



Autism Spectrum Disorder in Physical Education in Primary School: a Systematic Review

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Abstract

Autism spectrum disorder (ASD) is diagnosed daily in children all over the world. Although the effects of physical exercise in this population have been extensively studied, there is still little research analysing the benefits of physical activity as part of Physical Education in schools. Therefore, this article aims to analyse the effects of physical exercise carried out in the area of Physical Education as a curricular subject on primary school pupils diagnosed with ASD, as well as the methodological strategies applied by teachers in this area. For this purpose, a systematic review was carried out in accordance with PRISMA standards, by searching for scientific articles in the databases: Web of Science, Scopus, PubMed and SportDiscus. After applying the established inclusion and exclusion criteria, a total of 11 articles were selected, in which the following variables were analysed: participation, stereotyped behaviour, general behaviour and emotional control, social and communication skills, and motor skills. The results obtained suggest the application of cooperative learning strategies to improve their participation; the introduction of psychomotor activities and team games to reduce stereotyped behaviour, improve conduct and emotional control, and foster social and communicative skills; and the inclusion of tasks and games aimed at developing basic motor skills and coordination abilities to improve motor skills.

Keywords: ASD, autism, methodology, physical exercise.

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Introduction

In recent decades there has been a large increase in members of the population diagnosed with autism spectrum disorder (ASD) (Chiarotti & Venerosi, 2020), especially among primary school pupils. In fact, in Spain, it is estimated that the rate of children with ASD aged 0-14 could be close to 13 per 10,000 (Bejarano et al., 2017). An international inclusion-oriented approach has been successful in increasing the intake of students with ASD in mainstream schools (Hodges et al., 2020). However, there is still widespread ignorance about this disorder (Terrazas Acedo et al., 2016).

Pérez-Pichardo et al. (2018) consider ASD as a neurodevelopmental disorder in which persistent deficits in communication and social interaction in multiple contexts, repetitive behaviours and limited interests are displayed. However, although there are numerous conceptualisations, it is particularly difficult to provide an exact definition of ASD, as each individual presents different symptoms (Baena Beato et al., 2010).

People with ASD often show difficulties when planning tasks and altering their thinking, tending to self-isolate in environments that require high cognitive flexibility and extensive socialisation, such as those found in Physical Education classes; and they tend to perform repetitive, routine and stereotyped movements and actions (Talero-Gutiérrez et al., 2015). With regard to learning, they are also considerably affected in terms of language, socialisation and communication skills; and their executive functions, specifically the planning of complex behaviours, due to a deficit in their working memory (Pérez-Rivero & Martínez, 2014; Pérez-Pichardo et al., 2018). In addition, children and adolescents with ASD often show limited levels of physical activity, as well as delayed acquisition and development of motor skills and physical fitness, which can lead to a higher incidence of becoming overweight and obesity, and even health complications (Toscano et al., 2017).

According to Moscatelli et al. (2020), the practice of physical activity in people with ASD has a remarkable influence on the improvement of stereotyped behaviour, on the increase of hippocampal volume, on the growth of newly reproduced cells, on vascularisation and neurogenesis through aerobic exercise, and on social intervention, communication and sports skills in children and adolescents with autism. Furthermore, if physical activity is successfully implemented at an early age, the benefits gained may persist as the child grows older and reaches adulthood due to the acquisition of adaptive

behaviour (Tiner, 2020; MacDonald et al., 2014). In this context, Physical Education emerges as a curricular subject with a high potential for the correct psychomotor development of students with ASD, not to mention the wide range of possibilities that this subject offers in the educational context to achieve their inclusion, not only at school, but also in society in general (Marín-Suelves & Ramón-Llin, 2021).

However, although research on the effects of physical exercise in children with ASD at primary school age is widespread (Dillon et al., 2017; Ferreira et al., 2019), there are few studies that specifically analyse the practice of physical activity within the scope of Physical Education as a curricular subject. Moreover, at present, teaching practice in Physical Education sessions is still not adapted to the abilities and characteristics of autistic pupils for different reasons. While some authors attribute this maladaptation to a lack of resources and administrative support or inadequate teacher preparation (Lirgg et al., 2017), others refer to the lack of curriculum specifications on how to develop Physical Education sessions for autistic students (Maravé-Vivas et al., 2021). For these reasons, it would be advisable to rethink the teaching-learning process based on the characteristics, needs and difficulties of children with ASD in order to adjust to their level of psychomotor development. This would encourage the creation of integrated and inclusive schools where diversity is a challenge for educational planning (Booth et al., 2000).

Therefore, the aim of this systematic review was to find out about and analyse the effects of physical exercise carried out in the area of Physical Education on primary school pupils diagnosed with ASD and to analyse the different methodological strategies applied in order to offer basic guidelines for the design of games and tasks adapted to their characteristics.

Methodology

A systematic review was developed, according to the taxonomy proposed by Grant & Booth (2009), following the PRISMA (*Preferred Reporting Items for Systematic reviews and Meta-Analyses*) standards (Urrútia & Bonfill, 2010). The search was carried out in the electronic databases Web of Science, Scopus, PubMed and SportDiscus, using the following search strategy: ((*autism*) OR (*autism spectrum disorder*)) AND (*physical education*). Thus, the above terms were searched for in the title, abstract and/or keywords.

In addition, the following inclusion and exclusion criteria were established:

Inclusion criteria:

- Experimental articles.
- Publication date between January 2010 and March 2022.
- Published in English or Spanish.
- Full text available online.
- Ages corresponding to the Primary Education stage (6-12 years).
- Students with ASD.
- Exercise-based interventions.
- Study carried out in the area of Physical Education as a curricular subject.

Exclusion criteria:

- Review articles, book chapters, books, academic papers and/or meeting proceedings.
- Pupils from educational stages other than Primary.
- Pupils with disorders other than ASD.
- Non-exercise-based interventions.
- Study carried out in areas other than Physical Education as a curricular subject.

Thus, in this first phase of the search (Table 1), a total of 1,165 articles were found, of which 6 were ultimately included in the present review (Figure 1) after applying the above-mentioned eligibility criteria. Additionally, in a second phase, 5 more articles were added by manual search and expert suggestion (Figure 1), identifying articles that contained some of the words included in the search strategy of the first phase and that met all the inclusion criteria, as other authors have done previously (Felis-Anaya et al., 2017). Thus, after this second phase, the search yielded 11 articles, which were subjected to a detailed content analysis (Table 2).

Results

The analysis of the 11 articles ultimately selected provides different interventions for participants with ASD in Physical Education sessions. Table 2 shows a summary of the articles included in this review, presenting for each of them the sample, the type of intervention, the variables analysed and the main results obtained.

As can be seen in Table 2, it is possible to find similarities between the different articles in relation to the type of intervention and the variables analysed. In general, physical exercise carried out with students diagnosed with ASD in the field of Physical Education improved the variables studied.

Firstly, it seems that the participation of autistic students in Physical Education sessions increases with the use of

cooperative learning methods. In this regard, Ayvazo & Ward (2010) reported an increase in participation after incorporating hitting exercises into the sessions along with a methodology based on peer mentoring (*Classwide Peer Tutoring*). In a similar line of research is the study carried out by Heredia & Duran (2013), in which two cooperative learning strategies were incorporated: cooperative play (*Co-Op Play*) and shared discovery, and also found an increase in the participation of these students.

Secondly, the stereotyped behaviour of students with ASD (such as hand flapping or body swaying) has been analysed in several of the articles included in this review, with different results depending on the type of intervention. Tse et al. (2018) conducted an intervention in which they introduced ball-hitting drills followed by a *storytelling* activity. Thus, they observed a reduction in hand flapping after hitting exercises, but not in body sway. In addition, the *storytelling* activity had no effect on either of these two variables. Similarly, Stavrou et al. (2018) succeeded in reducing stereotyped behaviour in students with ASD by incorporating different types of psychomotor activities (balance, self-awareness, visual-motor coordination, lateral movement) and team games and spatial-temporal orientation. Finally, regarding these students' behaviour and emotional regulation, Tse (2020) reported improvements in these two variables through the application of running-based exercises, in comparison to the control group, which did not show any change.

Thirdly, in relation to social and communication skills, Stavrou et al. (2018) reported an improvement in vocabulary use, student/teacher communication and forms of expression used by students with ASD through the above-mentioned psychomotor activities and games, but no significant changes in communicative intention were found. Zhao & Chen (2018) observed an improvement in autistic students' communication skills and socialisation through the use of group games and object manipulation exercises (with a ball). Similarly, Sansi et al. (2021) also saw improvements in social and communication skills after the introduction of the IPA programme (*Inclusive Physical Activity*). In addition, Bo et al. (2019), using the *Classroom Pivotal Response Teaching* (CPRT) methodology, a naturalistic behavioural intervention for children with autism, also found improvements in social functioning, especially in those with greater social impairment prior to the intervention. And finally, Chiva-Bartoll et al. (2021), also observed greater social inclusion of students with ASD in Physical Education sessions through the use of team games involving basic motor skills and body expression, introduced through a service-learning programme.

Table 1
Summary of articles selected in the first phase of the search.

Database	Articles identified	Discarded articles	Selected articles
Web of Science	546	544	2
Scopus	548	547	1
PubMed	25	23	2
SportDiscus	46	45	1

Adapted from Rovira-Font & Vilanova-Soler (2022)

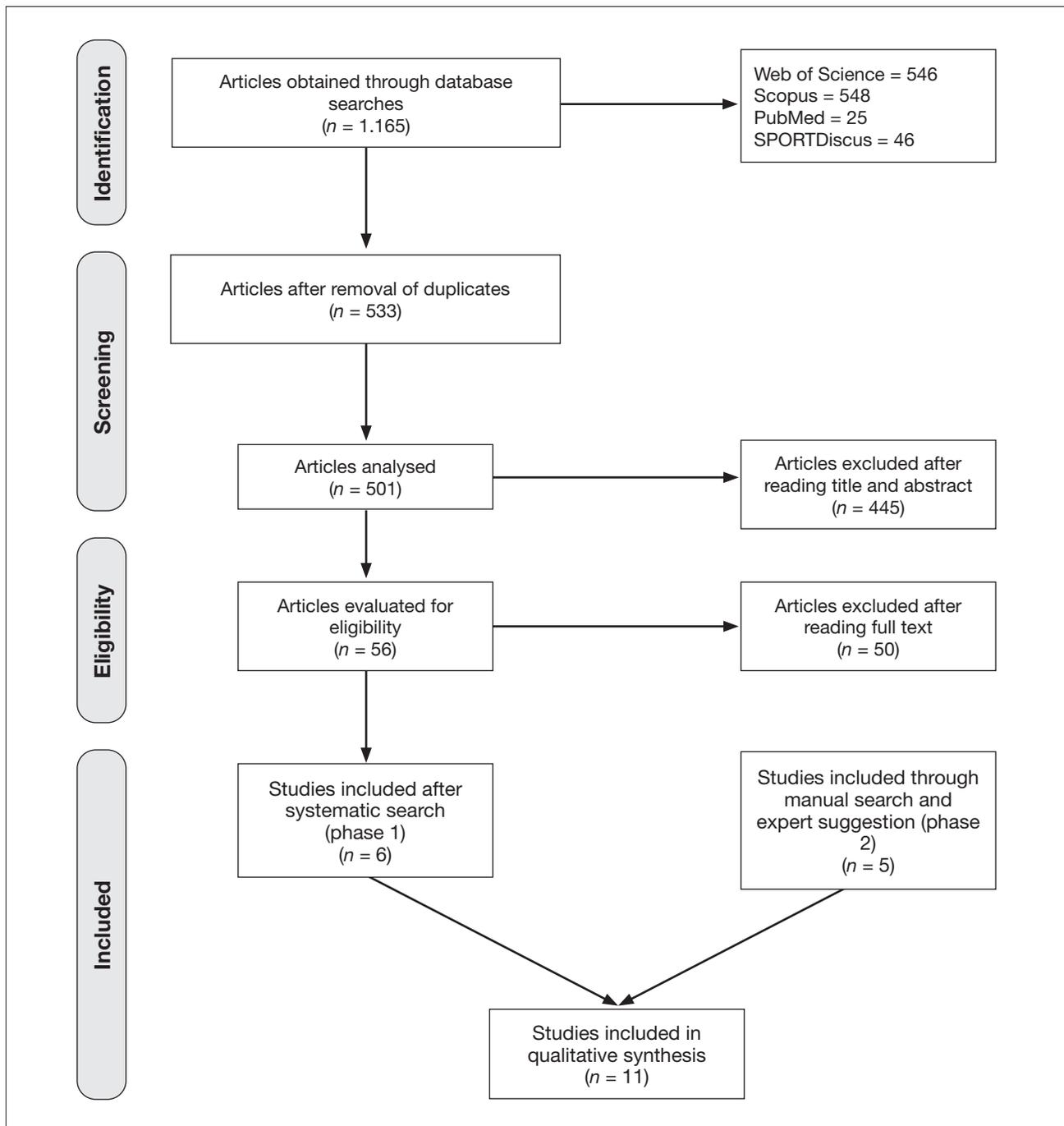


Figure 1
Diagram of PRISMA flow of the articles included in the review after the screening process.

Table 2
Summary of selected articles.

Author(s) (year)	Sample	Intervention	Variables	Results
Ayvazo & Ward (2010)	EG: $n = 2$ (0 W) 8 years old	Hitting exercises + Peer mentoring • 13 weeks (2 ses./wk. - 30 min/ses.)	Participation	+
Bo et al. (2019).	EG: $n = 9$ (0 W) 9.11 ± 1.54 years old	<i>Classroom Pivotal Response Teaching</i> • 2 weeks (5 ses./wk. - 3.5 h/wk.)	Social functioning Locomotive skills	+ +
Chiva-Bartoll et al. (2021).	EG: $n = 15$ (4 W) 10.13 ± 2.56 years old CG: $n = 10$ (1 W) 10.13 ± 3.09 years old	Basic motor skills games, body expression and teamwork introduced through a service-learning programme. • 31 weeks (2 ses./wk. - 60 min/ses.)	Motor skills Social inclusion	+ +
Heredia & Duran (2013)	EG: $n = 1$ (0 W) 7 years old	Cooperative learning strategies (cooperative play and shared discovery) • 4 sessions (no further information is provided)	Participation	+
Henderson et al. (2016).	EG: $n = 37$ (2 W) 5-12 years old	Locomotor skills and object manipulation exercises • 20 weeks (2 ses./wk. - 40 min/ses.)	Locomotive Skills Running Horizontal jumps Gallop Lunge jumping Leap Movement Manipulation and Control of Objects Turns Grip Hand launch Bouncing Foot launch Hitting	+ + ∅ + ∅ + + + + + + +
Rafiei Milajerdi et al. (2021) #	EG Spark: $n = 20$ (1 W) 7.95 ± 1.60 years old EG Kinect: $n = 20$ (1 W) 8.15 ± 1.50 years old CG: $n = 20$ (1 W) 8.45 ± 1.43 years old	SPARK Programme (<i>Sports, Play and Active Recreation for Kids</i>) • 8 weeks (3 ses./wk. - 35 min/ses.) <i>Exergaming</i> (tennis game on Xbox Kinect) • 8 weeks (3 ses./wk. - 35 min/ses.)	Motor Skills Aiming Grip Manual dexterity Balance Executive Functions Correct answers Conceptual answers Persistent errors Motor Skills Aiming Grip Manual dexterity Balance Executive Functions Correct answers Conceptual answers Persistent errors	+ + ∅ ∅ ∅ ∅ ∅ - - ∅ ∅ ∅ ∅ ∅

EG = Experimental Group; CG = Control Group; W = women; + = improves; - = worsens; ∅ = no changes;
= only the changes found in the interaction group X time are cited.

Table 2 (Continued)
Summary of selected articles.

Author(s) (year)	Sample	Intervention	Variables	Results
Sansi et al. (2021).	EG: $n = 13$ (1 W) 8.69 ± 0.86 years old CG: $n = 9$ (1 W) 8.26 ± 0.78 years old	IPA Programme (<i>Inclusive Physical Activities</i>) • 12 weeks (2 ses./wk. – 60 min/ses.)	Locomotive Skills	
			Running	+
			Gallop	+
			Jump	∅
			Leap	+
			Horizontal jump	∅
			Movement	∅
			Ball Skills	
			Two-handed striking	+
			One-handed striking	∅
			Dribbling	∅
			Catching	∅
			Kicking	+
Over-the-shoulder throw				
Below-the-shoulder throw	∅			
Social and Communication Skills	∅			
	+			
Stavrou et al. (2018)	EG: $n = 1$ (0 W) 7 years old	Balance, self-awareness, visual-motor coordination and lateral movement activities; along with team games and spatial-temporal orientation. • 12 weeks (3 ses./wk. – 40-45 min/ses.)	Motor skills	
			Communication intention	∅
			Use of vocabulary	+
			Communication with teacher	+
			Forms of expression	+
Motor Skills	+			
Stereotyped Behaviours	+			
Tse et al. (2018)	EG: $n = 30$ (8 W) 10 years old	Ball-hitting drills (A) followed by <i>storytelling</i> activity (B) • No information on frequency and duration is provided	Repetitive hand flapping (<i>measured after A</i>)	+
			Repetitive hand flapping (<i>measured after B</i>)	∅
			Body swaying (<i>measured after A+B</i>)	∅
Tse (2020)	EG: $n = 15$ (2 W) 10 ± 1 years old CG: $n = 12$ (2 W) 9 ± 1 years old	Running exercises • 12 weeks (4 ses./wk. – 30 min/ses.)	General behaviour and emotional regulation	+
Zhao & Chen (2018)	EG: $n = 21$ (7 W) 6.14 ± 0.96 years old CG: $n = 20$ (5 W) 6.1 ± 0.98 years old	Group exercises on manipulation of objects (ball) • 12 weeks (60 min/ses.)	Social and communication skills	+

EG = Experimental Group; CG = Control Group; W = women; + = improves; - = worsens; ∅ = no changes;
= only the changes found in the interaction group X time are cited.

Finally, locomotor skills and object manipulation and control seem to improve after the application of specific exercises for these skills. In this regard, Henderson et al. (2016) found an improvement in all object manipulation and control skills tested, as well as in virtually all locomotor skills (with the exception of galloping and jumping). Similarly, Chiva-Bartoll et al. (2021) observed progress in the motor competence (assessed in three dimensions: manual dexterity, aiming and catching, and balance) of their students, as did Bo et al. (2019), who found a significant improvement in the locomotor skills of their ASD students following their intervention. Furthermore, Sansi et al. (2021) also reported improvements in most of the locomotor and object manipulation and control skills (involving a ball) tested. Finally, Rafiei Milajerdi et al. (2021), following implementation of the SPARK (*Sports, Play and Active Recreation for Kids*) programme, obtained improvements in several of the motor skills examined. It should be noted that these same authors also analysed the evolution of executive functions, but found no significant changes after their intervention.

Discussion

The aim of this review was to find out about and analyse the effects of physical exercise carried out in Physical Education sessions as a curricular subject on primary school pupils diagnosed with ASD. A further aim was to identify and analyse the different methodological strategies carried out by Physical Education teachers with ASD students in order to offer basic guidelines for the design of games and tasks adapted to their characteristics.

As Menear & Smith (2011) state, Physical Education presents students with ASD with simultaneous sensory challenges. In this way, Physical Education emerges as a favourable working space for the introduction of appropriate methodological strategies that promote the improvement of variables that are essential in the daily development of this type of student, such as participation, behaviour, emotional control, social and communicative skills, or locomotor skills. However, facilitating the potential benefits of Physical Education for autistic students requires careful planning (Lamb et al., 2016), so it is particularly important to understand the effects of different types of interventions in order to adapt the teaching-learning process to meet the specific diagnosis of each student at all times (Menear & Smith, 2011).

Effects on Participation

Participation is a variable commonly analysed in research with autistic students, both in primary and secondary

schools, as participation levels of autistic students in PE sessions tend to be lower than their non-ASD counterparts (Arnell et al., 2018; Kerem & Kocak, 2020). This lower participation may be due to factors such as a low perception of their physical abilities and their own competence in physical activity, low self-confidence and low self-esteem (Arnell et al., 2018), which also leads them to exhibit reduced levels of motivation to engage in physical activity (Pan et al., 2011). In addition, factors such as the lack of social skills that allow the autistic child to relate satisfactorily with peers, and even the negative view that some families have of these individuals, would also negatively affect their participation (Kerem & Kocak, 2020). According to Arnell et al. (2018), although a small proportion of students with ASD affirm that physical activity reduces their stress levels, most of them suffer from stress and anxiety simply from thinking about it.

Therefore, an appropriate strategy to increase the participation of students with ASD would be to offer them the option to choose the activity they wish to do and to let them know what is expected of them (Arnell et al., 2018). Furthermore, considering that the use of cooperative learning strategies also increases the participation of students with ASD (Ayvazo & Ward, 2010; Heredia & Duran, 2013), the introduction of these types of activities through this methodology could further improve their participation in Physical Education sessions.

Effects on Stereotyped Behaviour, General Behaviour and Emotional Control

Stereotyped behaviours, such as rocking, hand flapping, repeated manipulation of objects or finger movements, are involuntary movements whose sole function is to produce physical and sensory self-regulation, and are one of the most common symptoms among people with ASD (Ferreira et al., 2019). In addition, according to Lee and Haegele (2016), many autistic individuals also display what are known as 'challenging behaviours', including aggression, self-harm, destructiveness, classroom disruptions and non-compliance. Such behaviours tend to limit student participation in activities, as they tend to divert the teacher's attention (Lee & Haegele, 2016), so minimising all such behaviours in students with ASD will have a direct effect on the overall dynamics of the classroom.

Similar to the studies by Stavrou et al. (2018) and Tse et al. (2018), recent research conducted outside the school setting among autistic children in which interventions based on physical exercise such as running or jogging (Oriol, 2011), kata performance (Bahrami, et al., 2012), or even the self-selection of an aerobic activity (exercise bike, elliptical trainer, or treadmill running)

(Schmitz et al., 2017), have demonstrated the existence of a positive relationship between physical exercise and the improvement of these symptoms, thus emerging as an effective tool to reduce this type of behaviour in autistic children (Ferreira et al., 2019). In fact, as little as 15 minutes of moderate to vigorous intensity physical activity (MVPA) can achieve a decrease in stereotyped behaviour for two hours (Liu et al., 2015).

Like stereotyped behaviour, behavioural problems and emotional control in autistic individuals have also been extensively studied, as these are two of the most prevalent factors associated with ASD (Weiss et al., 2014). Furthermore, the effects of physical exercise on these variables have also been extensively analysed, as behaviour may be determined by the interactions that occur during physical activity between the autistic person and other participants (Bremer et al., 2016). Just as Tse (2020) reported improvements in these variables through the introduction of running exercises in Physical Education sessions, Greco & De Ronzi (2020) also managed to improve them through a martial arts training programme developed outside the school environment. It is worth noting that in the latter study, three non-autistic children were previously trained to support the learning of autistic individuals, using a strategy similar to peer tutoring (*Classwide Peer Tutoring*) implemented by Ayvazo & Ward (2010). In addition, it appears that the introduction of motivational elements and meditation and breathing exercises were key to achieving these improvements.

As mentioned above, the interactions that arise during physical activity between the autistic person and the rest of his/her peers can significantly affect his/her behaviour. In this regard, Lapresa et al. (2020) conducted an observational study in which they applied a motor skills development programme to an adolescent student during six sessions of Physical Education to analyse behaviour and verbal and non-verbal interactions. Although stereotypes and echolalia were not assessed in this study, as was done by Tse et al. (2018), and Stavrou et al. (2018), the timing of these interactions according to the type of interaction between the teacher and the autistic student, was analysed. Thus, the results showed a greater willingness to perform the task, a favourable socio-affective interaction and a positive attitude towards the teacher when the interaction was verbal and based on positive reinforcement, reflection towards the task and the establishment of sanctions.

Therefore, the application of physical exercise programmes, especially those based on psychomotor activities and team games, reinforced with correct verbal interaction by the teacher and focused on positive reinforcement and reflection, would be an appropriate intervention for the reduction of stereotypical behaviour typical of students with ASD.

Effects on Social and Communication Skills

One of the core symptoms of ASD is social function deficits, which include difficulties in initiating or joining social activities, understanding others' point of view, distancing from people, lack of eye contact and communicative gestures, and poorly functional use of language, etc. (Syriopoulou-Delli et al., 2018).

According to Healy et al. (2013), in general, autistic students have a negative perception of Physical Education sessions, and also show low socialisation and a negative experience (Blagrave, 2017) during their development. Thus, factors such as a preference for free rather than structured activities, fear of injury, experiencing bullying and exclusion by peers, low difficulty of activities (leading to boredom), or an overly stimulating environment would negatively affect their socialisation and participation (Healy et al., 2013). However, students with ASD's interest in physical activity, both inside and outside the classroom, can be increased by addressing a number of factors, such as the inclusion of positive reinforcement, the development of self-management skills, the introduction of self-management activities, etc. (Holland et al., 2019). In this way, Physical Education will emerge as the most appropriate environment to promote greater participation in physical activity for this type of student (Pan et al., 2005).

Therefore, in this context, the subject of Physical Education, due to its eminently practical nature, could emerge as a favourable environment for the development of social and communicative skills, as it develops playful and participative-collaborative activities more frequently than other subjects in the educational curriculum. If the acquisition of these skills does not occur during the pre-school and primary school years, autistic students may reach adolescence and adulthood with serious socio-communicative difficulties (Lee & Shivers, 2019). In fact, according to Cummins et al. (2020), society uses communicative elements that people with ASD are not able to include in their communication (eye contact, appropriate voice volume, etc.) and that the mere fact of communicating makes them anxious.

In this sense, the practice of psychomotor activities and team games during Physical Education sessions in primary school has been shown to be effective in improving social and communication skills (Bo et al., 2019; Sansi et al., 2021; Stavrou et al., 2018; Zhao & Chen, 2018) and social inclusion (Chiva-Bartoll et al., 2021) in students with ASD, as well as outside the school environment through similar interventions, such as the SPARK programme (Sport, Play and Active Recreation for Kids) (Najafabadi et al., 2018). Therefore, as with stereotyped behaviour, general behaviour and emotional control, the practice of activities and games that promote cooperation and interrelation between autistic students and their peers without ASD seems to be, once again, the most effective intervention to improve their social and communication skills.

Effects on Motor Skills

Although the core deficits of ASD are in the social and behavioural domains, recent evidence suggests that children with ASD experience early-emerging motor developmental delays (Ketcheson et al., 2017). In fact, the emergence of motor impairments at an early age has a later impact on the child's development of social and communication skills (Ohara et al., 2020), possibly because having such problems can lead to adverse motor situations, such as being excluded from playground games, or even problems with academic tasks such as writing (Wilson et al., 2018). In relation to the latter, it appears that children with ASD have lower levels of manual dexterity and fine motor accuracy and integration than their peers without ASD (Lourenço et al., 2020).

Thus, recent studies, such as those by Bo et al. (2019), Chiva-Bartoll et al. (2021), Henderson et al. (2016), Rafiei Milajerdi et al. (2021), Sansi et al. (2021), and Stavrou et al. (2018), in the educational field, have shown that regular physical activity is effective in improving motor skills in children with ASD. While it is true that the interventions carried out by the authors mentioned above are very diverse and different from each other, they are all based on the introduction of tasks and games aimed at the development and improvement of basic motor skills (such as running, jumping or manipulation of objects) and co-ordination skills (such as balance or orientation). Therefore, it seems that this type of physical-sports practice, framed within a cooperative environment, as mentioned above, would be the most appropriate for improving motor skills in students with ASD.

Conclusions

The following conclusions are drawn from this literature review:

- The use of cooperative learning strategies, such as peer tutoring, shared discovery, or cooperative play, encourages the participation of students with ASD in Physical Education sessions.
- The introduction of psychomotor activities and team games, reinforced with appropriate verbal interaction by the teacher focusing on positive reinforcement and reflection, reduces stereotyped behaviour and improves the behaviour and emotional control of students with ASD.
- Social and communicative skills are fostered through the practice of psychomotor activities and games that encourage cooperation and interpersonal relationships.
- Including tasks and games aimed at developing and improving basic motor skills and coordination skills will enable students with ASD to improve their motor skills.

Based on the results obtained in this systematic review, the introduction of psychomotor team games aimed at the development of basic motor skills and co-ordination abilities carried out through co-operative methodologies is proposed. Therefore, future research should experimentally analyse whether this proposal, developed within the area of Physical Education, is indeed effective in improving the variables analysed in this study in primary school pupils diagnosed with ASD.

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