becomes even more evident when we look at the last column of Table 1 or even the list of assessment instruments used in the studies. Adaptive behaviors were the most frequently reported, with positive results after the intervention, such as improved social interaction, greater attention to verbal instructions, reduction in repetitive behaviors, as well as gains in emotional regulation, attention, and readiness for PA^{9,15,17,18,20,24,25}.

Among these aspects, social interaction and executive functions were the most frequently mentioned. Social interaction, one of the areas most affected by ASD⁴, improved by interventions with PE. Studies showed gains in communication, peer engagement, and overall social functioning.^{22,24,25} These data align with other studies that indicate PE as a facilitating factor in the development of social skills in children with ASD²⁶⁻²⁸.

Regarding executive functions, studies highlighted significant improvements in working memory, inhibitory control, and cognitive flexibility^{8,16}. These findings are in line with the scientific literature that demonstrates the relationship between movement and cognition, reinforcing the idea that the body, by interacting with the environment, directly influences higher mental functions^{16,29,30}.

Therefore, we reinforce the concept that mental health involves not only the absence of disorders, but also a state of well-being, in which the individual is able to cope with life's stressors, be productive, and contribute to their community, even while living with diagnosed clinical conditions^{10,31}. Therefore, PE stands out as an integrated strategy for promoting mental health, acting simultaneously in the physical, emotional, and social domains of children with ASD. Thinking about health in a fragmented way, dissociating body and mind, compromises the development of effective interventions.

Most frequent physical exercises in intervention protocols

Regarding the type of intervention performed, we observed that 61.5% of the studies used sports modalities^{9,16,18-20,22-24}. The remaining 38.5% of the articles used PE, many with their own protocols, working on physical capabilities^{8,15,17,21,25}.

Among the studies that used PE comprehensively, we observed diverse interventions, including conventional sessions focused on aerobic capacity, strength, balance, and motor coordination, classes with motor circuits, dance classes, and sessions with virtual reality^{8,15,17,21,25}. Despite methodological differences, all studies reported significant improvements in participants' mental health.

It is essential to conduct a detailed analysis of the types of PE used in the intervention protocols of the selected studies, in order to understand which PE modalities are most commonly used with children with ASD and whether any modalities are more beneficial.

The studies that used sports as an intervention included adapted sports games, cycling, karate, basketball, and running. These interventions can be characterized as aerobic activities^{16,18-20,22-24}.

According to a literature review, aerobic exercise, as well as resistance exercise, has been widely used in research with individuals who have mental disorders, especially in cases of depression and anxiety, due to its ability to increase neurotransmitters, catecholamines, and serotonin biosynthesis³². Furthermore, this type of exercise is able to trigger a cascade of biochemical alterations, including increased blood flow to the brain and availability of brain-derived neurotrophic factor, thus strengthening brain plasticity¹⁹, leading to improvements in cognitive function, quality of life, and overall mental health. However, more research is still needed to understand whether the frequency, duration, and intensity of exercise significantly influence the observed therapeutic effects³².

Recent evidence suggests that aerobic exercise, when applied in isolation, does not produce the same cognitive and behavioral benefits as interventions that integrate motor and cognitive challenges in children with ASD^{23,24}. Therefore, it is important that PE goes beyond the physical component, to include activities that stimulate cognitive skills, such as strategic thinking, decision-making, and specific motor engagement, as occurs in structured game situations, in which movement is directly linked to problem-solving and

adaptation to the environment.

In this regard, Tse et al.²² conducted a comparative study between two groups of children with ASD: one group participated in stationary cycling sessions, while the other underwent a bicycle riding instruction program, an activity that requires greater cognitive engagement¹⁹. At the end of the interventions, the authors observed that the group involved in the complex motor learning task showed better results in cognitive variables such as self-regulation, self-efficacy, and cognitive flexibility¹⁹. These findings suggest that interventions that link PE to the acquisition of new skills may promote broader benefits in the cognitive functioning of children with ASD.

These findings corroborate the meta-analysis conducted by Tan, Pooley, and Spellman³³, who evaluated the effectiveness of PE on the cognition of individuals with ADHD and/or ASD. From the analysis of 22 studies, the authors found that interventions with PE promoted significant benefits in the cognitive functioning of these individuals. However, the data did not allow the precise identification of which specific domains of cognition were most impacted, highlighting the need for further investigations³³.

In the study conducted by Chen et al.¹⁶, the authors investigated the effects of an intervention based on adapted sports games on the executive functions of children with ASD. The results indicated significant improvements in inhibitory control and cognitive flexibility. These advances have been associated with neurobiological alterations, including increased brain activation and functional connectivity, suggesting that the systematic practice of adapted PA may promote the effective development of complex cognitive skills in children on the autism spectrum¹⁶.

These results corroborate the systematic review by Liang et al.³⁴, which evaluated the influence of PE on executive functions in children and adolescents with ASD. The authors found 7 articles and concluded that the interventions had a small to moderate positive effect on executive functions overall. Among the components evaluated, cognitive flexibility and inhibitory control showed the most significant and consistent gains after the intervention. Working memory, while demonstrating a favorable trend, did not reach statistical significance, indicating the need for further research with robust designs and larger samples to validate these findings³⁴.

Studies that worked with mini-basketball^{20,24} also

demonstrated significant cognitive gains, such as improvements in executive functions, social communication, social cognition, and repetitive behaviors. In the study of Yang et al.²⁰, the authors observed that exercise was able to generate the cited improvements by modulating the values of magnetic resonance imaging used to assess functional brain activation. Similarly, the review of Lourenço et al.³⁵ showed that PE leads to improvements in social and stereotyped behaviors, quality of life, academic performance, and motor behavior in individuals with autism.

It is widely recognized that children with ASD have a higher prevalence of sleep disorders compared to neurotypical children²². Sleep-related problems can intensify autism symptoms, and impair cognitive performance and behavioral issues, compromising the quality of life for the child and their family²². In this sense, Tse et al.²² conducted an experimental study demonstrating that regular PE can significantly contribute to improved sleep quality in children with ASD. The authors suggest that this effect is related to the increased melatonin secretion promoted by PE, promoting the regulation of the sleep-wake cycle and, indirectly, positively impacting quality of life²². These findings are reinforced by Liang et al.³⁶, who, in their systematic review, identified that exercise has positive effects on several aspects of sleep in children with ASD, including reducing nighttime awakenings, increasing sleep duration and efficiency, and improving resistance to falling asleep. Thus, PE has become established as an effective non-pharmacological strategy in the management of sleep disorders, which are highly prevalent in the autistic population³⁶.

Also consistent with the literature, the studies found that used sports as an intervention reported significant improvements in multiple dimensions of the development of children with ASD. Li et al.³⁷ analyzed several studies on sports programs and their influence on the main symptoms of autism, including 6 different modalities (dance, ball sports, equestrian, aquatic, martial arts, and comprehensive PE). According to the authors, these interventions reduced core ASD symptoms by up to 37%, with positive effects especially in the areas of social interaction and a decrease in stereotyped behaviors. Furthermore, children who participated in team sports showed greater activation of brain functions, developing social, communication, visual processing, and attention skills³⁷.

With an innovative methodological approach, Ji

et al.⁸ proposed virtual reality sessions to address the disengagement from PA frequently observed in children with ASD. The results showed improvements in executive functions, especially working memory, inhibitory control, and cognitive flexibility. However, these benefits were not sustained in the follow-up, reinforcing the importance of continuing these practices for sustainable results⁸. This evidence is consistent with the study by Lima et al.³⁸, which presented a comprehensive analysis of the use of exergames (video games with physical interaction) in promoting PA for children and adolescents with ASD. Although still relatively unexplored, this strategy was proven to be highly effective in improving engagement, physical fitness, and cognitive functions, contributing to the reduction in repetitive and stereotyped behaviors³⁸.

Jackson et al.¹⁷ and Silva et al.²¹ applied conventional interventions, adapted to the individual abilities of each child. While the first study conducted in-person appointments, the second opted for telehealth during the pandemic. Both found improvements in quality of life. Jackson et al.¹⁷ highlighted a reduction in daytime sleepiness and repetitive behaviors, while Silva et al.²¹, based on family reports, indicated an improvement in quality of life, despite low adoption of the remote format.²¹ Similarly, Almeida et al.³³ applied an intervention using a virtual reality game with telehealth and found positive results, highlighting the high level of satisfaction among the participating children.

Finally, we highlight the study of Castaño et al.¹⁵ which used motor circuits composed of five stations, aimed at developing gross motor skills (such as running, jumping, throwing, and kicking) and motor integration. The results demonstrated significant progress in the experimental group, especially in relevant behavioral changes, such as increased instructional control, greater social interaction, and better response to verbal commands¹⁵.

These findings reinforce the potential of PE as a multidimensional intervention tool in the care of children with ASD, contributing significantly to their holistic development. Given these findings, it is essential to promote interdisciplinary approaches centered on the holistic development of children with ASD, overcoming reductionist views and strengthening evidence-based practices.

Assessment instruments used

The assessment instruments used include the Social Re-

sponsiveness Scale (SRS-2), which appeared in five articles^{9,17,19,20,24} and the Child Autism Rating Scale (CARS), used in four^{8,20,24,25}, which consist of assessments commonly used when working with children with autism.

In conclusion, the present review showed that interventions with PE in children with ASD promote significant benefits in several areas of development, including executive functions, adaptive behavior, social interaction, sleep quality, and quality of life. However, a significant gap was observed: most of the studies analyzed do not address mental health in a direct or structured way, with analyses being limited to associated variables that, while relevant, do not encompass the complexity of the subject. The diversity of methods, types of intervention, and assessment instruments used in the reviewed studies enrich the understanding of the effects of PE in children with ASD, but also represent a challenge for standardization and comparisons between results. In this context, the need for new research that considers mental health in a more comprehensive and integrated way is highlighted, recognizing it as a state of general well-being that goes beyond the absence of mental disorders.

Future studies should prioritize interventions with PE that consider mental health as a multidimensional outcome, assessed using specific instruments and complemented by cognitive, emotional, behavioral, and social indicators, through interdisciplinary approaches that promote the comprehensive development of children with ASD. Moving in this direction is essential to strengthen more effective, sustainable, and humane strategies for promoting health and well-being, contributing to the construction of more inclusive, healthy, and happy pathways for this population.

Conflict of interest

The authors declare no conflict of interest.

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Authors' contributions

Crepaldi RA: Conceptualization; Methodology; Software development, implementation, and testing; Data and experiment validation; Data analysis; Research; Tool provision; Data curation; Supervision; Project administration; Data presentation design;

Funding acquisition; Original manuscript writing; Writing - revision and editing; Approval of the final manuscript version. Gomes JHB: Data and experiment validation; Data analysis; Research; Data curation; Original manuscript writing; Writing - revision and editing; Approval of the final manuscript version. Fernandes PT: Supervision; Project administration; Original manuscript writing; Writing - revision and editing; Approval of the final manuscript version.

Statement regarding the use of artificial intelligence tools in the article writing process

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The underlying content of the research text is contained in the manuscript.

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Editor in ChiefÁtila Alexandre Trapé 

São Paulo University, Ribeirão Preto, São Paulo, Brazil.

Section editorInês Amanda Streit 

Federal Univeristy of Amazonas, Manaus, Amazonas, Brazil.

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Reviewers' assessment

The authors and/or reviewers did not authorize the publication of either of the two reviews.