

PHYSICAL EDUCATION IN STUDENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER. STATE OF THE ART

EDUCACIÓN FÍSICA EN ALUMNADO CON TRASTORNO DE DÉFICIT DE ATENCIÓN E HIPERACTIVIDAD. ESTADO DEL ARTE

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PE and ADHD: State of the art

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Abstract

Attention deficit hyperactivity disorder (ADHD) is one of the most common disorders in schools. The aim of this study was to analyse studies on the topic and the impact of physical education on students with ADHD. The research team conducted a systematic review using the PRISMA method. The results showed that most of the research was carried out in centers in Spain, the USA, Canada and China. The interventions, which included different types of Physical Education activities, showed positive effects on improving the symptoms of people diagnosed with ADHD, as well as their physical condition, body image self-perception and motivation to engage in physical activity. However, there are barriers to achieving educational inclusion in heterogeneous groups: in teacher training and in the organization of resources, which proved to be key factors.

Keywords: Physical education, ADHD, inclusion, school, review.

Resumen

El trastorno de déficit de atención e hiperactividad (TDAH) es uno de los trastornos de mayor incidencia en el ámbito escolar. Este estudio tuvo como objetivo analizar estudios sobre la temática y la incidencia de la educación física sobre el alumnado con TDAH. Para ello, se utilizó una revisión sistemática siguiendo el método PRISMA. Los resultados señalaron que la mayoría de las investigaciones se han realizado en centros de España, USA, Canadá y China. Las intervenciones realizadas con diferentes tipos de actividades en el área de Educación Física mostraron tener efectos positivos para la mejora de la sintomatología en personas diagnosticadas con TDAH, así como en su condición física, percepción de la imagen corporal y motivación hacia actividades motrices. Sin embargo, existen barreras para conseguir la inclusión educativa en grupos heterogéneos, en la formación del profesorado y en la organización de recursos, que han demostrado ser factores clave.

Palabras clave: Educación física, TDAH, inclusión, escuela, revisión.

Introduction

Today's society is characterised by the importance attached to inclusive values, which are essential for achieving more equitable, democratic and high-quality schools. Inclusive education advocates equal opportunities for all students, especially those with disabilities or special educational needs (Gámez-Calvo et al., 2024), including students with attention deficit hyperactivity disorder (ADHD).

ADHD, classified as a neurodevelopmental disorder in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) (APA, 2013), is one of the disorders with the highest incidence among school-aged children (with an estimated prevalence of between 5.9% and 7.1%) and has a significant impact on all domains (cognitive, emotional, social) and contexts of the affected individual (Fernández-Andrés et al., 2019; Sánchez & Cohen, 2020).

The DSM-5 (APA, 2013) indicates that the disorder is multi-causal (genetic, epigenetic, psychosocial) and shows neuroanatomical and neurofunctional differences compared to typically developing individuals. These differences are mainly found in the regulation of neurotransmitter levels such as serotonin, dopamine and norepinephrine, which are responsible for the proper functioning of executive functions such as sustained and selective attention, working memory, inhibitory control, planning and cognitive fluency.

The symptoms meet specific criteria of intensity, frequency and duration that correspond to two main diagnostic criteria: inattention or difficulty sustaining attention; and hyperactivity – motor or verbal – and impulsivity, resulting in difficulty inhibiting responses. The inattentive, hyperactive/impulsive, or combined profiles are the result of the presence or absence of these symptoms, and their needs depend on their individual characteristics and the impact on their functioning in all contexts (APA, 2013).

Similarly, the DSM-5 notes that ADHD symptomatology results in motor developmental deficits, with a degree of clumsiness that can affect feelings of self-efficacy and motivation (Bowling et al., 2017). This self-perceived ineffectiveness in relation to the skills required for physical activities is not only an often-invisible discomfort, but also reduces opportunities for participation. Combined with a lack of self-regulation and attention difficulties, it can lead to behaviour that is not always understood by the group, to voluntary isolation of the person with ADHD, to feeling or being excluded from the group, and even to a situation of vulnerability to bullying (Bejerot et al., 2022).

According to Carriedo (2014), several reasons may limit the participation of students with ADHD in physical activity. In some cases, Physical Education (PE) is the only time that students with ADHD devote to physical activity, while in other cases, families have fewer active lifestyles or do not value it as much as they could because they are overwhelmed by the impact (economic, social, personal) that raising a child with ADHD can have. This limits the opportunities to improve motor development, which in turn reduces their chances of participating in physical activity in the future. Furthermore, according to Villa and Méndez (2021), the increased time that students with ADHD spend on academic tasks also hinders and reduces their participation in physical activities. Thus, this increased sedentary lifestyle favours the development of hypokinetic diseases such as obesity (Villa & Méndez, 2021).

On the other hand, in addition to the problems associated with a sedentary lifestyle (it has a high comorbidity rate and is associated with behavioural problems), ADHD requires a rigorous diagnosis by a clinical specialist, together with the contribution of information from the family and teachers, and an intervention that is properly adapted to the inter-individual situation of the individual (Fernández-Andrés et al., 2019). Nevertheless, the treatment of these symptoms should always be multimodal, not only because pharmacological treatment is controversial due to its side effects (Carriedo, 2014), but also because behavioural and psychoeducational aspects should be considered.

In this regard, some studies and scientific literature reviews (Benzing & Smith, 2019; Rivera & Remón, 2017; Santolalla, 2022) indicate that physical activity has some benefits that can counteract or reduce the effects and manifestations of ADHD symptoms. It can improve motor skills, executive functions, and neurocognitive performance, which has an impact on behaviour, interpersonal relationships, and academic performance. The results show an increase in neurotransmitter levels, which also counteracts effects – often due to medication – such as insomnia, anxiety, or depression (Bowling, 2017). In addition, as Ruiz and Villa (2023) point out, there are benefits for students with ADHD in executive functions, motor skills, and academic performance.

On the other hand, other studies point to the difficulties experienced by students with ADHD, particularly in the subject of PE. For example, Villa and Méndez (2021) reported a lack of impulse control and poorer frustration management. Furthermore, Villa et al. (2020) concluded that these students are less active, prefer more individualistic activities, and are less motivated towards the subject. Finally, Llopis (2014) observed more disruptive behaviour during PE lessons among students with ADHD.

Therefore, the aims of this literature review are: 1) to describe the interventions carried out in the last decade for students with ADHD in the field of PE, 2) to analyse the strategies and measures applied by professionals and the resources used in PE, 3) to determine the influence of PE on students with ADHD, and 4) to extract the key elements of interventions based on scientific evidence for the design of inclusive proposals from PE.

The questions to be answered in this paper are, firstly, related to the characteristics of the documents analysed, such as: what is the temporal evolution of the analysis of this topic? Who are the researchers working in this field? What countries are the studies coming from? Which journals deal with ADHD and PE issues? And what language do researchers use to disseminate their results? The second set of questions relates to methodological aspects, such as: what kind of studies are being conducted? What is their design approach? What data collection tools do they use? And what are the characteristics of their participants? Finally, content questions are addressed, such as: what are the characteristics of interventions with students with ADHD in PE? What strategies and resources do they use, and what measurements were do they perform? What are the effects of these interventions? And what are the key elements for improving the inclusion of students with ADHD in PE?

Materials and Methods

This literature review is based on the PRISMA method (Page et al., 2021). We used the Scopus database because of its recognized prestige and the number of documents it contains (García et al., 2020).

We searched using a combination of keywords and Boolean operators: 'physical education' AND 'ADHD' OR 'attention-deficit disorder' OR 'hyperactivity disorder', both in English and Spanish, in the title, abstract or keywords.

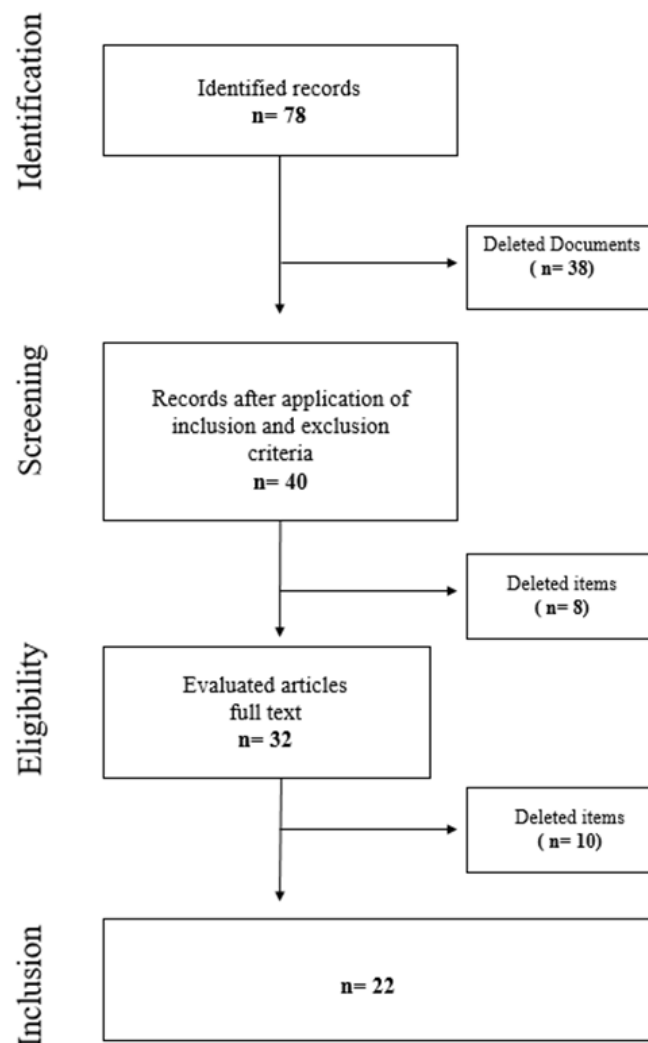
Table 1 shows the inclusion and exclusion criteria we used to select the documents to be analysed.

Table 1
Selection Criteria

Variable	Criteria	
	Inclusion	Exclusion
Types of documents	Intervention papers published in Scopus journals	Review articles, chapters, books, theses and conference proceedings
Date	Last decade	Prior to 2013
Participants	Students with ADHD of any age	Teachers, family members, and students with or without other special educational needs
Language		No filter
Availability		No filter

In the first stage, we identified a total of 78 documents. By selecting those that had been published in the last ten years, we selected 49 items, 40 of which were papers. After reading the title and abstract, five were discarded because they did not relate to PE or were not conducted in a school context. A total of 32 full papers were therefore assessed. Of these, 22 were finally selected for analysis because they described interventions involving students with ADHD. Figure 1 shows the four-stage document selection process.

Figure 1
Framing Scores for Different Reward Sizes



Drucker et al. (2016) defined selection bias as the failure to identify all available documents or data on a topic. In this paper, the type of outcomes achieved by students with ADHD was not set as an inclusion criterion, i.e., studies were included for analysis regardless of whether the interventions had an effect or not, or whether this effect was positive or negative. This reduces publication bias, whereby only studies with statistically significant results are more likely to be analysed (Khan et al., 2022; Sutton et al., 2000).

The following variables, which emerged from the researchers' independent reading of the papers, were included in the content analysis (Table 2).

Table 2
Variables Analysed

Typology	Variables	Description
Identification	Year	Date of publication
	Author	Characteristics of the authors
	Country	Location where the study was carried out
	Journal	Source or publication
	Journal Rank	SJR impact (quartile of the journal on the year of publication)
	Language	Language in which the article is written
Methodology	Design and tool	Research approach and information gathering tool
	Sample	Educational level, age, gender and number of participants
Content	Goals	Objectives pursued
	Type of physical/sports activity performed	Activities of the intervention programme
	Results	Findings of the study

Note. SJR= SCImago Journal Ranking refers to the impact of the journal in Scopus.

Results

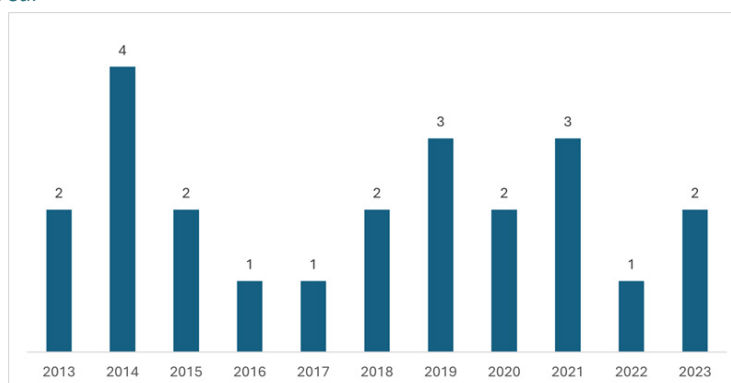
This work analysed identification, methodology, and content variables.

With regard to identification, we took into account the authors, date of publication, country, journal (and rank), and language.

Firstly, we must note that a total of 81 authors contributed to the 22 papers analysed. There are no major differences in the number of men and women involved, as the percentage is close to 50% for each sex. It is worth noting the number of papers in which all the authors are of the same sex (with two papers are signed by women only and eight are signed by men only). However, the rate of collaboration is high: all papers are written by three or more authors, with the exception of two signed by a single author – Reche García (2016), who analysed the potential of extracurricular fencing, and Jun (2023), who focused on achievement motivation – and another by two authors on interactions between Chinese students (Qi & Wang, 2018). The paper with the largest number of authors is Gökçen et al. (2013), signed by more than 10 authors. This paper analyses the choice of sports activities among students in higher education. All identified authors are occasional producers with one or two published articles (the authors with two published documents are M. Vila de Gregorio, N. Grizenko, R. Joobar, S. Wilkinson, E. Inglés, V. Labrador and F.J. Hernández).

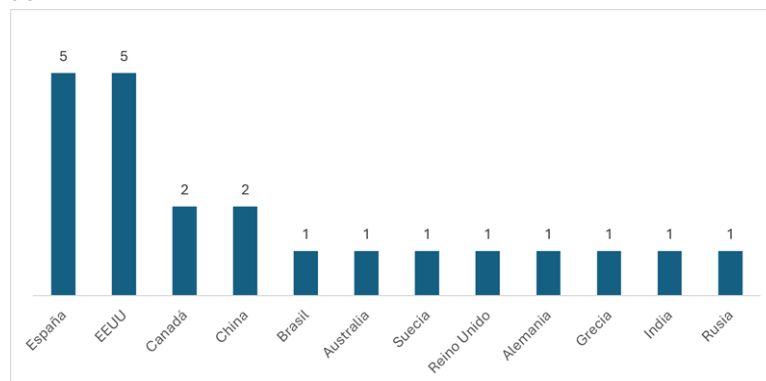
In terms of date of publication (Figure 2), there are no major differences in the number of articles published over during the last ten years.

Figure 2
Articles Published by Year



Focusing on where the studies were carried out (Figure 3), the weight of countries such as Spain (Labrador-Roca et al., 2019; Labrador-Roca et al., 2020; López-Sánchez et al., 2015; Reche García, 2016; Villa de Gregorio et al., 2022; Villa de Gregorio et al., 2023) and the USA (Bowling et al., 2017; Hoza et al., 2020) is significant, with five papers each published on this topic. Canada ranks third with two papers (Harvey et al., 2014; Wilkinson et al., 2013), together with China (Jun, 2023; Qi & Wang, 2018). A further 10 countries have published an article on PE with students with ADHD in the last decade, e.g., Australia, Turkey or Brazil.

Figure 3
Countries of Intervention



We did not find any clustering of articles in the same journal, except in the case of *Physical Education and Sports Pedagogy*, which published four of the articles analysed (Harvey et al., 2014; Qi & Wang, 2018; Thoren et al., 2021; Wilkinson et al., 2013). The diversity of the sources identified, related to the fields of physical education and sport, psychology or medicine, is therefore striking and reflects the transversal nature of the object of study, given that attention to diversity is everyone's business. In terms of the rank of these journals, measured by the quartile listed in the SCImago Journal Rank (SJR), the following stand out in Q1: *Physical Education and Sport Pedagogy*, *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *Frontiers in Psychology*, and *Mental Health and Physical Activity*.

Finally, the predominant language for the dissemination of results in this field is English, which is used in 77.3% of the total number of articles analysed.

Secondly, with regard to the methodological variables, we considered the research design, the tools used to collect the information, and the characteristics of the sample. In terms of research design and paradigm, all the studies analysed met the inclusion requirement of having carried out an intervention. Most (64%) used a positivist-quantitative paradigm through the use of questionnaires (e.g., Jun, 2023; Villa de Gregorio et al., 2022, 2023), while a minority of interpretive studies (18%) used interviews and/or field diaries (e.g., Wilkinson et al., 2013; Labrador-Roca et al., 2019). A few studies (14%) used mixed designs (e.g., Harvey et al., 2014; Qi & Wang, 2018). Among the 64% of quantitative studies, only 29% had a control group (e.g., Bowling et al., 2017; Reche García, 2016) and 43% conducted pre- and post-tests (e.g., Jarraya et al., 2019; López-Sánchez et al., 2015). Furthermore, 86% of the analysed studies used questionnaires – 32% of them to detect symptoms or diagnose ADHD (e.g., Hoza et al., 2020; Tsimaras et al., 2014), 21% to assess motor skills (e.g., Harvey et al., 2014; Jeyanthi et al., 2021) or self-perception of motor competence (Makunina et al., 2021), and 16% to assess behavioural aspects (e.g., Bowling et al., 2017; Labrador-Roca et al., 2020) or social interaction (Qi & Wang, 2018). Finally, we also found one study assessing the level of cognitive development (Hoza et al., 2020), another to determine preferences between different elements of the learning process (Villa de Gregorio et al., 2022), another to assess self-perceptions of body image (López-Sánchez et al., 2015), and one to compare attitudes towards the inclusion of a student with ADHD in PE lessons (Pedersen et al., 2014).

Regarding the characteristics of the sample in the different studies, 15% of the studies conducted interventions exclusively with male student samples (e.g., Jun, 2023; Jeyanthi et al., 2021; López-Sánchez et al., 2015), while 62% analysed both sexes (e.g., Villa de Gregorio et al., 2022, 2023; Thoren et al., 2021). One study focused on teachers (Wilkinson et al., 2013), while 19% did not specify gender (e.g., Labrador-Roca et al., 2019; 2020) and no study focused exclusively on women. In terms of age and stage of participants, 10% studied pre-school children (e.g., Hoza et al., 2020; Jarraya et al., 2019), 46% were conducted in primary schools (e.g., Taylor et al., 2019; López-Sánchez et al., 2015), 23% in high schools (e.g., Bowling et al., 2017; Qi & Wang, 2018), and 14% in university or other higher education institutions (e.g., Gökçen et al., 2013; Makunina et al., 2021). Furthermore, almost 70% of studies used a sample whose members had already been diagnosed with ADHD, and 50% of those used two groups, one with an ADHD diagnosis and one without (e.g., Hoza et al., 2020; Thoren et al., 2021).

Thirdly, in terms of content, we distinguish between the objectives to be achieved, the physical/sport activities used, and the outcomes of the studies analysed. Most studies (60%) focused on analysing the effects of the interventions on different psychological variables, such as achievement motivation or improvement of attention symptoms, hyperactivity, and desirable or undesirable behaviours (e.g., Bowling et al., 2017; Labrador-Roca et al., 2020; Villa de Gregorio et al., 2023).

On the other hand, 17% of the studies focused on analysing social issues for both improved inclusion and cooperative learning (e.g., Qi and Wang, 2018; Thoren et al., 2021; Wilkinson et al., 2013), 13% analysed improvements in motor skills (Jeyanthi et al., 2021), body image (López-Sánchez et al., 2015) or motivation to participate in physical activities (Harvey et al., 2014). Finally, two studies analysed teacher training or tried to improve teacher resources for teaching students with ADHD (Pedersen et al., 2014).

Regarding the type of physical/sport activity performed, 20% of the studies carried out their interventions within regular PE lessons, without specifying their content (e.g., Thoren et al., 2021), 17% of the studies used multisport games (e.g., Makunina et al., 2021; Villa de Gregorio et al., 2022; 2023), 13% performed isolated exercises or stage circuits (e.g. Hoza et al., 2020; Jeyanthi et al., 2021), 13% performed psychomotor games or physical activity scrapbooking (e.g., Harvey et al., 2014; Jarraya et al., 2019; Rodrigues Costa et al., 2015). Finally, some studies used specific sports, such as football (Jun, 2023), fencing (Reche García, 2016), virtual cycling (Bowling et al., 2017) or tennis (Tsimaras et al., 2014).

Regarding the results, we observed that among the studies that carried out an intervention with some kind of physical or sport activity to improve psychological variables in people with ADHD, most (77%) found improvements in executive function, inhibitory control and ADHD symptomatology (e.g., Hoza et al., 2020; Jun, 2023; Jeyanthi et al., 2021; Reche García, 2016). The main problems emerged when comparing participants with people without ADHD, as people with ADHD showed higher levels of anxiety (Makunina et al., 2021; Villa de Gregorio et al., 2023) and lower self-perceptions of motor competence (Villa de Gregorio et al., 2023), no improvement in undesirable behaviours (Labrador-Roca et al., 2019; 2020) or improvements that were lost at the end of the intervention process (Bowling et al., 2017).

Regarding studies that analysed social skills for both improved inclusion and learning, only 40% reported benefits for improving cooperation, competence and individualism, or participation (Taylor et al., 2019; Villa de Gregorio et al., 2022), while other studies reported problems for educational inclusion (Qi & Wang, 2018; Thoren et al., 2021). In this regard, Wilkinson et al. (2013) indicated that although students valued positively strategies such as service learning to improve inclusion, teachers' pedagogical training was perceived as inadequate. This is in line with the findings of other research, which indicated that better organisation of teaching resources and more teacher training led to higher levels of inclusion (Pedersen et al., 2014).

Finally, all studies that analysed the effects of interventions involving physical activity or sport on motor skills or self-perceptions of body image reported benefits in physical fitness (Jeyanthi et al., 2021), body image (López-Sánchez et al., 2015) or motivation for motor scrapbooks (Harvey et al., 2014).

The following table presents the main results of the variables mentioned in each of the 22 articles analysed.

Table 3
Results of the Studies Analysed

ID	Methodology		Content		
Author, date of publication, journal, SJR, and language	Design and tool	Sample	Goals	Type of physical/sports activity performed	Results
Jun, 2023 <i>Brazilian Journal of Sports Medicine</i> <i>SJR Q4</i> English	Experimental design 6-week intervention during school hours. Screening using Conners Child Behavior Scale and SNAP-IV ADHD symptom rating scales. Pre- and post-test with E-Prime 2.0 software Executive functions: inhibitory control, cognitive flexibility and working memory.	N =74 students with ADHD, aged 6–8 from a Jingmen primary school EG1 Routine sports physical activity and football program (N=26) EG2 Sports physical activity and extra activity time for jumping, running, walking (N=24) CG Routine sports physical activity (N=24).	To evaluate the impact of football practice, added to the PE curriculum, on executive functions in children diagnosed with ADHD.	Physical activity specific to the PE curriculum, in 4 weekly sessions of 40 minutes, extra physical activity (running, jumping, walking) twice a week for 20 minutes, soccer sports program.	EG1 (additional football program) significantly increased executive functions of inhibitory control and cognitive flexibility, while EG2 and CG did not present any pre-test or post-test differences.

Villa de Gregorio et al, 2023	Experimental design	N = 26 students (18 boys, 8 girls), 15-16 years old.	To analyse the effect of regular physical education lessons on achievement motivation in a group of schoolchildren with ADHD, compared to a group without the diagnosis.	Fitness, athletics, basketball, orienteering, badminton, and acrosport.	The ADHD group showed a lower self-perception of motor competence and higher levels of anxiety about their mistakes than the control group, although there was an improvement in the rest of the dimensions of the instrument.
<i>Complutense Journal of Education</i>	12-week intervention, 2 weekly sessions	EG: ADHD diagnosis (N = 13) CG: Typical development (N = 13)			
<i>SJR Q3</i>	Pre- and post-achievement motivation test in Physical Education AMPET e-4 (Ruiz et al., 2015).	High school in Madrid			
Spanish					
Villa de Gregorio et al., 2022	Pre-experimental design	N = 13 students with ADHD (9 boys and 4 girls, 15 years old) and 13 students (9 boys and 4 girls, 15 years old) without ADHD from a high school in Madrid (Spain).	To establish how a PE program influences social preferences for learning.	Fitness, athletics, basketball, orienteering, badminton, and acrosport.	The PE content helped students with ADHD increase their scores in cooperation, competition, and individualism.
<i>RICYDE</i>	12-week intervention during school hours, in 55-minute sessions.				
<i>SJR Q3</i>					
English	Graupera/Ruiz Scale of Social Interaction Preferences (GR-SIPPEL) (Ruiz et al., 2004).				
Jeyanthi et al., 2021	Quasi-experimental design	N = 20 children Age:8-12 years	To evaluate the benefit of a PE program on the motor skills, physical fitness, and attention of children with ADHD.	Program with aerobic exercises, resistance, motor skills, and attention skills (strengthening limbs, jumping rope, throwing a ball, stringing beads, and finding differences).	The program achieved improvements in motor skills, physical fitness (balance, endurance, muscle strength and flexibility), and attention. Work aimed at improving fine and gross motor skills increases functionality and autonomy, which can significantly improve performance at school.
<i>eNeurologicalSci</i>	Pre- and post-test: - Vanderbilt Teacher Reported Scale (ADHD symptoms) - Nine-Hole Peg Test (motor skills)	ADHD diagnosis (N=10) Typical development (N = 10)			
<i>SJR Q3</i>					
English	Program of 3 weekly sessions, 45 minutes long, for 6 weeks.				
Makunina et al., 2021	Experimental study. Ural State University.	EG: 25 higher education students of PE with ADHD symptoms.	To test the benefits of the psychophysiological health system on the social adaptation profile of student athletes.	Sports.	Student athletes diagnosed with ADHD were more exposed to stressors. Regular physical activity is beneficial for emotional and social adaptation, and is associated with academic and competitive progress.
<i>Teoriya i Praktika Fizicheskoy Kultury</i>	Toulouse Pieron Test. Luscher test.	CG: 25 higher education PE students without ADHD symptoms.	To identify mediating variables in the success of student athletes with ADHD symptoms.		Need for a follow-up service for efficient social adaptation and individualised training methods and customisable tools.
<i>SJR Q3</i>	Self-assessment survey of sports success.				
Russian					

Thoren et al., 2021 <i>Physical Education and Sport Pedagogy</i> SJR Q1 English	Transactional study Field observations (9 observations of 90 minutes in PE sessions) Semi-structured interviews.	N = 13 children (4 girls, 9 boys) Age: 10–11 years 3 lessons from 2 different schools in Sweden.	To evaluate what PE practices are like when they are inclusive of people with neurodevelopmental disorders.	PE classes: educational activities under the motto “organise, cooperate, sweat and win”.	The study reveals that practices that are inclusive for students with a particular disorder are not inclusive for other children with different disorders – due to their heterogeneity – or with typical development, so inclusion involves dynamics with greater scope and collaboration (active and permanent communication) by all the agents involved in the children's lives (students/ teachers/families).
Hoza et al., 2020 <i>Journal of Child Psychology and Psychiatry and Allied Disciplines</i> SJR Q1 English	Pre-experimental design 30-minute sessions, 2 to 4 times per week, 19–22 weeks during 1 school year Assessment tools: Rapid picture naming subtest from Woodcock-Johnson IV Tests of Early Cognitive Academic Development (Schrack et al., 2015). ADHD Rating Scale – IV Preschool Version. The evaluation was done at three points while the program was being conducted (fall, spring, and summer) and two moments when it was not (holidays).	N = 85 preschoolers from 7 different classrooms in Vermont Age: M = 4.14	To evaluate whether moderate to intense physical activity in preschool age can regulate ADHD symptoms and processing speed.	Early childhood (preschool) aerobic exercise program, with interspersed periods of discussion and feedback.	Moderate to intense physical activity in preschool age improves levels of processing speed and ADHD symptoms.

Labrador- Roca et al., 2020	Pre-experimental design with mixed methodology (quantitative-qualitative)	N = 6 students with ADHD Age: M = 9.50, SD = 1.12 Public, private and subsidised primary schools in Barcelona.	To test the effects of behaviour modification techniques in PE to increase desirable behaviours and reduce undesirable ones.	PE lessons. Curricular program of experimental centres.	The results of observation and recording show positive effects of the application of behaviour modification techniques to maintain attention and desirable behaviours (emotional regulation, social skills of interrelation between teachers and peers). However, the effect is not so significant in reducing undesirable behaviours (disruption, disobedience), only in the case of direct instructions, and punishment or extinction is not recommended.
<i>Journal of Physical Education and Sport</i>	Behaviour modification techniques, interviews and observation (field notes, narrative record during 42 PE sessions).				
<i>SJR Q2</i>					
English					
Jarraya et al., 2019	Experimental design	N = 45 (28 girls, 17 boys) Age: 5 years Preschool centre in Tunis	To test the impact of Yoga practice for preschool pupils on cognitive, visual-motor development and inattentive-hyperactive behaviour.	EG1: Warm-up, Asana, Pranayama, Yogi games EG2: Regular Physical Education.	The results indicate an improvement in certain parameters of attention, visual-motor coordination, and a reduction in hyperactive behaviour in children in the Yoga group, compared to children in the regular PE group and much higher than in the group without physical exercise.
<i>Frontiers in Psychology</i>	Intervention for 12 weeks 2 weekly sessions of 30 minutes	EG1: Hatha-Yoga (N = 15) EG2: PE regular program (N = 15) CG: not performed (N = 15).			
<i>SJR Q1</i>	Pre-test and post-test evaluation: -NEPSY-II Neurodevelopmental Assessment Scale: Visual Attention and Visual-Motor Coordination Scale - ADHD Rating Scale-IV.				
English					
Labrador-Roca et al, 2019	Pre-experimental design	N = 6 students with ADHD Age: M = 9.50, SD = 1.12 Public, private and subsidised primary schools in Barcelona.	To identify the behavioural patterns of students with ADHD in PE lessons.	PE lessons. Curricular program of experimental centres.	Among the desirable behaviours recorded are the willingness to assume responsibilities, good mood and optimism, and willingness to carry out the tasks entrusted to them. willingness to help the teacher and to help/ collaborate with peers. However, teachers recorded 18.65% of desirable behaviours and 81.35% of undesirable behaviours, so the results suggest changing the focus and paying more attention to the potential than to the difficulties inherent to the disorder.
<i>Movement</i>	Observational study of 42 PE sessions. Interviews with PE teachers to assess observed behaviour.				
<i>SJR Q3</i>					
English					

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Taylor et al., 2019	Quasi-experimental design	N = 12 Age: 11–12 years United Kingdom school	To examine the effect of intense physical exercise with varied activities on ADHD symptoms and involvement/participation.	Sports sessions with 5–10 minutes of warm-up and multiple and varied activities, of short duration and with rotation. Chosen by a sports scientist and a sports psychologist, both in the gym and outdoors. They established leadership turns among the children and social guidelines (thanking the rival at the end)	The sessions were associated with a significant reduction in ADHD symptoms. There was an increase in participation due to the type of activities (varied and short) and the rotating leadership favoured the inclusion of all students.
<i>Healthcare Switzerland</i>	ADHD Rating Scale-IV for parents and teachers	EG: 5 boys and 1 girl diagnosed with ADHD			
<i>SJR Q2</i>	12-week intervention, with 2 weekly 40-minute sessions	CG: 3 boys and 3 girls without ADHD diagnosis.			
English	Parent/teacher check-in and assessment before, in the 6th week and in the 11th week.				
Qi & Wang, 2018	Pre-experimental design	N = 45 Age: 13–14 years old	To examine social interactions in PE lessons between students with and without special educational needs.	Regular 45-minute PE sessions, three times a week, including warm-up, guided activities and sports (basketball, gymnastics) and conclusions.	The results show a lack of interaction in PE classes between students with and without SEN. The focus on differences to address inclusion in activities led to greater isolation of students with SEN and interviews with students showed that this emphasises limited interaction. Teaching approaches are needed in PE that allow for greater participation by all students.
<i>Physical Education and Sport Pedagogy</i>	Sociodemographic survey, systematic observation	1 student with ASD diagnosis			
<i>SJR Q1</i>	(AIPE-S systematic observation), system files (Hodge et al. 2000) for the analysis of social interaction), non-participant observation, semi-structured individual and group interviews.	2 students diagnosed with ADHD			
English		Shanghai school.			
Bowling et al., 2017	Quasi-experimental design with control group. 7-week intervention, with two weekly sessions of 30–40 minutes.	N = 103 underage students, 83 boys, 17 girls. Age: 7–16 years (M = 11.8)	To analyse the effects of aerobic exercise through virtual virtual cycling sessions on the behaviour of underage students with behavioural problems.	Virtual cycling sessions of different duration and intensity.	The intervention program had significant results. In children diagnosed with ADHD, the duration and intensity of the sessions produced positive changes in self-regulation problems, but only the duration of the sessions had an effect on disciplinary time.
<i>Mental Health and Physical Activity</i>	Conners Scale for Teachers and Daily Behavioural Records of Disciplinary Time-Out.	Specific centre for children with behavioural problems (ASD, ADHD, Anxiety), participants in Manville Moves			
<i>SJR Q1</i>		EG: receives intervention.			
English					

Reche García, 2016 <i>Culture, Science and Sport</i> SJR Q4 Spanish	Quasi-experimental design with control group. 8-week intervention, in two weekly sessions of 9 minutes. IOWA Conners Rating Scale for Parents (Miranda et al., 2001).	N = 18 students, 2 girls and 16 boys. Age: 9–13 years (M = 10.94, SD = 1.25) Two schools in Valencia (Spain). EG: fencing classes. CG: did not participate in the program.	To determine the impact of a fencing training program on the frequency of symptomatic behaviours of ADHD in diagnosed children.	Fencing. Conceptual aspects (guarding and coordination, attack and defence, round rules, and required physical qualities), procedural aspects (warm-up, greeting, problem solving, rounds improvement in their social and stretching), and attitudinal aspects (active and positive participation and assessment of the effects on quality of life).	EG: less frequent restlessness and movement and fewer attention problems. According to parents, fencing produced positive changes: their children were less restless and more attentive to the task. They reported significant overall improvement in their performance, hyperkinetic symptoms and an expected and academic activity.
Lopez-Sanchez et al., 2015 <i>Sports Psychology Notebooks</i> SJR Q3 Spanish	Quasi-experimental design: pre-test, intervention and post-test. 2 days/week of physical activity, 60 minutes, for 12 weeks. Stunkard silhouettes.	N = 12 children. Age: 7–12 years (M = 9.83). Diagnosed with ADHD and receiving drug treatment. Murcia (Spain).	To study the effects of a physical activity program on the body image of a group of schoolchildren with ADHD.	Medium-high intensity aerobic physical activity, outside of school hours, with circuits and exercises to improve physical condition: muscle inhibition, postural control, relaxation, and self-esteem.	Significant improvements in body image (p=0.039) of schoolchildren with ADHD after a non-pharmacological intervention program.
Rodrigues Costa et al., 2015 <i>Brazilian Special Educacao Magazine</i> SJR Q3 Portuguese	Pre-experimental design Observational study. 40 intervention sessions. Participant observation with registration in field diaries and filming.	N = 4 students. Age: 6–10 years, both sexes. Diagnosed with ADHD.	To plan, implement and analyse an intervention program. Stimulate memory, attention and concentration in children with ADHD.	Psychomotor, recreational, and strategy games.	The intervention stimulated participants' memory, attention and concentration.
Harvey et al., 2014 <i>Physical Education and Sport Pedagogy</i> SJR Q1 English	Mixed methodology: -Test of Gross Motor Development-2 (TGMD-2) -Movement Assessment Battery for Children-2 (MABC-2) -Daily log self-report (2 weeks) -Interviews.	N = 10 children diagnosed with ADHD Age: 9–12.	To explore how children with ADHD regulate their participation in physical activities by listening to stories about physical activities.	Stories of physical activities.	Children with ADHD expressed a desire to participate more in physical activities when listening to the stories, and they also valued physical activities for their socialisation possibilities, but never as a competitive endeavour.

PHYSICAL EDUCATION IN STUDENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER. STATE OF THE ART

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Pedersen et al., 2014	Quasi-experimental design	N = 56 Practicum students of the University of Tasmania (UTAS) (N = 31) and Latrobe University at Bendigo (LUB) (N = 25).	To analyse the degree of preparation of future PE teachers to teach in inclusive classrooms according to academic level.		The differences between the two universities are found in both training program and academic level.
<i>Australian Journal of Teacher Education</i>	PEITID survey Likert scale.				After analysing the beliefs, attitudes and intentions of students regarding PE teaching, the results indicate that the more training, the more willingness towards inclusiveness.
<i>SJR Q2</i>					
English					
Tsimaras et al., 2014	Experimental design	N = 20 (10 women and 10 men) from a special education centre with a diagnosis of ADHD and ID	To identify the effect of an interactive digital game on people with ADHD and ID.	Interactive digital tennis game.	Participation in the interactive tennis game improved hyperactive-impulsive and attention deficit symptoms in adults with ADHD and ID in the experimental group. The CG improved in impulsivity but not in hyperactivity, which could be because the instructions were group-based in the PE lesson and individual in the digital game.
<i>Journal of Physical Education and Sport</i>	Pre- and post-measurements ASRS - V1.1 questionnaire.	Age: 20-25 years			Physical exercise through play improves attention and performance, which impacts behaviour.
<i>SJR Q2</i>		EG (N = 10) CG (N = 10)			
English	EG: Playful tennis in the special education centre through a projector for 12 weeks, 3 times a week in 20-minute sessions. CG: regular PE program, 2 times a week in 45-minute sessions.				
Gökçen et al., 2013	Comparative study of pre-experimental design	Gaziantep University	To compare the incidence of students with and without ADHD in higher education courses in Physical Education and Sports and other faculties (medicine, nursing, administration, and engineering) under the hypothesis that people with ADHD are more likely to participate in sports.		The results of the WURS scale explain not only the progressive reduction of ADHD symptoms over time but also that physical exercise can mitigate the hyperactive symptoms of ADHD.
<i>International Journal of Psychiatry in Medicine</i>	-Sociodemographic questionnaire -Wender-Utah Rating Scale (WURS) Adult ADD/ADHD DSM-IV				
<i>SJR Q3</i>	-Based Diagnostic Screening and Rating Scale (ADD/ADHD).				
English					
Wilkinson et al., 2013	Pre-experimental design	N = 6 Students for Physical Education teacher training in Canada	To analyse the behaviour of children with ADHD during the implementation of a Physical Education Service Learning Project (SLP).	Sports sessions planned with cooperative activities.	The students' reflection revolved around awareness, the need to address diversity in the classroom, and the importance of sharing experiences among professionals.
<i>Physical Education and Sport Pedagogy</i>	Qualitative, phenomenological study	Age: 22-28 years (M = 24.8) 4 women and 2 men.			Students perceived that pedagogical training was insufficient to meet the needs of the classroom. Working through SLP was motivating for students and was highly valued for the degree of theoretical and practical learning, as well as for their community involvement.
<i>SJR Q1</i>	Semi-structured interviews and video recording	Project applied in a mental health clinic in the ADHD area. Observation of 10 children between 6 and 12 years old.			
English	2-hour sessions, once a week, for 12 weeks.				

Discussion

This work was based on publications deposited and available in Scopus, to complement previous studies that used WOS (da Silva and Maia, 2024; Quesada et al., 2023) or other databases such as Redalyc, Dialnet, Scielo or Google Scholar (Vélez and Uribe, 2023).

Considering the bibliometric variables, the results of this study show that studies have been carried out in different countries from different continents, although the USA is predominant, as in other studies focused on PE, such as the one by Yaakop et al. (2023) on teaching knowledge.

Furthermore, no upward or downward trends were found in the number of publications per year, in contrast to the temporal growth of publications found in recent studies, as in the case of the work by Tuero et al. (2023), focused on sexual diversity in PE, through the analysis of publications centred on the trans collective, or in that by Marín et al. (2022) on exergames.

On the other hand, there is a high level of collaboration in scientific publications on the subject, with articles often signed by three or more authors, as in previous studies analysing the general inclusion of all students in the field of PE (Marín and Ramón-Llin, 2021).

However, as in other studies carried out in the field of education, such as that by Marín and Vidal (2019), the impact of the publications studied is low compared to what often happens in other fields of knowledge, such as health sciences.

In this study, the publications were not concentrated in a few journals, forming a solid core, as in other studies where the concentration of publications on the subject in certain journals was evident (Gámez-Calvo et al., 2024).

With regard to the gender perspective in the analyses, in this study we have found a balance between the contributions of male and female researchers, compared to the results obtained in the analysis of publications published over two decades in the journal Retos, specifically focused on physical education, sport and recreation, in which men represented 70% of the total papers (Ramos-Álvarez et al., 2024).

In terms of the participants in the studies analysed, primary school students are the main target group for PE interventions, as has been found in previous studies, for example, when the focus was on the use of exergames in education (Marín et al., 2022).

In terms of the results obtained with students with ADHD, the benefits of participating in physical/sport activities stand out. Learnings go beyond motor skills to other social and personal skills. In the same vein, Bernate and Puerto (2023) concluded that PE could have an impact on the development of students' civic competences.

Conclusions

This study was carried out to analyse the state of the art and the effects of physical education on students with ADHD. Interventions using different types of physical activity showed positive effects on symptom improvement in those diagnosed with ADHD, as well as on their physical condition, self-perception of body image and motivation for motor activity. Problems were identified in achieving educational inclusion in mixed ability groups, with teacher training and organisation of resources identified as key factors.

Therefore, in line with previous studies, we conclude that information about inclusion and in particular about the diversity of the student population is essential (Alcoser et al., 2023) and that teachers' attitudes towards disability are key to achieving inclusion (Gámez-Calvo et al., 2024).

Although Scopus is a reference database in the social sciences and for publications in the area of education, future studies could consider conducting searches that include other databases, such as Web of Science or Dialnet, as the use of a single database could limit the scope of this work. Furthermore, this study did not use a specific tool to measure the methodological quality of the papers included in the analysis. The use of a tool such as AMSTAR-2 (Ciapponi, 2018) could have great potential for future research.

Also, in order to advance in this field, we encourage future studies to present longitudinal analyses from which interpretations can be made to analyse the interventions in the longer term and to analyse the barriers and facilitators of inclusion, as well as the analysis of cognitive-behavioural interventions or combined with pharmacological treatment to analyse the effectiveness and impact that PE can have on these students.

Ethics Committee Statement

Not applicable because it is a literature review study, with no live intervention.

Conflict of Interest Statement

There is no conflict of interest.

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Authors' Contribution

Conceptualization J.R.; Methodology D.M.; D.M.; Validation A.T. y D.M.; Formal Analysis A.T., J.R. y D.M.; Investigation A.T., J.R. y D.M.; Resources A.T., J.R. y D.M.; Data Curation A.T., J.R. y D.M.; Writing – Original Draft A.T., J.R. y D.M.; Writing – Review & Editing A.T., J.R. y D.M.; Visualization A.T., J.R. y D.M.; Supervision A.T., J.R. y D.M.; Project Administration A.T., J.R. y D.M.; Funding Acquisition J.R. All authors have read and agree with the published version of the manuscript.

Data Availability Statement

Data available on request from the correspondence author (jesus.ramon@uv.es).

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